State of Texas Hazard Mitigation Plan

2013 Update

Cover photo courtesy of the Texas A&M Forest Service

Record of Changes

CHANGE NUMBER	DATE OF CHANGE	DESCRIPTION OF CHANGE	INITIALS AND DATE ENTERED
01	May 29 2015	Page 30. Updating. “three-year update process” is changed to “five-year update process”. This plan will expire on October 21, 2018. The State resolution will be amended accordingly at the time of adoption .	Mitchell A. Osburn 5-29-2015

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Table of Contents

INTRODUCTION

Mitigation is defined in emergency management as sustained actions taken to reduce or eliminate long-term risk to people and their property from the effects of natural hazards. Risk exists whenever, and wherever, the natural environment collides with the built environment and the population inhabiting it.

Mitigation is doing something today to reduce future risk. The key to successful mitigation is a well-planned strategy based on identified risks, shared goals, and implementable solutions through active, committed and collaborative partnerships. The purpose of mitigation planning is to determine: what can happen, how often is it likely to happen, how bad can it get, and what can be done about it.

The greater goal within emergency management is to break the repetitive cycle of response and recovery by implementing mitigation actions that produce long-term results.

Not all mitigation actions are tangible. While building tornado safe rooms, acquiring and removing flood prone properties, and constructing better drainage conveyance result in measureable repetitive benefits, there are also many benefits from less tangible actions. Implementing or upgrading ordinances and building codes; creating public warning systems using social media; initiating behavior change through public awareness campaigns; and public works programs may all provide beneficial results.

The State of Texas provides the Texas Hazard Mitigation Plan every three years to the Federal Emergency Management Agency (FEMA) and, as a result, is eligible to receive Hazard Mitigation Assistance (HMA) funding to help both state and local communities achieve mitigation goals.

The state will comply with all applicable federal statutes and regulations during the periods for which it receives grant funding and will amend its plan whenever necessary to reflect changes in state or federal laws and statutes as required in 44 CFR §13.11.

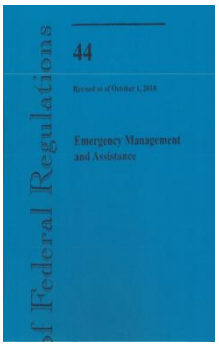
AUTHORITIES

44 CFR 201

13.11 - State plans.

(a) *Scope.* The statutes for some programs require States to submit plans before receiving grants. Under regulations implementing Executive Order 12372, "Intergovernmental Review of Federal Programs," States are allowed to simplify, consolidate and substitute plans. This section contains additional provisions for plans that are subject to regulations implementing the Executive Order.

(b) *Requirements.* A State need meet only Federal administrative or programmatic requirements for a plan that are in statutes or codified regulations.



(c) *Assurances.* In each plan the State will include an assurance that the State shall comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding. For this assurance and other assurances required in the plan, the State may:

(1) Cite by number the statutory or regulatory provisions requiring the assurances and affirm that it gives the assurances required by those provisions,

(2) Repeat the assurance language in the statutes or regulations,

or

(3) Develop its own language to the extent permitted by law.

(d) *Amendments.* A State will amend a plan whenever necessary to reflect: (1) New or revised Federal statutes or regulations or (2) a material change in any State law, organization, policy, or State agency operation. The State will obtain approval for the amendment and its effective date but need submit for approval only the amended portions of the plan.

Authority for development and maintenance of this plan is as follows:

State Authorities

- Texas Disaster Act of 1975, V.T.C.A., Government Code, Chapter 418
- Executive Order of the Governor pertaining to Emergency Management
- State of Texas Emergency Management Plan

Federal Authorities

- Public Law 93-288, as amended by Public Law 100-707 (Stafford Act)
- Public Law 100-707, as amended by Public Law 103-181 (Hazard Mitigation and Relocation Assistance Act)
- Public Law 103-324 (Reigle Community Development and Regulatory Improvement Act of 1994)
- Public Law 106-390 (Disaster Mitigation Act (DMA) of 2000)
- FEMA Regulation, 44 CFR Part 206, Subparts M and N
- FEMA Regulation, 44 CFR Part 9
- FEMA Regulation, 44 CFR Part 1
- FEMA Regulation, 44 CFR Part 13
- FEMA Regulation, 44 CFR Part 14
- FEMA Regulation, 44 CFR Part 201
- Executive Order 11988, Floodplain Management
- Executive Order 11990, Protection of Wetlands
- Executive Order 12612, Federalism

ADOPTION OF THE PLAN

Adoption of the State of Texas Hazard Mitigation Plan is authorized through signature of the Governor of Texas.

STATE OF TEXAS

STANDARD MITIGATION PLAN

ADOPTION AND IMPLEMENTATION

The purpose of hazard mitigation is to implement actions that eliminate risk or reduce the severity of the impact of hazards to people and property. Mitigation actions are both short-term and long-term activities that reduce the cause or occurrence of hazards; reduce exposure, or effects of hazards through prevention and preparedness activities to include mitigation planning and projects.

This Plan applies to all state agencies, boards, commissions, and departments assigned mitigation responsibilities and others as designated by the Governor or the Chief/Assistant Director of the Texas Division of Emergency Management.

The State of Texas Mitigation Plan was prepared in compliance with Public Law 106-390, Disaster Mitigation Act of 2000, as amended. This plan implements hazard mitigation measures intended to eliminate or reduce the effects of future disasters throughout Texas. It was developed through a collaborative endeavor with members of the State Hazard Mitigation Team.

The State of Texas will comply with all applicable Federal statutes and regulations to include the 44 Code of Federal Regulations (CFR) §13.11(c) with respect to the periods grant funds are received. The State of Texas will amend the plan when necessary to reflect changes in State and/or Federal laws and statutes as required in 44 CFR, §13.11(d). The State will review and update the plan no less than every three (3) years from the date of approval, in accordance with the 44 CFR, §201.3(c)(2) and (3) to maintain program eligibility.

The State of Texas Mitigation Plan is hereby adopted and accepted for implementation to protect the lives and property of the citizens of Texas. This Plan supersedes all previous editions.

10/15/13

Date

Rick Perry

Rick Perry
Governor
State of Texas

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SECTION 1 - THE PLANNING PROCESS

The 2013 State of Texas Hazard Mitigation Plan Update represents the fourth rendition. The original plan was approved by the Federal Emergency Management Agency (FEMA) in 2004; then, updated in 2007 and 2010. With each update, new issues are identified, new strategies proposed, and when incorporated, the plan grows in complexity, but, not necessarily in utility. With this rendition, the Texas Division of Emergency Management (TDEM), as the lead for the development of this plan, attempts to practice what it preaches to local mitigation planners: "Keep it Simple; Keep it Relevant; and Keep it Succinct."

This update attempts to adhere to those recommendations. Keeping with that premise, TDEM decided to review the evolution of its planning processes throughout the previous ten years. The following is the result of that effort.

COLLABORATIVE PROCESS

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.

As the planning process moves forward over the next three years, the mitigation staff can better capture how, on many different levels, a multitude of agencies conduct mitigation and contribute to plan goals and strategies.

Texas state agencies, together with local partners across the state, can learn to speak a common mitigation language; work on similar risk and preventive strategies; and exchange useful information to achieve a common goal.

TDEM's Mitigation Section consists of a core staff of mitigation specialists, mitigation planners, and program administrators. In 2012, the section's State Coordinator assumed the role of the State Hazard Mitigation Officer (SHMO) from the Mitigation Section Administrator. The SHMO has oversight over the overall direction of strategy and the timely production and maintenance of the planning document.

TDEM does not produce this plan on its own. Successful planning pivots on collaborative participation that seeks input from a multitude of sources, including the State Hazard Mitigation Team (the SHMT). The process used by the SHMT is one of coordination of expertise and resources. The SHMT is a standing committee that gives input on mitigation issues from other agency

perspectives. All members are invited to participate in the planning process as part of the planning team. Each member can address strategy from their perspective and working knowledge of hazard related issues. The SHMT has established long term relationships among local, regional and state governments and will continue to be active players in mitigation planning and in the implementing of mitigation strategies that are developed.

The role of the team is to identify areas of vulnerability and problems intrinsic to different types of hazards, develop strategies for preventing or reducing loss of life, injuries and damage to property. They can also make specific recommendations regarding changes to state regulations, strategies, or laws that can reduce the risk of loss to the citizens of Texas.

Other representatives from commissions, agencies and boards, and private sector may be asked for additional assistance and input.

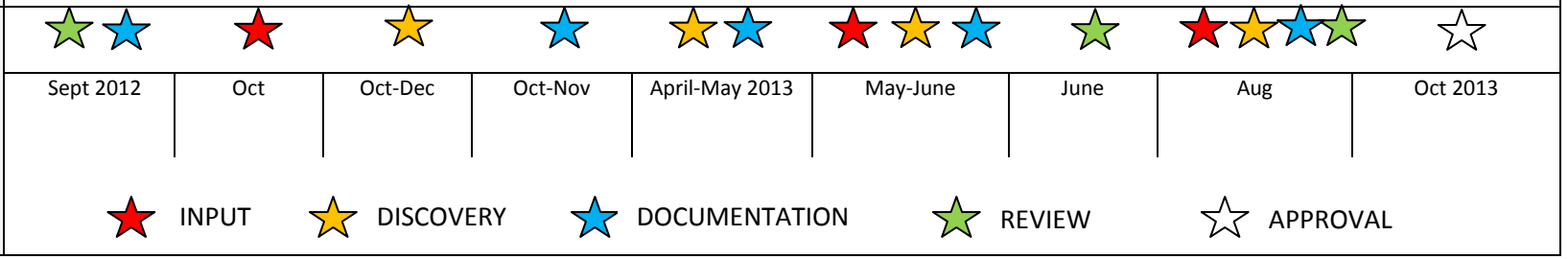
One strategy from the 2010 update was to change the composition of the core team. The team was recently expanded to include members of academia within the technical sub-committee. In addition, a local government representative selected from the Emergency Management Association of Texas (EMAT) the team.

The team lost a member agency due to changes in authorities and responsibilities relevant to statewide mitigation. The Texas Department of Rural Affairs (TDRA) assisted rural communities in key areas of economic and community development, rural health, rural housing, and administered the federal Community Development Block Grant non-entitlement program (CDBG). TDRA was abolished per the 82nd Legislature, effective September 28, 2011. Several functions were transferred to the Texas Department of Agriculture as the Office of Rural Affairs. The governor designated the General Land Office (GLO) to administer the CDBG disaster recovery funds received for Hurricanes Rita, Dolly, and Ike. CDBG funds are eligible for use as match funds for the cost sharing grants -- the FEMA Hazard Mitigation Grant Assistance (HMA) programs that TDEM and the Texas Water Development Board (TWDB) administer at the state level.

2013 Planning Team

State Hazard Mitigation Team	Technical Sub-Committee
Texas Division of Emergency Management *	Texas A&M University*
Texas A&M Forest Service*	Texas Floodplain Management Association
Texas Commission on Environmental Quality*	Texas Geographic Society*
Texas Department of Insurance*	Texas Tech University System*
Texas Department of Transportation*	University of North Texas*
Texas General Land Office*	University of Texas*
Texas Parks and Wildlife Department	**Local Government**
Texas Water Development Board*	Emergency Management Association of Texas
Railroad Commission of Texas	

*These members actively participated in the 2013 mitigation planning process.

Overview of Team Involvement	TDEM Mitigation Staff, including mitigation plan reviewers, program specialists, administrator, and State Hazard Mitigation Officer, was responsible for plan facilitation and coordinates throughout the process with other state agency team members and stakeholders. Initially, staff reviewed the 2010 plan with consideration of its organization and content and decided to reformat the current plan to better reflect the entire planning process; identify additional agencies involved in mitigation missions outside standard FEMA oversight, and introduce the need to develop database tools to better capture and analyze data between updates to the plan in the future. Responsibilities were identified and assigned to team members per function: input, research, documentation and review. A kick-off meeting was held in October 2012 at DPS and included a presentation and round table discussion on existing and new issues. The primary goals of this meeting were to identify initial information needs, propose a project schedule, and determine responsibilities. Also, at this presentation, TDEM's Preparedness Section gave a brief overview of the Threat And Hazard Identification and Risk Assessment (THIRA) process. Additional issues were discussed, such as sea level rise, climate change, and utility grid failure as a result of hazard incidents. These three issues were tabled for further discussion during the next update window. The core of the team is the State Hazard Mitigation Team (SHMT). Historically, the SHMT is actively involved in the analysis, selection, and prioritization of HMGP and PDM grant applications and, therefore, maintains a familiarity with state mitigation strategies, objectives and goals expressed in the plan. In addition, sub-committee members, drawn mainly from academia, addressed informational needs in hazard subject matter and technical expertise. For example, the University of Texas member contributed significantly to the earthquake profile; Texas A&M to the hurricane profile, and the TWDB contributed significantly to the Flood Profile and the Severe Repetitive Loss Strategy. The depth of involvement from any one team member fluctuated with the need for information to fill requirements identified in the review of each section of the plan. An example of stakeholder involvement is through the GIS expertise provided by Texas Natural Resources Information System (TNRIS) due to their involvement in Texas floodplain mapping. Additional graphics were provided by the Texas Geographic Society. Additional stakeholders included the TDEM Regional Coordinators representing six regions across the state and 254 county level emergency management coordinators through an opportunity to respond to a questionnaire on locally identified hazards, impact and capabilities. Additionally, the TDEM Preparedness Section provided input based on the findings of the statewide THIRA. Most team members took the opportunity to provide input on the overall 2013 strategy, including changes to risk, law and policy, funding sources, or capabilities. Several agencies, the TWDB, Texas A&M Forest Service, and GLO provide individual agency mitigation strategies. Earlier contributions from previous planning were reviewed and updated by each agency. The team reconvened in May 2013 through a webinar presentation covering the proposed strategy developed by TDEM. Discussion centered on how strategy corresponded to the goals of the plan and the state's capability to initiate actions. Discussion was robust as team members discussed the implications of each action. Further revisions and refinement were made to the strategy based on this input.
Timeline	

	★ Input	★ Discovery	★ Documentation	★ Review
Expectations	Identify team members by roles and issues. Establish vision, goals and expected outcomes. Note areas of expected improvement in methods.	Identify relevant mitigation related activities initiated by individual agencies and expand through ongoing planning and outreach.	Create a robust document that expands upon the role of mitigation within Texas agencies and serves as a model for local mitigation plan development.	Give team and TDEM management an opportunity to affect content and develop the plan's overall vision. Review also conducted by FEMA Region 6 to result in feedback to incorporate into plan.
Results	At the kick-off meeting, the topics of sea-level rise and electric grid failure due to extreme temperatures were introduced for further consideration by TDEM and Texas Tech University representatives. Due to the prevalence of hurricane, flood and wildfire incidents those team members with oversight over these mitigation strategies, the Texas A&M Forest Service (wildfire), the TWDB (flood), and GLO (coastal erosion) contributed significant information to hazard profiles and strategy. Other team members such as TxDOT and TDI also provided their perspectives on strategy and actions. TDEM Preparedness Section provided input on the THIRA process giving the plan a foundation on which to begin addressing technological hazards.	Much of the information from the 2010 Update continued to be relevant to the 2013 update and previous team efforts were still considered relevant. Staff researched reports, websites, and media and conducted interviews to expand upon and document agencies' activities and committees relevant to mitigation planning. Staff used the existing hazard profiles from the 2010 plan as a springboard to update 14 hazard profiles and added one. More recent incidents were researched from emergency operation center reports and media reporting. Our three academia sub-committee partners have been actively developing background information for anticipated websites that feed into hazard profiles on tornado, earthquake and hurricane. Additional information provided by Texas A&M University on hurricane and the University of Texas on earthquakes.	Early in the update process, staff completed an analysis of the plan and decided that much of the content on hazard analysis remained relevant but the overall organization and format of the material could be improved. Staff was responsible for the organization and formatting of the plan, gathering the information from all the team members, and making final editing decisions. Staff organized the plan to address the four basic sections of the plan: planning process and plan maintenance; hazard profile; strategy; and grant/planning coordination. Submitted input and new discovery were reviewed, edited and incorporated into the plan.	A first draft of the plan was released for review and input to the team and TDEM regional staff. Revision recommendations from the team were incorporated into the plan. The plan then went to TDEM management for review and additional revisions were made to the plan. In June, the plan went to FEMA Region VI for its review and request for approval. The first draft was reviewed by the region and returned with a request for revisions. It then went through a revision process based on comments written by FEMA addressing required and recommended revisions. The Governor of Texas has the authority to adopt the plan after review of the final draft. This will occur after the plan is deemed by FEMA as approvable pending adoption.

2013 Team Contributors				
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TABLE OF TEAM MEMBERS & RELEVANCE TO HAZARD MITIGATION

		SHMT Status Change Since 2010	Description of Agency Relevance to Hazard Mitigation
State Hazard Mitigation Team (SHMT) Members			
TDEM	Texas Division of Emergency Management Johnna.cantrell@dps.texas.gov Gregory.pekar@dps.texas.gov	None	Oversees and implements missions required of emergency management: response, recovery, preparedness and mitigation. Program exists to ensure that Texas and its local governments can respond to and recover from emergencies and disaster, and implement plans and programs to prevent or lessen the impact of emergencies and disasters. Program includes pre- and post-disaster mitigation of natural hazards to reduce impact. The Mitigation Section of TDEM maintains the State Hazard Mitigation Plan, reviews local mitigation plans, and provides hazard mitigation training for local officials. The section also administers the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM).
TCEQ	Texas Commission on Environmental Quality Warren.samuelson@tceq.texas.gov	None	Oversees the Dam Safety Program, monitors and regulates private and public dams in Texas. Program periodically inspects dams that pose a high or significant hazard and makes recommendations to dam owners to help them maintain safe facilities. Provides technical assistance to dam owners (includes political subdivisions); assists dam owners in addressing deficiencies that could become problems during flood events; evaluates adequacy of law/regulations to prevent flood damage to dams/levees; evaluates data used to prevent flood damage to dams/levees; conducts dam/levee failure studies; publishes information on dams and emergency action plans; evaluates proposed mitigation projects to assure compliance with dam/levee safety; and provides information/assistance on public inquiries regarding dams and levees.
TxDOT	Texas Department of Transportation Amy.ronnfeldt@txdot.gov	None	The agency encourages and promotes local participation in the planning process of any community's master drainage plan. The concept is for the community to be aware of TxDOT's long range plans within their community, which enables the community to work with the agency to actively plan mitigation projects in their area and conserve and coordinate resources while providing drainage

			improvements through mitigation. TxDOT actively promotes the Certified Floodplain Manager (CFM) certification within its organization.
TPWD	Texas Parks and Wildlife Department Tom.heger@tpwd.state.tx.us	None	Provides proactive comments on development projects that fall under the authority of the Clean Water Act, Fish and Wildlife Coordination Act (FWCA), and other federal/state regulations. Also coordinates U.S. Army Corps of Engineers flood abatement/floodplain restoration projects. A primary focus is preventing exacerbation of flood events from degradation of flood storage and conveyance functions of wetlands and riparian zones. Staff provides technical assistance and outreach/information on wetland and riparian functions and the protection of natural resources.
TDI	Texas Department of Insurance Scott.helmcamp@tdi.texas.gov	None	Lead agency for windstorm and hail mitigation in Texas. TDI has undertaken an ongoing process for the reduction of damage from windstorms in the coastal area through legislation and policy. Per the Texas Insurance Code, in order to be considered for windstorm and hail insurance through the Texas Windstorm Insurance Association (TWIA), all new construction, repairs, or additions on or after January 1, 1988, in Tier 1 coastal counties shall be inspected or approved by TDI for compliance with the building specifications adopted by the Commissioner of Insurance. TDI educates consumers about issues related to windstorms and other natural disasters through publications and by conducting outreach presentations.
TWDB	Texas Water Development Board Gilbert.ward@twdb.texas.gov Michael.segner@twdb.texas.gov	None	Administers the portion of the FEMA Hazard Mitigation Assistance (HMA) grant program which provides federal funding for mitigation activities that reduce or eliminate the long-term risk of flood damage to lives and property participating in the National Flood Insurance Program (NFIP) and the Flood Protection Planning grant program, through the state's Research and Planning Fund and the Fund Development program, which provides loans for the planning, design, and construction of water supply, wastewater and flood control projects. Tasked with coordinating the NFIP within the state. The NFIP State Coordinator acts as the liaison between the

			federal component of the program and the local communities, with the primary duty to provide guidance and education to the communities to assist in meeting the federal eligibility requirements for entrance into the NFIP and its Community Rating System (CRS) program and also assists the communities with maintaining their participating status. Develops the State Water Plan, incorporating the regional water planning process. The State Water Plan serves as a guide to the state's water policy. Their Innovative Water Technologies advance the use of non-traditional water supplies such as desalination and rainwater harvesting.
RRC	Railroad Commission of Texas	Pending	Removal from team pending, RCC is more closely involved with preparedness than mitigation but as the plan transitions to technical hazards inclusion, representation will be relevant. This seat is currently vacant.
TDRA	Texas Department of Rural Affairs	Agency Closed	Agency Closed
TDA	Texas Department of Agriculture Tom.entsminger@texasagriculture.gov		The TDA Office of Rural Affairs provides rural communities the tools needed to attract and retain businesses, expand and improve public infrastructure, and secure quality health care. The office also provides financial assistance and grants, including the Rural Community Block Grants (CDBG)
GLO	Texas General Land Office Craig.davis@glo.texas.gov	None	GLO is the management agency for state lands and mineral rights totaling 20.4 million acres. As steward of the Texas coast, this agency is responsible for the management of 367 miles of Gulf shoreline and 3,300 miles of bay shoreline, beaches, bays, and other "submerged" lands extending 10.3 miles out from the shoreline. GLO manages grant programs that regulate submerged land, beaches and dunes, and offshore oil production impacts—providing federal grants for studies and mitigation projects that relate to hazards. The Coastal Erosion Planning and Response Act (CEPRA) program also provides state funds to address coastal hazards such as erosion.
TFS	Texas A&M Forest Service	Name	The Texas Forest Service name changed to Texas A&M Forest Service September 1, 2012, to clarify that the agency operates under the umbrella of The Texas

	Lmcneely@tfs.tamu.edu	Change	A&M University System. Wildfire mitigation activities center on public awareness projects and providing technical support for local jurisdictions. TFS prevention staff work with local governments and the public to develop targeted prevention campaigns based on local fire activity. TFS Wildfire-Urban Interface staff helps jurisdictions determine wildfire risk levels, identify hazards, and determine mitigation treatment options through the Texas Wildfire Risk Assessment Portal (www.texaswildfirerisk.com), the Community Wildfire Protection Plan (CWPP) process, and Firewise Communities USA.

Technical Sub-Committee			
EMAT	Emergency Management Association of Texas www.emat-tx.org	New	EMAT represents the local emergency management perspective. In partnership with TDEM, EMAT offers the Texas Emergency Managers (TEM) certification program that acknowledges an emergency management professional's experience, hard work, continuing education, dedication to integrity and creativity. Achieving this certification empowers emergency managers with the knowledge to effectively accomplish the goals and objectives of comprehensive emergency management in Texas, including mitigation. The Emergency Administration and Planning Program and Center for Public Management (EADP) at the University of North Texas (UNT) and EMAT partner to administer the program.
A&M	Texas A&M University Squiring@geog.tamu.edu	New	Texas A&M University provides expertise on hurricane hazards and contributes to the State Hazard Mitigation Plan. In addition, Texas A&M University provides a website and online decision support tools on hurricane hazards to support the development of local mitigation plans. Texas A&M University is dedicated to the discovery, development, communication, and application of knowledge in a wide range of academic and professional fields.
UNT	University of North Texas Laura.siebeneck@unt.edu	New	The University of North Texas provides expertise related to tornado hazard, risk and vulnerability. This information is used to guide recommendations pertaining to tornado mitigation at the individual, local and state level. Additionally, the representatives instruct courses in the Public Administration and Emergency Administration and Planning (EADP) programs, and provide curriculum aimed at developing the professional competency of undergraduates and graduate students pursuing careers in emergency and disaster management.

TFMA	The Texas Floodplain Management Association www.tfma.org	None	As an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program (NFIP), flood preparedness, warning and disaster recovery, TFMA has become a respected voice in floodplain management because it represents such a wide variety of professionals. The association includes flood hazard specialists from local, state and federal governments, the mortgage, insurance and research community, and the associated fields of flood determination specialists, engineering, hydraulic forecasting, emergency response, water resources and others. The TFMA has pioneered the way for the professional certification of local floodplain managers and is in the forefront of efforts to increase the educational opportunities and professional skills of the state's floodplain management professionals. TFMA has now joined the ranks of those few states, which are nationally accredited through ASFPM, and now provides training and testing for those seeking their National Certification as Floodplain Managers.
TXGS	Texas Geographic Society contactTXGS@txgs.org	None	The objective of the Texas Geographic Society is to use geographic data and Geographic Information System (GIS) technologies to help improve government services and education in and around Texas. TXGS partners with public and private organizations to reach its objective.
TTU	The Texas Tech University System Ernst.kiesling@ttu.edu	None	Texas Tech University offers wind engineering expertise. The Texas Tech representative also represents the National Storm Shelter Association (NSSA), a private non-profit group dedicated to improving tornado shelter construction.
UT	University of Texas Cliff@utig.ig.utexas.edu	New	The University of Texas Institute of Geophysics writes and maintains the earthquake profile in the State Hazard Mitigation Plan. The institute maintains the Texas Seismic Monitoring Network and will soon host and maintain an earthquake hazard analysis website to be used by state and local mitigation planners to determine earthquake risk.

SIGNIFICANT EVENTS BETWEEN 2010-2013

The last three years, 2010 – 2013, have been a period of significant events affecting Texas and Mitigation Planning*:*

Three federally declared disasters since 2010 – one hurricane (DR 1931) and two wildfire declarations (DR 1999 and DR 4029); plus one tropical storm and a 2011 state drought emergency declaration with continuing renewals. In 2013, USDA designated 157 counties in Texas as disaster areas due to drought.

Texas 82nd Legislature met in 2011 and 83rd legislature met in 2013.

→ The 83rd Texas Legislature, January 2013, used the 2012 Texas Water Plan as a springboard to reconsider strategy and funding for water resource projects and addresses the financial deficits of the Texas Windstorm Insurance Association.

In 2010, the Texas Supreme Court rules in favor of property owners and limits the State's ability to enforce the Open Beaches Act.

→ The Court declared that the state cannot enforce the removal of homes on private property converted to public "open beach" due to natural forces such as erosion or storm.

Congress passed the Biggert-Waters Act Flood Insurance Reform Act of 2012.

→ The Biggert-Waters Act influences changes in the requirements and management of NFIP related HMA funds.

The development Threat Hazard Identification Risk Analysis (THIRA) requires a settlement between hazards identified through preparedness planning and those identified through mitigation planning.

→ The 44 CFR 201 requirements for both state and local mitigation planning focus on natural hazards. THIRA identified the need for coordinated hazard identification, as it applies both to THIRA and the State Mitigation Plan. As a result, TDEM forecasts that future inclusion of technological hazards into the Plan will create a more comprehensive planning document and, therefore, will take a preemptive approach to future planning with an inclusion of a summary addressing technological hazards and their risk to the state.

Tightened standards affect the FEMA mitigation plan review process – concern over the quality of mitigation planning results in new review tools, a new planner's manual, and a more stringent interpretation of the 44 CFR 201 requirements.

→ Meanwhile, TDEM implements the two-county maximum policy restricting the footprints of local mitigation plans in order to encourage more local involvement and county-wide cooperation.

NEW ISSUES IDENTIFIED

In preparing the 2013 plan, several other significant issues were identified and their implications considered:

How Texas should approach sea level rise is raised by the team. In the 2010 plan, the topic is discussed briefly as a causal effect on coastal subsidence and coastal erosion. Further discussion culminated in the decision to address in terms of an identified issue, as the risk of sea level rise and an appropriate mitigation strategy remains inconclusive and continues to be under debate. The team concluded that the most appropriate approach at this time is to not list sea level rise as a hazard, but to continue to monitor research on this issue from this plan forward until more decisive conclusions are drawn.

The issue of utility outages, particularly if occurring as a cascading event from a natural weather incident, should be considered and addressed. The issue remains to be reviewed for inclusion into the future plans.

Texas coastal communities have expressed concern of the potential for tsunami occurrence along the Gulf Coast. Tsunami is not considered a high risk to the Texas coastline but the issue of its risk will remain under consideration. TDEM's role may be to lead through communication of the risk and research warning system capabilities.

One hazard missing from the plan, but addressed almost across the board in local mitigation plans, is lightning, either as a stand-alone hazard or as a component of thunderstorm. The Team decided to include lightning as a stand-alone hazard, in order to bring the state's identification of hazards into conformance with what is identified at the local level. The other components of thunderstorm frequently delineated in local planning are hail and straight-line winds. Hail and wind are addressed as separate hazards in the state plan and will remain separate rather than combining into thunderstorm. The plan now identifies 15 natural hazards.

Profiling dam failure continues to be problematic for local mitigation planners. Mitigation's focus is not on the technical failure of a dam from any particular cause, but on the flood inundation area if there is a breach. The location of the flooding impact is a difficult measurement to identify and many planners express frustration over unavailability of access to dam emergency action plans that may provide the information they need. A 2005 opinion from the Texas Attorney General Office restricts access to those documents for security reasons. TCEQ supports the decision but will continue to work with local emergency management to share information whenever possible.

FEDERAL AND STATE AGENCY INVOLVEMENT IN THE PLANNING PROCESS

Threat Hazard Identification Risk Analysis (THIRA)

During this update cycle, the foremost action affecting FEMA/TDEM coordination efforts with an impact on mitigation planning has been the requirement to produce a state-level Threat and Hazard Identification and Risk Assessment (THIRA), as outlined in the Comprehensive Preparedness Guide 201, March 2012. THIRAs are required by the end of 2012 as a condition of receiving Emergency Management Planning Grants (EMPG) and Homeland Security Grant Program (HSGP) grant funding. THIRA is developed to be an all hazards capability tool to assess a jurisdiction's understanding of its threats and hazards and how impacts vary across time, location and other factors, in order to target resources accordingly. FEMA has emphasized to the states the importance that both preparedness and mitigation approach their strategies from the same hazard identification standpoint, so that consistency is maintained in the identification and profiling of hazards across planning mechanisms.

NOAA, Coastal Communities and Tsunami Threat Potential

In 2013, due to coastal communities' interest of tsunami threat along the Texas Gulf Coast, The National Oceanic and Atmospheric Administration (NOAA) sponsored a workshop and webinar addressing the potential of this hazard. Approximately 20 emergency management coordinators (EMCs) from the area were in attendance, with TDEM representatives attending and co-presenting via webinar. Topics included tsunami risk assessment along the mid-Texas coast, outreach and preparedness, an overview of NOAA's Storm Ready and Tsunami Ready programs; and a round table discussion.

Wildfire Mitigation Cooperation

The Texas A&M Forest Service (TFS) conferred frequently with the TDEM mitigation specialists and planners while developing their Texas Wildfire Risk Assessment Portal (TxWRAP), which was released in 2012. The portal provides firefighting personnel the ability to address and manage wildfire and wildfire-urban interface (WUI) strategies. TFS coordinated the development of TxWRAP with TDEM to assure that a significant component of the database would tie directly into researching and creating wildfire profiles for local communities and risk analysis at the state level.

Hazard Mitigation Assistance

Since FEMA's Hazard Mitigation Assistance (HMA) grants are divided between TWDB and TDEM, these two agencies benefit from working together and sharing information. There is substantial overlap between the types of projects that can be done with these grants, so local jurisdictions

can approach either agency, and each agency's staff is trained to be able to provide information on all five programs. Moreover, funding appropriations and local cost shares vary for each of these grants, so each agency works with local jurisdictions to find the most appropriate grant to suit their needs. TWDB and TDEM also have the capacity to share data and experience, which strengthens the strategies of both agencies.

The Texas Natural Resources Information System

The Texas Natural Resources Information System (TNRIS) is a division of the TWDB. TNRIS supports hazard mitigation in a variety of ways. TNRIS has significant collections of base map data available to communities and the public. These include digital aerial photographs, soil surveys and transportation, boundaries, surface water, and elevation maps and data. TNRIS has census data, historical aerial photos, and paper maps from different state and local agencies. In addition, TNRIS established an NFIP Mapping Services Group in 2009 to serve as the state's principal center for statewide floodplain mapping resources.

TNRIS manages the Strategic Mapping Program, a Texas-based, public and private sector cost-sharing program to develop consistent, large-scale computerized base maps describing basic geographic features of Texas. In addition, TNRIS has provided TDEM Mitigation technical assistance on a variety of GIS capacity services focusing on hazard analysis and houses the State Critical Facility Database for TDEM Mitigation.

The Texas Geographic Society

The Texas Geographic Society continues to provide HAZUS-MH based instruction and the Texas Hazard Mitigation Program (THMP) http://www.thmp.info for use in developing hazard profiles. In Fall 2013, they expect to roll out the Comprehensive Hazard Assessment and Mitigation Planning Service (CHAMPS). CHAMPS is an automated natural hazard risk assessment for communities, defined by counties. The primary product of CHAMPS is the Preliminary Hazard Risk Assessment Report, which will contain exhibits – primarily maps and statistical tables that illustrate and quantify risk to natural hazards. The primary intention of the report is to provide scientific rationalization for developing hazard mitigation plans.

STAKEHOLDER PARTICIPATION OUTREACH

In addition to federal and state agency participation, stakeholder input is very important. Stakeholders are identified as those persons, or representatives of particular special interests, who are either involved in local and regional hazard mitigation including public works, zoning, emergency management floodplain administrators, or those that may be partners in hazard mitigation and response activities. Creating these partnerships result in a dynamic, whole community approach to mitigation planning.

During this update process, discussion has focused on how TDEM can address hazard mitigation to private concerns, through business associations, utility companies, or private-non-profits. The goal is to reach those associations whose members are motivated to take an active role as an advocate for mitigation planning.

A general notice was placed in the Texas Register announcing that the plan was in the process of being updated. Interested parties could use this opportunity to become stakeholders in the update by reviewing the plan and providing comments to TDEM Staff.

A questionnaire was circulated to the emergency management coordinators (EMCs) of all 254 county seats requesting input on their top-ranked natural and technological hazards; their vulnerabilities and impacts; and the local capability to address their mitigation.

At both the EMAT Symposium in February 2013 and Texas Emergency Management Conference in March 2013, a manned booth provided another platform to solicit input. In addition, fliers placed in TDEM training classrooms requested input from a wide audience of class registrants related to all missions of emergency management.

Additional outreach will continue. TDEM is in the process of identifying statewide business organizations as potential ongoing stakeholders.

INTEGRATION ACROSS PROGRAMS

The plan is often a springboard for initiating research and analysis of mitigation planning and projects occurring within the state. A plethora of information generated by state agencies, universities, and other associations on the topic of mitigation and hazard analysis only enriches our planning processes.

Mitigation Awareness

It may be in the arena of public outreach that the state agencies best demonstrate a common voice in moving the state's mitigation planning strategy forward. The following agency websites include information on hazard mitigation and provide links to each other's sites.

Texas Department of Insurance *http://www.tdi.texas.gov/consumer/storms/index.html*
Texas Department of State Health Services *http://www.texasprepares.org/survivingdisaster.htm*
Texas General Land Office *http://www.glo.texas.gov/GLO/disaster-recovery/index.html*

Additionally, state institutions of higher learning provide sources of information. Two sources of extensive information on hazards and their mitigation associated with Texas A&M University:

Texas A&M Agri/life's Extension Disaster Education Network (EDEN) *http://eden.lsu.edu*
Office of the State Climatologist *http://atmo.tamu.edu/osc*

MITIGATION WITHIN AGENCY PROGRAMS

To produce a more comprehensive strategy at the state level, the team will to be tasked with pulling together input from other areas within their agencies involve in mitigation of identified hazards. These mitigation activities have been under-recognized during our previous planning processes.

- Department of Public Safety takes the "Turn Around Don't Drown", the popular slogan attributed to NOAA National Weather Service, and incorporates into the State of Texas Drivers Handbook
- Texas Department of Transportation incorporates tornado saferooms into their Safe Rest Stops program through a federally funded Transportation Enhancement program
- Texas Department of Transportation revises its design manual to include improved guidance on NFIP requirements. The agency supports the effort to certify floodplain managers (CFMs) by encouraging all their personnel to become certified, with the result that all engineers in TxDOT's central hydraulics branch are CFMs
- Texas A&M Forest Service's programs and funding opportunities, such as Urban Tree Canopy Project, address mitigation by decreasing impact from summer heat, flooding, and erosion
- Texas Water Development Board's Innovation Water Technologies Program promotes and advances the use of non-traditional water supply development and management technologies, such as desalination, rainwater harvesting, water reuse, and aquifer storage and recovery
- Texas General Land Office intends to continue utilizing education to increase public and private sector awareness and support for mitigation planning along the Texas coast, including the Texas Storm Smart Coasts Network website, Texas Coastal Homeowners Handbook, and the Texas Hazard Mitigation Guidebook
- Texas Department of Licensing and Regulation (TDLR) licenses and regulates weather modification programs and hosts the Texas Weather Modification and Advisory Committee meetings. Cloud seeding projects designed to increase rainfall from convective cloud towers are conducted in nearly 31 million acres of Texas (or almost one-fifth of the state's land mass). In administering the Texas Weather Modification Act (enacted in 1967), TDLR's weather modification program issues licenses and permits for projects using specialized

aircraft and sophisticated weather radar systems, operated by skilled meteorologists, at sites near Amarillo, San Angelo and Pleasanton. TDLR also issues permits for hail suppression projects.

COMMITTEES

Regularly, Texas agencies come together to form teams drawing from various expertise to address hazards and advocate for mitigation.

Texas Flash Flood Coalition

The Texas Flash Flood Coalition serves as the comprehensive flood resource council for the prevention of flooding injuries and deaths; to prepare Texans for adverse flash flood events; to make recommendations to stakeholders to promote relevant research, education, and communications that will save the lives and property of Texans.

The group was established in October 2007 to address an abnormally high occurrence of flash flood fatalities in Texas that year. Stakeholders from what is called "flash flood alley", which lies along the IH-35 corridor from San Antonio to Dallas, convened to discuss and brainstorm new ideas and strategies to mitigate these preventable fatalities. Over 25 public and private organizations currently participate.

Cities of Austin, Bastrop, Round Rock and San Antonio and Travis County	Harris County Flood Control District	URS Corp
Council of Governments—Capital Area Council of Governments	Lower Colorado River Authority, San Antonio River Authority and US Geological Survey	Texas Floodplain Management Association
Department of State Health Services DPS-Texas Division of Emergency Management Texas Department of Transportation	NWS Offices in Texas and the West Gulf River Forecast Center National Weather Service Southern Region	Texas State University University of Texas at San Antonio

Texas Wildfire Prevention Task Force

This task force was formed by Texas Agriculture Commissioner Todd Staples in 2012 to address wildfire prevention and mitigation.

DPS-Texas Division of Emergency Management	Coryell County	Prescribed Burn Alliance of Texas
Texas Commission on Environmental Quality	Texas Fire Chiefs Association	Texas and Southwestern Cattle Raisers Association
Texas A&M Forest Service	County Judges and Commissioners Association of Texas	Texas Prescribed Burning Board
Texas Parks & Wildlife Department	Texas Association of Regional Councils	Independent Insurance Agents of Texas

Texas Department of Insurance	Texas Wildlife Association	Texas Municipal League
Texas State Soil and Conservation Service	Texas Farm Bureau	Texas AgriLife Extension Service
Texas Forestry Association	South Texans' Property Rights Association	Sheriffs' Association of Texas

Drought Preparedness Council

The Drought Preparedness Council was authorized and established by the 76th legislature (HB- 2660) in 1999, subsequent to the establishment of the Drought Monitoring and Response Committee (75th legislature, SB-1).

The Chief of the Texas Division of Emergency Management is the state drought manager. The state drought manager is responsible for managing and coordinating the drought response component of the state water plan.

Texas Division of Emergency Management	Texas AgriLife Extension Service	Texas Department of Transportation
Texas Parks and Wildlife Department	Texas Department of Agriculture	Texas State Soil and Water Conversation
Texas State Climatologist	Texas Water Development Board	Texas Commission on Environmental Quality
Texas A&M Forest Service	Texas Department of State Health Services	Office of the Governor – Economic Development and Tourism
Texas Alliance of Groundwater Districts	Texas Department of Housing and Community Affairs	

ADDITIONAL CROSS-AGENCY COOPERATION

Texas Association of Regional Councils (TARC)

ARC was organized in 1973 as an association of Texas' 24 regional councils of governments (CoGs). CoGs are small state-funded regional planning units that assist local governments in the development of plans to enhance economic development and to plan intelligently for population growth. At the regional level they provide a variety of services including homeland security resources and funding, and mitigation planning. CoGs have been the sub-applicant administrator of many mitigation planning grants, provider of hazard profiles, and often the lead plan developer for local mitigation action plans. TARC has been proactive in inviting both state and FEMA mitigation representatives to give presentations at their conferences.

Firewise Communities

The National Fire Protection Association's (NFPA) Firewise Communities programs encourage local solutions for wildfire safety by involving homeowners, community leaders, planners, developers, firefighters, and others in the effort to protect people and property from wildfire risks. The program is co-sponsored by the USDA Forest Service, the U.S. Department of the Interior, and the National Association of State Foresters. There are two major Firewise programs which the Forest Service supports. The first is an ongoing, practical program aimed at educating and empowering property owners located in the wildfire-urban interface (WUI) to mitigate wildfire hazards themselves by modifying their landscaping and land use so that it will be more adaptive. The second program is the Firewise Community/USA program, aimed at small communities, community associations, and master-planned communities to assess risk and create a network of cooperation. Being recognized as a Firewise Community requires that the community has an ongoing commitment towards mitigating wildfire hazards within their community.

Cross-Agency Wildfire Mitigation

The state certifies and regulates prescribed burn managers through the Texas Department of Agriculture (TDA) Prescribed Burning Board. The board certifies commercial and private prescribed burn managers to ensure that they have the proper training, experience and financial responsibility to protect themselves and those they serve. The Texas A&M Forest Service supports the TDA program by providing certified training in East Texas forest fuels and through public education on the benefits of prescribed burning as a mitigation tool.

The TFS also provides subject matter expertise and fuels reduction services to Texas Parks & Wildlife and the General Land Office. Its Predictive Services staff calculates and predicts the statistical probability of fire occurrence and behavior, disseminate wildfire assessment information to elected officials, including drought information for burn ban determinations, and work with the National Weather Service to determine areas of extreme fire danger to pre-position personnel. Wildfire-Urban Interface staff helps communities determine wildfire risk levels, identify hazards, and determine mitigation treatment options through the Community Wildfire Protection Plan (CWPP) process, http://texasforestservice.tamu.edu/main/popup

Certified Floodplain Manager (CFM) Training

The Texas Floodplain Management Association (TFMA), TDEM and TWDB continue to collaborate to bring workshops that provide continuing education opportunities for CFM certification. In addition, several mitigation planning and grant courses offered through the TDEM G-series are eligible for continuing education credit.

CROSS INTEGRATION OF PLANS ACROSS AGENCIES

Texas Wildfire Protection Plan

The updated information for this plan's wildfire hazard profile, and specifically on WUI, draws from the TFS Texas Wildfire Protection Plan.

Department of State Health Services Risk Assessment Tool

In 2011, the Texas Department of State Health Services (DSHS) Community Preparedness Section contacted TDEM mitigation for advice and input on completing jurisdictional risk assessments submitted to TDEM as part of their local mitigation plans and assessed by TDEM as part of its state planning process. This information supports a project tasked by the Centers for Disease Control to assess risk in terms of potential health impact and population vulnerability factors of Texas' most probable disasters.

Texas Water Plan

The 2012 State Water Plan: *Water for Texas* has been a key source of strategy for the 83rd Legislative Session of 2013 for the mitigation of drought. At the end each regional water planning cycle, TWDB staff compiles information from the regional water plans and other sources to develop the state's plan, which is presented to the TWDB's governing board for adoption. The final adopted plan is then submitted to the Governor, Lieutenant Governor, and the Texas Legislature. The update to the State Hazard Mitigation Plan references its data collection.

State Annex P

The state of Texas has the *State of Texas Emergency Management Plan Annex P – Hazard Mitigation* prepared by TDEM. The purpose of the Annex P is to identify Emergency Support Function (ESF) tasks for hazard mitigation and to define organizations, responsibilities and procedures for taking action to eliminate or reduce long-term risk to life and property from natural or human-caused disasters. The primary focus of the annex is the coordination of state-level mitigation activities.

TDEM Drought Preparedness Plan

TDEM maintains a *State Drought Preparedness Plan*, which provides the framework for an integrated approach to minimize the impacts of drought on its people and resources. The plan outlines both long and short-term measures that are to be used to prepare for, respond to, and mitigate the effects of drought. To accomplish these goals, the *State Drought Preparedness Plan*:

- Identifies the local, state, federal and private sector entities that are involved with state drought management and defines their responsibilities
- Identifies the Drought Preparedness Council and the responsibilities of its committees
- Defines a process to be followed in addressing drought-related activities, including monitoring impact assessment and response
- Identifies long and short-term activities that can be implemented to prevent and mitigate drought impacts
- Acts as a catalyst for creation and implementation of local drought planning and response efforts

Threat Hazard Identification Risk Assessment

The need for a merged strategy to address hazards and their risks from both Preparedness and Mitigation perspectives addresses FEMA's desire for a "whole community" approach to response, recovery, preparedness and mitigation. During the planning stages of the Texas development of THIRA, representatives from Preparedness, Mitigation, and Homeland Security gave input.

Regional Plan for Sustainable Development

TDEM Mitigation and FEMA Region 6 partnered to attend and advocate mitigation at a meeting with Heart of Texas Council of Governments, after it was awarded The Department of Housing and Urban Development (HUD) Sustainability grant to develop a *Regional Plan for Sustainable Development* (RPSD). Each grant recipient was able to define sustainability in terms of local goals, but the goal of TDEM and FEMA Region 6 was to encourage the integration of mitigation into their planning processes. The RPSD includes assessment and mapping of existing conditions as well as analysis and recommendations in the following areas: housing, transportation, water, infrastructure, air quality, solid waste, community engagement and engagement resources, entrepreneurship and small business, community priorities, needs, and concerns; issues creating disparities in access, economic vulnerability points, both for physical communities and for characteristic communities, and climate vulnerability points, especially drought and subsequent flooding.

The General Land Office Hazard Mitigation Program

GLO's Hazard Mitigation Program focuses on the coastal area and is designed to achieve many of the goals and policies of the Texas Coastal Management Program (CMP).

The Coastal Zone Management Act of 1972 requires states to develop a coastal management program in order to receive and administer federal grants for managing and improving coastal lands.

The federally approved CMP brings approximately $2.2 million in federal Coastal Zone Management Act (CZMA) funds to state and local entities to implement projects and program activities. Texas is one of only a handful of coastal states that pass substantial amounts of CZMA funds through to coastal communities for projects in the coastal zone.

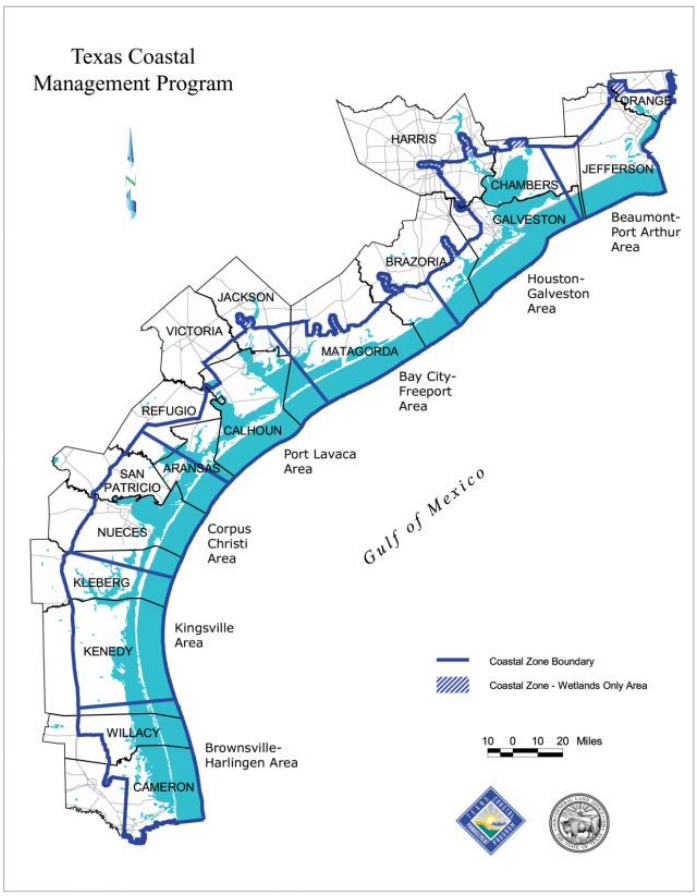
The Governor designated GLO as the state agency responsible for the development and management of the state coastal management program and established the Coastal Coordination Council to oversee the development of the plan, to adopt coast-wide management policies, and to implement the plan and designate the physical boundary for the coastal area.

Participants representing a variety of stakeholder groups, including federal and state agencies, local governments, non-profit organizations, universities, private industry, and the general public, were asked to:

- Identify the most important coastal management issues on the Texas coast
- Identify obstacles to effectively managing those issues

- Brainstorm innovative solutions to address the obstacles identified

The council and stakeholders identified growth and land use changes as the greatest challenge to Texas when addressing coastal hazards such as flood inundation and coastal erosion.



The Coastal Management Program boundary is set by statute and extends inland to encompass tidal waters.

The policy framework of the CMP is built around a uniform set of coastal goals and policies adopted by the council. The goals of the CMP are:

- Protect, preserve, restore, and enhance the diversity, quality, quantity, functions, and values of Coastal Natural Resource Areas (CNRAs)
- Ensure sound management of all coastal resources by allowing for compatible economic development and multiple human uses of the coastal zone
- Minimize loss of human life and property due to the impairment and loss of protective features of CNRAs

- Ensure and enhance planned public access to, and enjoyment of, the coastal zone in a manner that is compatible with private property rights and other uses of the coastal zone
- Balance the benefits from economic development and multiple human uses of the coastal zone, the benefits from protecting, preserving, restoring, and enhancing CNRAs, the benefits from minimizing loss of human life and property, and the benefit from public access to and enjoyment of the coastal zone
- Coordinate agency and local government decision-making affecting CNRAs by establishing clear, objective policies for the management of CNRAs
- Make agency and local government decision-making affecting CNRAs efficient by identifying and addressing duplication and conflicts among local, state, and federal regulatory and other programs for the management of CNRAs
- Make agency and local government decision-making affecting CNRAs more effective by employing the most comprehensive, accurate, and reliable information and scientific data available and by developing, distributing for public comment, and maintaining a coordinated, publicly accessible geographic information system of maps of the coastal zone and CNRAs at the earliest possible date
- Make coastal management processes visible, coherent, accessible, and accountable to the people of Texas by providing for public participation in the ongoing development and implementation of the CMP
- Educate the public about the principal coastal problems of state concern and technology available for the protection and improved management of CNRA

In addition, GLO's Hazard Mitigation Program provides assistance in amending, updating, and maintaining local mitigation plans and with developing a proactive approach for the minimizing and mitigating of coastal hazards. In 2009, with funding from the Texas CMP, Texas A&M University completed a study of local mitigation plans along the Texas coast. The study focused on plans' current quality and functionality with the goal to help coastal planners identify opportunities to make their mitigation plans more efficient and effective and to provide a better tool for coastal communities to be more resilient. The results of the study are provided to coastal communities to assist in updates to their plans. The program also helps local communities identify potential mitigation projects that could be eligible for mitigation grants.

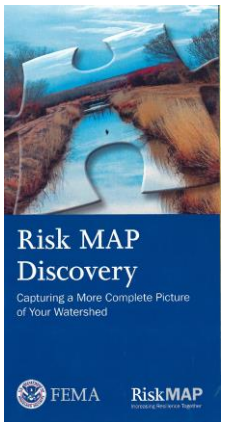
By providing education, outreach, and technical assistance, the program's focus is to help coastal communities be better prepared and more resilient to storm impacts. An initiative of the program is to improve coordination and cooperation of coastal communities in mitigation actions. Helping to establish local hazard mitigation workgroups and regionally integrating these workgroups will provide local emergency managers, floodplain administrators, and local officials the opportunity to work together on mitigation strategies and local and regional mitigation plan maintenance. More detail on the agency's strategy can be found in Appendix II.

INTEGRATION WITH FEMA MITIGATION PROGRAMS AND INITIATIVES

Earthquake Consortium State Assistance

Texas participated in the 2010 Earthquake Consortium State Assistance program funding. This funding was used to provide training through the National Earthquake Technical Assistance Program (NETAP) and FEMA and was sponsored by the Rio Grande Council of Governments (RGCoG). The trainings were held February 8, 2011 in El Paso, Texas and February 10, 2011 in Alpine, Texas.

NFIP Watershed Discovery Meetings



As part of its activities related to the National Flood Insurance Program (NFIP), FEMA began the transition from Map Modernization to Risk Mapping, Assessment, and Planning (RiskMAP) in 2009. The vision for RiskMAP is to work collaboratively with state, local, and tribal entities to deliver quality data that increases public awareness and leads to mitigation actions that reduces risk to life and property. During Discovery, FEMA gathers information about local flood risk; collects information about their flood history, development plans, storm water and floodplain management, and reviews local mitigation plans' actions. TDEM mitigation participated or contributed outreach information to several of these meetings in watershed districts in 2012 and 2013.

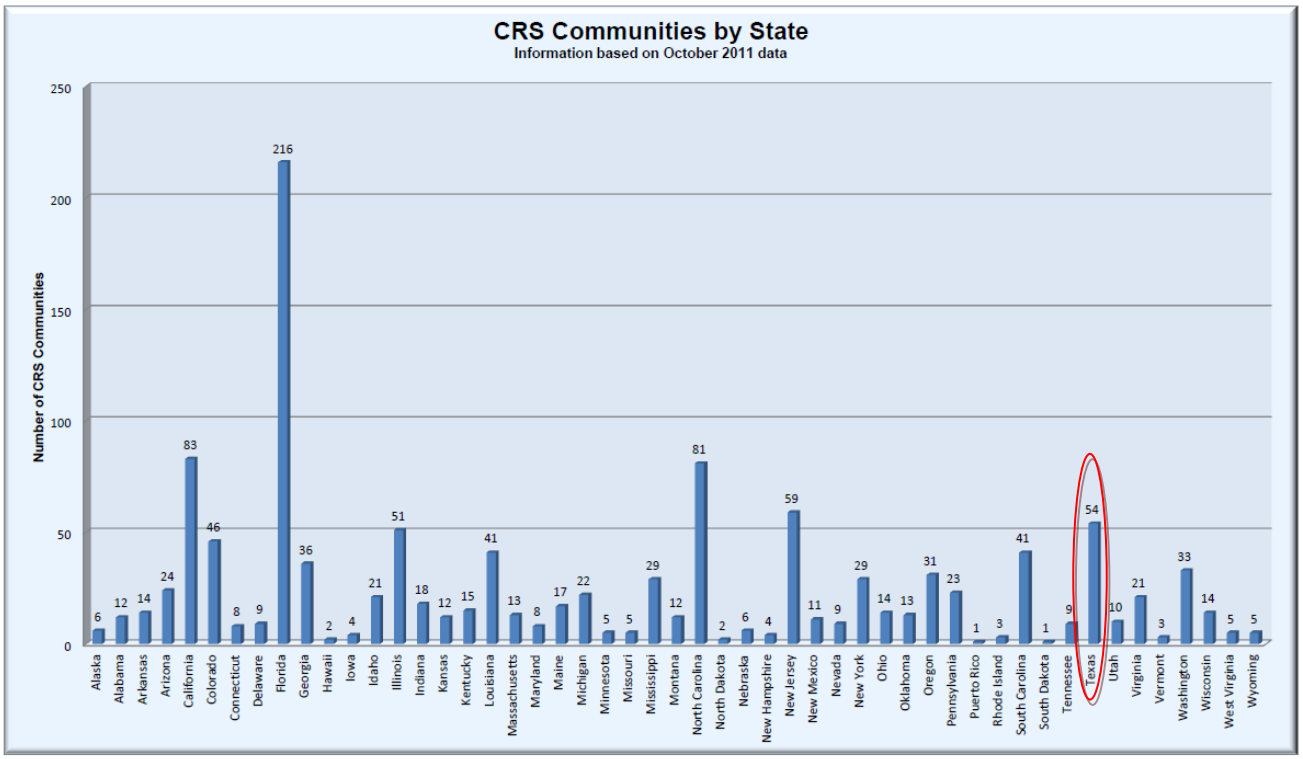
National Flood Insurance Program (NFIP) & Community Rating System (CRS)

In 2007, the TWDB was named by the 80th Texas Legislature as the state agency tasked with coordinating the National Flood Insurance Program (NFIP) within the state. The NFIP State Coordinator acts as the liaison between the federal component of the program and the local communities, with the primary duty to provide guidance and education to the communities to assist in meeting the federal eligibility requirements for entrance into the NFIP and also assist the communities with maintaining their participating status in the NFIP. According the FEMA Community Status Book Report, in 2013 Texas has 1,235 communities that currently participate in NFIP. These communities have floodplain ordinances and court orders. (http://www.fema.gov/cis/TX.html)

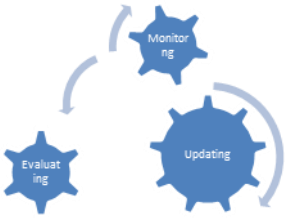
CRS is a voluntary program that recognizes and encourages a community's efforts that exceed the NFIP minimum requirements for floodplain management. The CRS program emphasizes three goals:

- The reduction of flood losses
- Facilitating accurate insurance rating
- Promoting the awareness of flood insurance

The CRS is an incentive-based program where communities exceeding the minimum NFIP requirements for participation can secure up to 45 percent premium reductions for the policyholders in that community. Currently within Texas, 54 communities currently participate in CRS.



MAINTENANCE OF THE STATE MITIGATION PLAN



The Mitigation Section staff is responsible for the maintenance of the plan. The State Hazard Mitigation Officer (SHMO) designates staff to identify, develop and implement methods, tools, and schedules to monitor, evaluate, and update the plan. With the development of more sophisticated database tools, it is anticipated that information can be better identified, collected and prioritized on an ongoing basis among team members. The greatest lesson learned during the updates of the plans is the best schedule builds sufficient document preparation, submittal, review, and revision time into the planning process.

Monitoring, evaluating, and updating the plan does not run in a linear timeline, as each action is interdependent on the others. Texas clearly recognizes that any hazard mitigation plan is not a static document and requires regular review and evaluation to address effectiveness.

Monitoring and Evaluating

During this update's evaluation, The Texas Division of Emergency Management (TDEM) staff analyzed their previously approved plan's monitoring and evaluation methods and concluded that the current activities necessary to maintain, monitor, and update could be improved through a more systematic approach. Because Texas offers a dynamic, expansive environment, the plan requires a continual – almost daily – timeframe for capturing and evaluating information. The mitigation staff is committed to proactive evaluation of the plan, as well as including those agencies, organizations, and associations that were a part of the initial planning process.

Media monitoring of emergency management issues, including mitigation projects, and hazard occurrence and impact is conducted on a daily basis by the TDEM Community Relations Unit and relevant articles are shared with mitigation staff, including the mitigation plans supervisor and section administrator. Mitigation administrative staff will log these into a database and capture any corresponding Emergency Operations Center (EOC) reports, called sitreps. On a monthly schedule staff will abridge these articles and sitreps for a mitigation report that evaluates the significance of hazard occurrences or issues that surfaced against relevant content in the plan. Quarterly, the staff will communicate information to the team through emails, webinars or other method, giving the team an opportunity for feedback. Input will be captured and evaluated against current strategy and recommendations will be made to TDEM management. Significant issues or events will trigger a monitoring of planning strategy, including actions, to see if any issue or action should be revisited implemented or reexamined. This report will be delivered to each team member to do the same from their agency's perspective. A follow-up meeting or webinar will follow for a collaborative round table discussion. In this way the team will work in partnership on the review of the risk assessment and capabilities portion of the plan and together concur on what information requires updating or modification. Addressing federal and Texas legislative-directed changes in policy will be aligned with this time frame. An ongoing opportunity (biannually) for evaluation of the plan will be conducted when outreach materials are developed for presentations. Success stories on mitigation are written by TDEM staff as

events occur in areas with completed projects and are evaluated as to the degree of mitigation achieved.

Team members will again assess strategy and projects post-disaster, when they come together in their role in the Hazard Mitigation Grant Program (HMGP) application evaluation process. The core team members identified as the State Hazard Mitigation Team (SHMT) are active in the selection of sub-applications process. They evaluate projects per each member's subject matter expertise and present those findings to the SHMO. This remains an advantageous opportunity to expand their evaluation beyond the sub-application process. From this process each member will report on how the projects for which funding is granted would contribute to achieving the goals stated in the plan.

The TDEM Preparedness Section will continue to keep mitigation informed on the annual State THIRA Update when completed and this information will be incorporated into the plan.

The roles and knowledge base of each SHMT and sub-technical team member contribute to the robustness of the dialogue on mitigation. Nonetheless, the composition of the team should also be evaluated on a yearly basis for best fit selection.

The method will follow the schedule below:

Daily	• Monitor media and sitreps for hazards events and outcomes • Analyze events around state for hazard occurrences, implementation of actions; best practices; success stories. File relevant material.
Monthly	• Review approved mitigation plans to capture local perspective on risk, including vulnerability, impact and frequency • Review relevant material from media and sitrep monitoring and associate hazard occurrence with location, and extent, abridge information and enter into database and create report for distribution to team • Staff and Team will evaluate media and sitrep report for relevancy to issues, strategy or actions and report feedback
Quarterly	• Communicate with team through appropriate methods. Request input on agency mitigation activities • Capture feedback and evaluate against the strategy and goals of the plan and adjust as necessary by TDEM management decision
Biannually	• Check on any changes in state facilities database. Notify agencies to keep up • Conduct outreach to business organizations; Texas Council of Governments • Analyze media monitoring and sitreps and update relevant portions of plan such as hazard profiles • Follow-up with contact persons on identified mitigation committees, studies, and policies

Annually	• Monitor federal legislature activities • Assess Team membership for relevancy to All-hazard approach • Team meets to discuss PDM grants selection against meeting plan's strategy and goals • Review HMGP, PDM and FMA sub-grants projects against meeting goals • Send out questionnaire on local hazards to EMCs and TDEM regional staff • Review update to state THIRA and incorporate findings into plan, as appropriate
2 – Year	• Monitor state legislature activities • Request policy statements program changes from state agencies based on legislature decisions
Event Trigger	• Analyze media monitoring and sitreps and update relevant portions of plan such as hazard profiles • Investigate relevant success stories based on mitigation actions previously implemented • Outreach to relevant agencies and affected areas on mitigation opportunities with approved mitigation plan • Reassess state's reported risk assessment and capabilities and adjust as necessary
Post-Disaster	• Team meets to discuss HMGP sub-application selection against meeting plan's strategy and goals • Monitor and capture documentation and contact person on additional mitigation studies, policies, committees formed due to event

Updating

For the next update cycle, the TDEM staff charged with the oversight of the plan, shall again reference the sub-section: "The Planning Process Redefined". Historically, the maintenance and monitoring of the plan did not involve interim updates. More robust cyclical evaluation may result in updating and revising content to reflect our dynamic, expansive environment. By keeping the current plan "more current" the five-year update process can also become more systematic and less demanding. If circumstances such as major hazard events or a significant change in policy direction indicate a need to reevaluate or revise the plan with major content overhaul, a truncated version of the planning process could go into effect on short notice.

Notwithstanding a major event, at the start of 2014, about 30-33 months prior to the next update, TDEM staff should initiate the planning process with a review of this plan's strengths and weaknesses as a document and a discussion of where to take it from here. The process will again require a detailed examination of all sections of the plan with active team participation. The State Hazard Mitigation Officer will advocate the importance of contributions from the Team. The State Mitigation Plans Supervisor will capture, track and document contributions per the schedule below. The process should become substantially more rigorous as the state's vision becomes more focused and defined as to what mitigation's role is in forming resilient communities.

2014	• Review plan for strengths and weaknesses against FEMA crosswalk recommendations • Pull up all captured documentation since 2013 plan approval ; analyze for relevance to next update and incorporate into new draft • Continue to advertise availability of state plan on TDEM website • Re-establish commitment from team members and identify potential new members or replacement • Request team stay current on mitigation activities and reread 2013 Update and give input for revision/editing • Capture relevant information from policies, committees, and the like, created since update • Initiate team planning sessions
2015	• Incorporate all captured documentation from 2014 into draft update • Communicate roles of team and assign sections to monitor and update per subject expertise • Conduct team planning sessions bi-annually
2016	• Accelerate team planning sessions to one per quarter • Establish that each section of the 2013 plan has been reviewed and recommendations for revising captured • Incorporate all captured documentation from 2014 into draft update • Incorporate input from team into plan • Advertise availability of draft plan for comment • Submit to FEMA for review four months before expiration

<table>
<tr><th colspan="2">SYNOPSIS OF 2010 PLAN REVISIONS</th></tr>
<tr><td colspan="2">In addition to the overall critique of our planning process, each section of the plan was reviewed and analyzed by the staff and the team to determine if changes were necessary. Updates were deemed necessary when the original data was no longer relevant, when new data was corrected or when the data lacked current hazard risk assessments or vulnerabilities. The state's goals and strategies were reviewed and analyzed to assess implementation, and to determine necessary actions.</td></tr>
<tr><td><u>Section 1</u>

This section discusses the planning process. Staff reviewed this section to determine if the planning process used for the 2007 and 2010 process could be improved. Staff analyzed the process of how planning was implemented throughout the plans' cycle, how the plan was reviewed and analyzed, and who should be involved in the update process.

The team reviewed how other agencies participated in the process and analyzed how adding additional team members benefited the plan. This section was revised as part of the update process.

Changes to the NFIP funded grants are addressed.</td><td><u>Section 2</u>

This section discusses the risk assessment. Staff and the team analyzed the risk assessment to determine if the natural hazards listed were still relevant. Information on the state's geography, weather, and demographic were consolidated from the 2010 plan and utilized as an introduction as to why natural hazard events occur in Texas.

Due to the conclusion that the majority of local mitigation planners selected to include lightning as a hazard, either as a primary hazard or a component of severe weather or severe thunderstorm, this plan included lightning as the 15 identified hazards.</td></tr>
<tr><td><u>Section 3</u>

The team played a larger part in Section 3 compared to other sections in the plan. This section discussed mitigation goals, capabilities, strategies and funding opportunities. The team gave a status of the current strategy and proposed a new strategy to align with the goals, including several new ones. This section was revised and updated as part of the update process.</td><td><u>Section 4</u>
This section discussed the process by which several state agencies provided funding and technical assistance for the development of local mitigation plans. The staff reviewed the current funding and technical assistance for the development of local mitigation plans and projects and requested updated input into changes in agency programs and funding. Technical assistance by TDEM was updated to reflect 2010-2013 outreach.</td></tr>
<tr><td><u>Section 5</u>

This section was incorporated into other sections of the plan as part of the update process. This section discussed the state's commitment to a comprehensive mitigation program. The staff and team reviewed the various programs and mitigation workshops outlined in Section 5 and conferred that much of the information in this section was either redundant or could best be used to enrich other sections of the plans.</td><td><u>Section 6</u>

Planning processes discussed in this section were merged into Section 1 – as the planning process to develop the update and its maintenance throughout its lifecycle are synergistic. Other information in this section was discussed in other sections when relevant.</td></tr>
</table>

FUNDING AND IMPLEMENTING RESILIENCY THROUGH MITIGATION

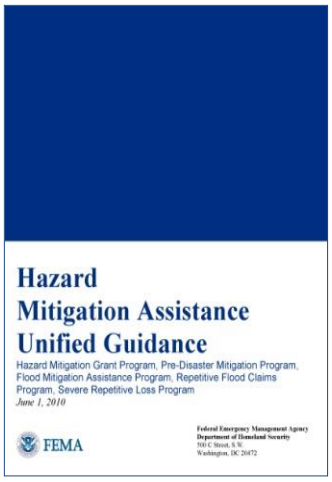
Who is Responsible?

The majority of mitigation actions are implemented at the local level rather than by the state alone. The capability to implement actions rests with how the legislation has distributed and separated state and local authority. State and local authority is discussed in Section 3.

As noted in the Section 3, cities have much greater ability to regulate than do the counties. through use actions. The Texas Water Development Board's NFIP State Coordinator acts as the liaison between the federal floodplain program requirements and the local communities' abilities to conform. The agency's primary duty is to provide guidance and education to the communities to assist them in meeting the federal eligibility requirements for entrance into the NFIP and to assist the communities with maintaining their participating status by adhering to floodplain ordinances.

The state, for the most part, achieves its mitigation goals and strategies by responsibly administering mitigation grants and programs that assist local projects. Mitigation projects funded under state agencies follow their own internal selection, monitoring, closeout procedures and the rules of their funding programs.

Grants under the umbrella of FEMA's Hazard Mitigation Assistance (HMA) grant programs, HMGP, PDM, and FMA operate within the confines of the FEMA *Hazard Mitigation Assistance Unified Guidance* in effect on the date of the opening of the application period. The TWDB oversees the Flood Mitigation Assistance program that is restricted to mitigating flood insured properties or issues. TDEM has oversight on the two all-hazard mitigation grant programs; HMGP (post-disaster) and PDM (pre-disaster).



TDEM's intent is to actively participate in all instances where HMGP and PDM funds are available and to saturate the maximum amount of funding available, with the best possible selection of eligible projects, in order to achieve the ultimate mitigation goals as set forth in the plan. When FEMA announces either HMGP or PDM, TDEM makes them available to all eligible sub-applicants within Texas.

TDEM monitors the implementation of these projects on two levels: programmatic and financial audit. By effective monitoring of the all-hazard grant programs TDEM and the state can reach their mitigation goals through the successful funding and implementing of local mitigation actions.

Programmatic monitoring is done through a combination of required, fully completed, quarterly reports that each program specialist reviews and reconciles against the sub-applicant's scope of work, timeline and budget. Additional communication to a sub-applicant is initiated as needed to keep the project on track. Sub-applicants are informed upfront that if they do not submit quarterly reports or adhere to timeline, funding may be withheld until performance is resumed. The specialist will also review all cost share reimbursement requests for completeness and eligibility of costs before submitting to the finance officer to process for reimbursement (PDM and HMGP programs are 75/25 cost share reimbursement funding). All requests for budget overruns trigger a reassessment of the cost feasibility of the project. At 50 percent reported completion of a structural project, the specialist will make a site visit to reconfirm scope of work and sub-grantee compliance. At 100 percent completion, a site visit, with a report and photos will be completed by the specialist. For mitigation planning grants, the approval letter from FEMA triggers the close out schedule. After a project has been documented with a Certificate of Completion, close out may begin.

TDEM advises the grant availability by: an announcement in the Texas Register; an announcement on the TDEM website; delivery of a statewide mail-out to each county judge, city mayor, emergency management coordinator and Councils of Government. The HMGP also includes additional outreach in the form of TDEM briefings in the declared area, and announcements issued through the FEMA Joint Field Office (JFO) activated for each disaster.

Following a disaster, when the HMGP becomes available, three documents for grant activity and project priorities are referenced. The first document is the State of Texas HMGP Administrative Plan, which includes the State of Texas Strategy developed by the State Hazard Mitigation Team (SHMT) and is updated periodically to identify mitigation project priorities that address the most damaging hazard impacts to the state. The second document is the Hazard Mitigation Implementation Strategy, which is a letter to the FEMA Federal Coordinating Officer from the Governor's Authorized Representative (GAR) which outlines the state's plan for HMGP implementation with the identification of any additional priorities or activities that will be included in the plan for that specific disaster only. These additional priorities and activities can be alterations or additions to the HMGP Administrative Plan. For example, TDEM may prioritize mitigation projects addressing the source of the disaster such as wildfire mitigation projects in a wildfire disaster declaration. The third document is the FEMA/STATE Hazard Mitigation Implementation Strategy which is an agreement between FEMA, TDEM and TWDB's State Floodplain Manager, that identifies the activities for which each organization assumes responsibility in the deployment of the HMGP.

The guiding principles for the management of the HMGP program are outlined in the TDEM's most current HMGP Administrative Plan. This plan must be updated and approved by FEMA after each federal disaster before HMGP funding can be allocated. The most current document can be found at http://www.txdps.state.tx.us/dem/downloadableforms.htm#hmgpgrant. It outlines the responsibilities, staffing requirements, policies, procedures and goals for HMGP participation in detail. The same guidance documents and TDEM operations are applied to both HMGP and PDM, although PDM is not steered by an administrative plan. TDEM's method of identifying and implementing mitigation activities has been relatively constant over the last two plans with no significant modification, although we have revised the quarterly reporting tool and our project tracking database tools to be more robust and thorough in the tracking of progress.

Every sub-applicant which the state can turn into a sub-grantee, and every sub-grantee's scope of work that turns into a completed project contributes to the state's achievement of its six mitigation goals.

The following is a brief description of the current selection, monitoring and closeout project of TDEM's HMA grant programs.

The mitigation staff reviews and assesses all incoming applications against the FEMA criteria for eligibility, technical feasibility, cost effectiveness, and environmental compliance. The SHMT, which is the core of the planning team, then does a preliminary project review and offers evaluations from their agency perspective on projects for submission to the GAR. The GAR, traditionally the Chief of the Texas Emergency Management Division, then evaluates the projects and approves a final prioritized list of selections. Under HMGP the state finalizes the review of selected project applications for submission to FEMA for completion of the federal review and approval process. Under PDM the state reviews the project applications and submits them to FEMA in the priority order approved by the GAR for FEMA's nationally competitive project selection and approval process.

FEMA retains final authority over the approval and award of any sub-application submitted by the state for funding. Once approved and awarded, TDEM notifies the sub-applicant, who is then designated the sub-grantee. The state award letter to the sub-grantee provides information concerning: CFDA funding stream and project number; the assigned TDEM project officer; amount of award; implementation requirements; environmental conditions; administrative procedures; progress monitoring and reporting requirements; and final review and closeout activities.

All programmatic requirements in effect on the date of the Federal Disaster Declaration (HMGP) or the federal announcement of the opening of the application period (PDM) will be applied to each HMGP and PDM grant program accordingly until the grant is completed and closed. The primary guidance documents are:

- Title 44 Code of Federal Regulations (CFR)
- The *Hazard Mitigation Assistance Unified Guidance*
- OMB Circulars A-21, A-87, A-102, and A-110 (Codified to Title 2 CFR § 215, 220, 225, and 230)
- Single Audit Act of 1984, Public Law 98-502 – OMB Circular A-133

The sub-grantees are accountable to the grantee (TDEM) for all funds awarded and the grantee monitors all implementation activities for programmatic compliance. Sub-grantees are required to submit all reports, complete and on time, for the entire period the project is open. Quarterly reports reflect the timely progress of the project activities in accordance with the FEMA approved scope of work, timeline, and budget. All changes or modifications to any elements of the approved project must be approved by TDEM and in some cases TDEM must obtain approval for the modification from FEMA. Site visits are scheduled at regular intervals.

Once a local mitigation project funded through HMGP or PDM is completed, TDEM conducts a final program inspection and initiates the closeout programmatic and financial compliance reviews.

Acquisition projects have an additional monitoring and reporting requirements following the closeout of the grant. Every three years the grantee shall provide the FEMA Regional Administrator a report certifying that all acquired properties continue to be maintained as open space consistent with programmatic requirements as defined in 44 CFR § 80.19(d).

The current TDEM reorganization, new federal legislation, and updated FEMA guidance will drive the changes to the next administrative plan.

The reorganization activities include the redistribution of duties and the upgrading of its internal systems with the goal to produce a more robust sub-recipient monitoring system from application to closeout. These systems are used to track the initiation, technical assistance needs, sub-grantee monitoring of project implementation, fiscal management, closeout activities, and programmatic compliance reviews through coordination between a TDEM project officer and the sub-grantee project team.

The two new primary federal legislations affecting the HMA grant programs are the Biggert-Waters Flood Insurance Reform Act of 2012, and the Sandy Recovery Improvement Act of 2013.

The updated FEMA *Hazard Mitigation Assistance Unified Guidance* was issued in July 2013.

These grants provide the state with an extremely valuable opportunity to build community resiliency from natural hazards for the state and its citizens. TDEM's goal is to capitalize on that opportunity by selecting projects that are determined to be the most beneficial and cost effective in meeting the states mitigation goals.

Continuous periodic evaluation of project effectiveness is best manifested in the success story method when completed projects are tested in future events.

Evaluating Mitigation Projects for Success

TDEM's system to conduct an assessment of completed mitigation actions is actually quite simple, but effective. TDEM Mitigation Section maintains a database of all completed projects that were funded by HMGP, RFC and PDM. This database has the latitudes and longitudes of the completed project.

When a situation occurs, TDEM check its records to see if a project mitigating the type of hazard occurring took place in the area. If the answer is yes, we contact the Emergency Management Coordinator (EMC) or the project officer for the project to get specifics. We also ask if the previously funded mitigation project is being tested by the disaster event. If the answer from the EMC is "no," then no further action is taken. If the answer from the EMC is yes, we run a report from the completed projects database to calculate the losses that were avoided.

In addition, TDEM reports on verifiable mitigation by producing success stories. TDEM is able to analyze the effectiveness of local mitigation policies, programs and capabilities through these mitigation success stories. After a jurisdiction completes a mitigation project, TDEM keeps in contact with that jurisdictions for years to come and requests reports from the local communities when a new natural hazards impacts the region. For example, the City of Houston has been steadily acquiring homes in the 100-year floodplain for the past several years. When and if a repeat flood event occurs in that area, TDEM will request pictures and documentation of the area to analyze if the buyouts were successful. What will be seen in the pictures is flood water inundating the property that once contained structures, but has since been open space.

THE ALL-HAZARDS HMA GRANT PROCESS	
The Post-Disaster Grant Process for HMGP • After a disaster occurs local jurisdictions and the state teams begin to assess the damages • The governor declares an emergency and submits a request for a federal declaration • The President authorizes a federal declaration that permits the state to participate in HMGP funding to mitigate losses • FEMA establishes a joint field office (JFO) within the area impacted by the disaster event • All jurisdictions statewide are notified of the availability of HMGP funds and public information meetings are held within the declared area • Applications and grant guidance are made available • Applications are received by TDEM and evaluated to determine applicant and project eligibility against the current FEMA guidance; then it reviews for project cost-effectiveness, feasibility and environmental considerations • The State Hazard Mitigation Team (SHMT) recommends and the Governor's Authorized Representative (GAR), currently identified as the Chief of TDEM, evaluates and selects the eligible projects for FEMA processing and selection • Applicants are notified of the terms and conditions of the FEMA approved projects; • Grants are administered within the time limits of the grant agreement • Upon completion, the project is inspected, audited and submitted to FEMA to be closed; • Continuous annual evaluation of project effectiveness	**The Pre-Disaster Mitigation Grant Process for PDM** • FEMA announces the fiscal year window for the grant along with its current Hazard Mitigation Assistance (HMA) Guidance • The state publishes its project eligibility criteria (in addition to FEMA's guidance) and instructs on how to: i. Request access to the online application system ii. Access the current guidance iii. Make deadlines for application iv. Identify state project priorities • All jurisdictions statewide are notified of the availability of PDM funds • Applications and grant guidance are made available • Applications are received by TDEM and evaluated to determine applicant and project eligibility against the current FEMA guidance; then it reviews for project cost-effectiveness, feasibility and environmental considerations • The State Hazard Mitigation Team (SHMT) recommends and the Governor's Authorized Representative (GAR), currently identified as the Chief of TDEM, evaluates and prioritizes eligible projects for FEMA processing and selection • Sub-applications are attached to the state application and submitted to FEMA Region 6, which reviews for application completeness, and forwards to FEMA, where each sub-application is analyzed and ranked against sub-applications nationwide • Applicants are notified of the terms and conditions of the FEMA approved projects • Grants are administered within the time limits of the grant agreement • Upon completion, the project is inspected, audited and submitted to FEMA to be closed • Continuous annual evaluation of project effectiveness

NFIP FUNDED GRANT PROGRAMS

The passage of the Biggert-Waters Act in 2012 has an effect on the current structuring of the NFIP funded grant programs:

- Severe Repetitive Loss
- Repetitive Loss Claims
- Flood Mitigation Assistance

These programs will consolidate into a single program to be funded at $90 million per year nationwide. The consolidated program will unify such elements as project eligibility, application requirements and grant process guidance. Specifics of the new program have not been announced as of spring 2012.

Flood Mitigation Assistance (FMA) and Severe Repetitive Loss (SRL) Programs

The Texas Water Development Board (TWDB) administers the FMA program in Texas on behalf of the state. TWDB also administers the SRL program in Texas. When NFIP funds are allocated to Texas each year by FEMA, TWDB:

- Announces funding availability
- Reviews and evaluates planning grant and project grant applications
- Reviews and ranks FMA projects
- Awards planning grants to eligible communities
- Forwards project grant applications that meet the FMA program criteria to FEMA for final review and approval
- Contracts responsibilities for both planning and project grants
- Require planning and project grant recipients to submit quarterly status reports to TWDB
- Communicates with the communities and their subcontractors at minimum on a monthly basis

Information on the Flood Mitigation Assistance Program can be found on the TWDB website at http://www.twdb.state.tx.us/wrpi/flood/fma.asp

Information on the Severe Repetitive Loss Program can be found on the TWDB website at http://www.twdb.state.tx.us/wrpi/flood/srl.asp

Repetitive Flood Loss

Due to the enactment of the Biggert-Waters Act, this program is transitioning from TDEM over to TWDB as part of the restructuring of the NFIP related programs.

TEXAS GENERAL LAND OFFICE COASTAL MITIGATION FUNDING SOURCES

The Coastal Erosion Planning and Response Act (CEPRA), and authorized the GLO to administer coastal erosion control grants in partnership with local governments, state and federal agencies, non-profits, and homeowner associations.

Funding for CEPRA comes from state funds appropriated each biennium. The 81st Texas Legislature provided approximately $25 million in state appropriated funding for Cycle 6 projects in the FY2010 – FY2011 biennium. CEPRA requires a local partner match for most projects, and the match requirement is specific to the type of project that is conducted (e.g., beach nourishment and dune restoration projects require, at a minimum, a 25 percent local match, and studies, shoreline protection or marsh restoration projects require, at a minimum, a 40 percent local match).

The goals of the CEPRA are to:

- Protect public infrastructure
- Protect and restore valuable habitat
- Protect public and private property
- Protect state natural resources
- Mitigate storm damage, and assess post-storm damage
- Remove debris and structures from the public beach easement
- Partner with local, state, and federal agencies to leverage funding opportunities and resources

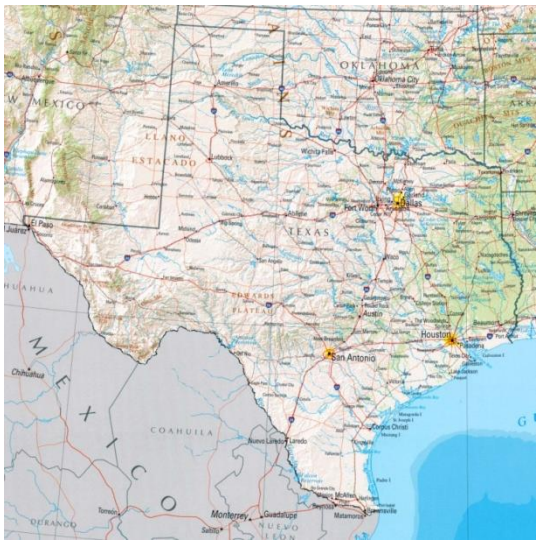
The Coastal Impact Assistance Program (CIAP) assists coastal states in mitigating the impacts associated with the Outer Continental Shelf oil and gas production. Governor Rick Perry named the Office of the Governor as the designated state agency for the Texas CIAP and appointed the General Land Office (GLO) as the administrative agency for CIAP. To oversee the state portion of the CIAP program, on January 26, 2006, Governor Perry established a three-member Coastal Land Advisory Board (CLAB). The CLAB is comprised of commissioners from the Texas General Land Office, Texas Railroad Commission, and the Texas Department of Transportation.

In order to receive CIAP funds, states are required to submit a coastal impact assistance plan that must be approved by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) prior to distribution of funds.

Specifically, the program goals are: to conserve, restore, enhance, and protect the diversity, quality, quantity, functions, and values of the state's coastal natural resources including, but not limited to, any effects of oil and gas development of the outer continental shelf. The objectives of the program will be to: restore, protect, and enhance coastal natural resources; improve water quality; enhance public access; improve onshore infrastructure and environmental management; mitigate erosion and stabilize shorelines; and educate the public on the importance of coastal natural resources. Protecting coastal natural resources, while facilitating economic development and multiple human uses of coastal resources, is a primary focus of this effort. Priority is given to projects that meet regional and/or coast-wide goals and objectives. Funding for projects under these categories must be used for one or more of the following authorized uses:

- Projects and activities for the conservation, protection, or restoration of coastal areas, including wetlands
- Mitigation of damaged fish, wildlife, or natural resources
- Implementation of a federally approved marine, coastal, or comprehensive conservation management plan

Section 2 – HAZARD ASSESSMENT



WHY IT HAPPENS HERE

To understand the breadth of hazards that can occur throughout Texas, a general overview of the physical character of the state and its weather patterns is desirable.

Texas, at over 267,000 square miles in area, and comprising roughly seven percent of the contiguous United States, exhibits a broad range of geographic characteristics. The longest straight-line distance is a general north-south direction of 801 miles from the northwest corner of the Panhandle to the extreme southern tip of Texas on the Rio Grande below Brownsville. The longest east-west distance is 773 miles from the extreme eastward bend in the Sabine River in Newton County to the extreme western bulge of the Rio Grande just above El Paso.

Texas covers about seven percent of the entire United States, or about 267,277 square miles (171,057,280 acres). That is about 261,914 square miles (167,624,960 acres) of land area and 5,363 square miles (3,432,320 acres) of inland water. Texas is drained by twelve river basins. These river systems played an important role during the early development of Texas and remain equally important to the state's economy today. The upper reaches of most of these river systems have been impounded by dams to reduce massive flooding downstream and to provide water for drinking, industry, and agriculture. Some provide a limited amount of hydroelectric power. Many of the lower reaches remain navigable and support an economically important commercial transportation system by way of a network of bays, sounds, and canals including the Inter-coastal Canal.

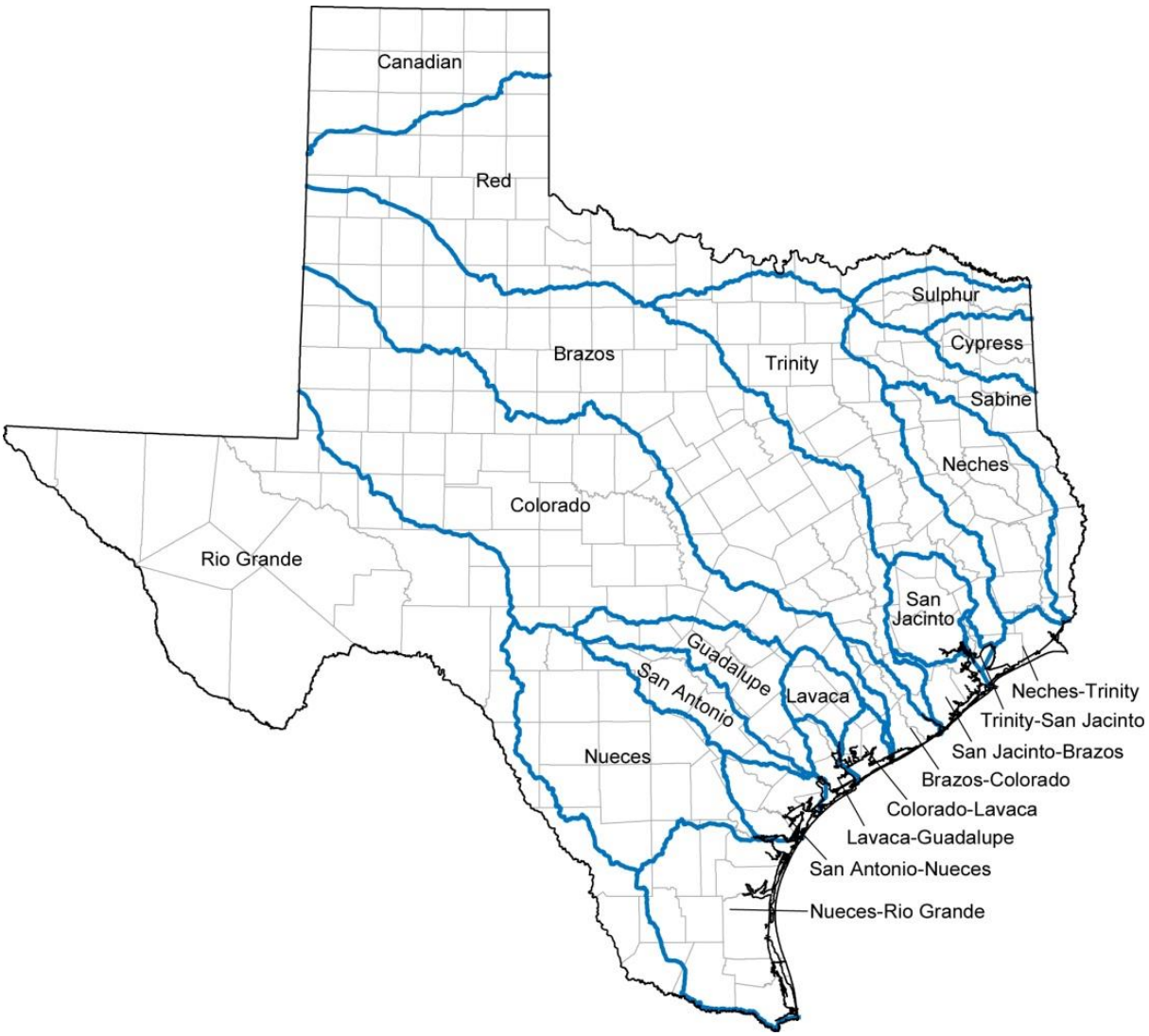
The highest point is Guadalupe Peak at 8,749 feet above mean sea level (MSL). Guadalupe and its twin, El Capitan (8,085 feet) are in west Texas near the New Mexico border. A plateau, elevated at 2,600 to 4,300 feet above MSL, extends across West Texas above the Caprock. Below the escarpment, the surface slopes downward to sea level along the Gulf Coast. The geographic center is about 15 miles northeast of Brady in northern McCullough County. The smallest county in terms of area is Rockwall County (148.6 square miles) and the largest is Brewster County (6,193.1 square miles).

Texas has 367 miles of open Gulf shoreline, of which 293 miles are open for public use. The coastline runs from just west of the mouth of the Sabine River in the most southeastern part of the state to Boca Chico, near the mouth of the Rio Grande River in the most southern part of the state.

River Basins of Texas

There are 15 major river basins within the state and eight coastal basins, each with varying hydrological regimes and water supply capabilities. Each of the basins has several unique features, both climatic (such as precipitation and evaporation), as well as physiographic (geology, slope, soil type, vegetation and land use practices) which contribute to the nature of runoff from the basins.

Major Rivers and Coastal Basins of Texas



Features of Major River Basins in Texas					
River Basin	**Total Area (Sq Mi)**	**Area in Texas (Sq Mi)**	**River Length (Miles)**	**Length in Texas (Mi)**	**Average Flow (Ac Ft/Yr)**
Brazos	45,573	42,865	840	840	6,074,000
Canadian	47,705	12,865	906	213	196,000
Colorado	42,318	39,428	865	865	1,904,000
Cypress	3,552	2,929	90	75	493,700
Guadalupe	5,953	5,953	409	409	1,422,000
Lavaca	2,309	2,309	117	117	277,000
Neches	9,937	9,937	416	416	4,323,000
Nueces	16,700	16,700	315	315	539,700
Red	93,450	24,297	1,360	695	3,464,000
Rio Grande	182,215	49,387	1,896	889	645,500
Sabine	9,756	7,570	360	360	5,864,000
San Antonio	4,180	4,180	238	238	562,700
San Jacinto	3,936	3,936	85	85	1,365,000
Sulphur	3,767	3,580	222	222	932,700
Trinity	17,913	17,913	550	550	5,727,000

Texas Gulf Coast

The Texas Gulf Coast consists of a system of barrier islands and peninsulas, which provides protection for numerous bays and inlets from oncoming waves. These features are relatively young and most are less than 7,000 years in age.

Up and down the Texas Gulf Coast there are a variety of coastal dune environments, each with its unique geomorphology and coastal processes. In areas along the upper coast, from Sabine Pass to the Freeport Ship Channel, the historical erosion rate varies

between two to 34 feet per year. Coastal dunes in this area are relatively small in comparison to other parts of the coast, and although there are pockets of the coastline in this area that are stable or accreting, this area is characteristically a sediment starved system. Sediment starved systems have a detrimental effect on the natural formation of coastal dunes.

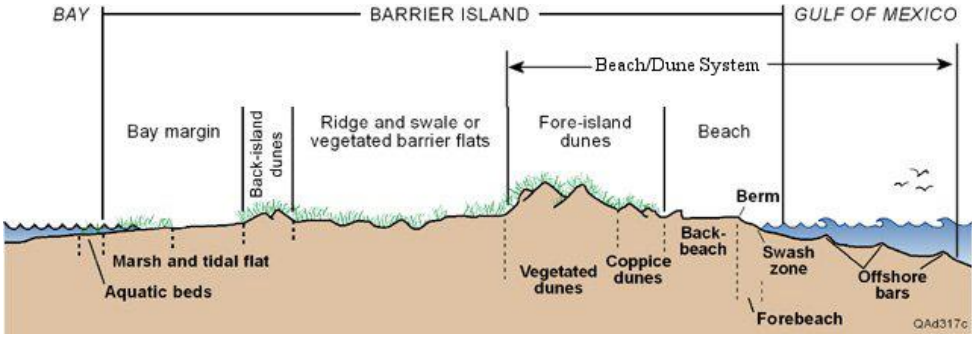
Along the middle coast, commonly referred to as the Coastal Bend, coastal dunes form an extensive and stable dune complex with fore-dune ridge approximately 26 to 40 feet high.

Barrier Islands

By definition, barrier islands are generally elongated, exposed narrow accumulations of sediment, usually sand, in the shallow coastal zone and are separated from the mainland by some combination of coastal bays and marshes. Texas has 17 barrier islands that total 191,762 acres. These islands serve as vital natural habitats and nesting areas for wading birds and sea birds, and a resting area for migratory birds. In Texas, barrier island fore-dunes are critical nesting sites for the endangered Kemps Ridley sea turtle.

Barrier islands provide a level of protection for the mainland against storm impacts. The first apparent feature landward of the beach along the Texas Gulf Coast, coastal dunes from Sabine Pass to the mouth of the Rio Grande vary in natural position, contour, volume, elevation, and vegetative cover. These variations are a direct result of natural processes, which include prevailing wind currents, sediment budget, climate, and biota. These variations influence dune formation. Coastal dunes are a dynamic component of the barrier islands that are in a constant state of change and part of a natural cycle that ensures the health of beaches, marshes, and wetlands along the Gulf and bay shoreline. The characteristic features of a barrier island are associated with high-energy environments on the Gulf side and low-energy environments on the bay side.

Cross Section of a Typical Texas Barrier Island



Critical Dune Areas

There is a natural system on the Gulf side of barrier islands, commonly referred to as the beach/dune system, which extends from offshore sandbars landward to the

landward side of the fore dunes. The beach/dune system is the front-line of defense against coastal storms and is essential to the integrity of the barrier island. Vegetated and non-vegetated sand dunes provide protective barriers for adjacent land and inland water against the action of waves, wind, and storm surge. A healthy beach/dune system allows barrier islands to recover from a storm. Sand dunes provide protective barriers for adjacent land and inland water against the action of waves, wind, and storm surge. Integral to a healthy dune system is the back beach or dune terrace area. The back beach area is easily identified as the sandy beach area having low relief seaward of the fore-dunes and above the mean high water line.

As a natural barrier to the destructive forces of wind and waves, sand dunes are an efficient defense against storm surge flooding and beach erosion. Immediately landward of the dry part of the beach, coastal dunes begin where there is an abrupt change in slope parallel to the beach called the fore-dunes or fore-dune ridge. At this boundary, the fore-dune ridge is usually the first line of dunes in a dune complex that can extend inland up to several thousand feet from the Gulf.

Dunes absorb storm surge and high wave impacts, preventing or delaying the intrusion of waters into inland areas. Dunes hold sand that help eroded beaches recover after storms. As part of a delicate natural cycle, storm tides remove sand from the dunes and pull most of it toward the shore. Some of this sand widens the beach profile allowing wave energy to dissipate sooner. Sand is also deposited just off shore in sand bars, which after the storm will make its way back onshore. The vegetation on the landward side of the dry beach traps this windblown sand and rebuilds the dunes for the next storm event.

During a coastal storm, the beach is eroded and the waves begin to attack the dunes, resulting in erosion and suspension of the sand stored in the dunes. Some of the dune sand is deposited on the beach, widening the beach seaward. The wider beach helps minimize wave energy by allowing waves to break further seaward. The remaining sand is deposited offshore in sandbars, and will eventually return to the beach. The sand dries and is carried landward by the wind where it is trapped by the recovering vegetation rebuilding the dunes and completing the cycle.

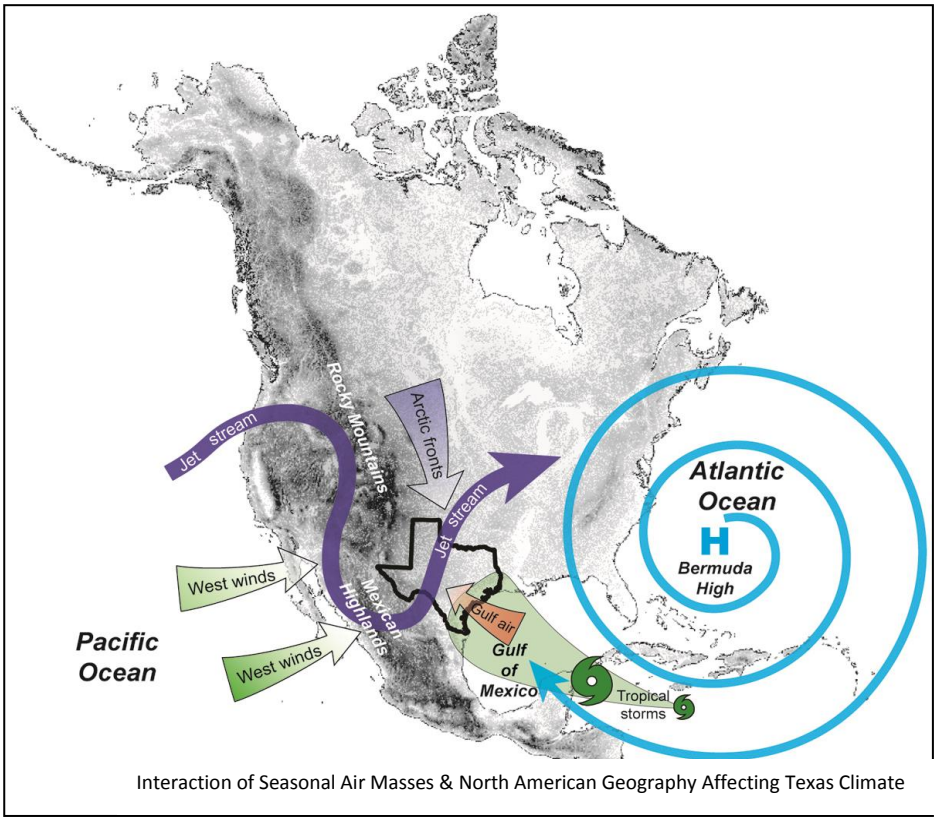
Relative Sea Level Rise

Scientific observations show evidence of climatic changes that are contributing to sea level rise. Model projections by the Intergovernmental Panel on Climate Change predict that global sea level rise will continue at an increase of as much as one meter during the next 100 years. Global average ocean temperatures are increasing, causing ocean water to expand, contributing to sea level rise. In addition, climatic change is causing widespread melting of snow and glacier ice contributing to rising global sea level. Because of climate change, the Texas coast is becoming exposed to increasing risk of inundation and coastal erosion over the coming decades. Sea level rise measured by Texas Coastal Ocean Observation Network tide gauges in the Galveston area measured a current rise of about six millimeters per year. At this current rate of rise, local sea levels in the Galveston area can be projected to be 0.6 meters (approximately two feet) by the year 2100.

With current rates of coastal subsidence and with the majority of the Texas Gulf Coast being characterized by low-lying topography, in addition to a broad gently sloping outer continental shelf, this anticipated rise in sea level is important. A small rise in sea level along the Texas coast can result in a significant shoreline retreat and an increased risk of inundation of wetlands, marshes, private property, and public infrastructure. Relative sea level rise increases the vulnerability of barrier islands and peninsulas along the Texas coast to inundation from storm surge, even from smaller storms and coastal weather systems.

CLIMATE

Texas' climate is as varied as its landscape. That variability is a result of the interactions between Texas' unique geographic location and the movements of seasonal air masses, including arctic fronts, the jet stream, subtropical west winds, tropical storms, and a subtropical high pressure system known as the Bermuda High.

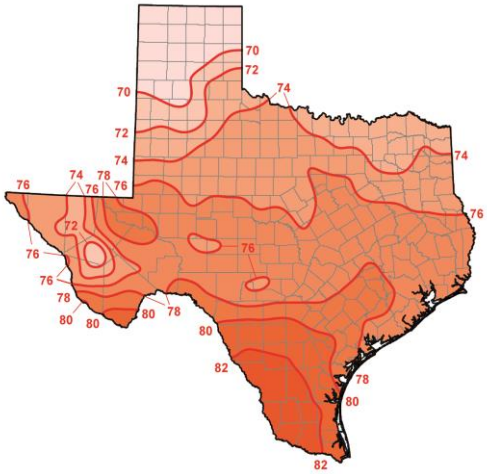


Interaction of Seasonal Air Masses & North American Geography Affecting Texas Climate

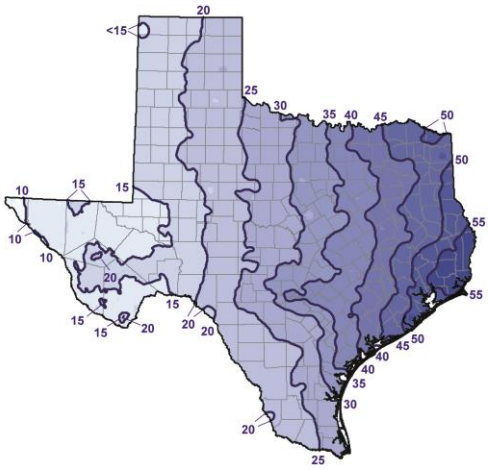
The range between summer and winter average monthly temperatures increases relative to distance from the Gulf of Mexico. In addition, the variability of both daily temperature and precipitation totals increase inland across the state and away from the Gulf of Mexico.

The Gulf Coast sees more pronounced rainy seasons in the fall and spring. These two rainy seasons are affected by polar fronts interacting with moist Gulf air during those seasons. The fall season also includes precipitation associated with tropical cyclones

or systems approaching or entering the state from the Gulf of Mexico. These tropical disturbances will often move in and stall out over Central and North Texas, dumping large amounts of rain and causing flooding.



Average Annual Maximum Daily Temperature



Average Annual Precipitation

Temperature

In general, average annual maximum daily temperature gradually increases from less than 70˚F in the northern Panhandle to more than 82˚F in the lower Rio Grande Valley, except for isolated mountainous areas of Far West Texas. In Far West Texas, the average annual maximum daily temperature sharply increases from less than 72˚F in the Davis and Guadalupe mountains to more than 80˚F in the Presidio and Big Bend areas.

The average date of the first freeze temperature in the fall is November 1, in the Panhandle and December 16, along the Lower Texas Coast. The average date of the last freeze in the spring is April 15, in the Northwest Panhandle and January 30, in the Brownsville area.

Precipitation

Average annual precipitation decreases from over 55 inches in Beaumont to less than 10 inches in El Paso.

Except for the wetter, eastern portion of the state, evaporation exceeds precipitation for most of Texas, yielding a semi-arid climate that becomes arid in Far West Texas. Relative humidity varies throughout the state, depending on rainfall and evaporation rates, but generally decreases from east to west.

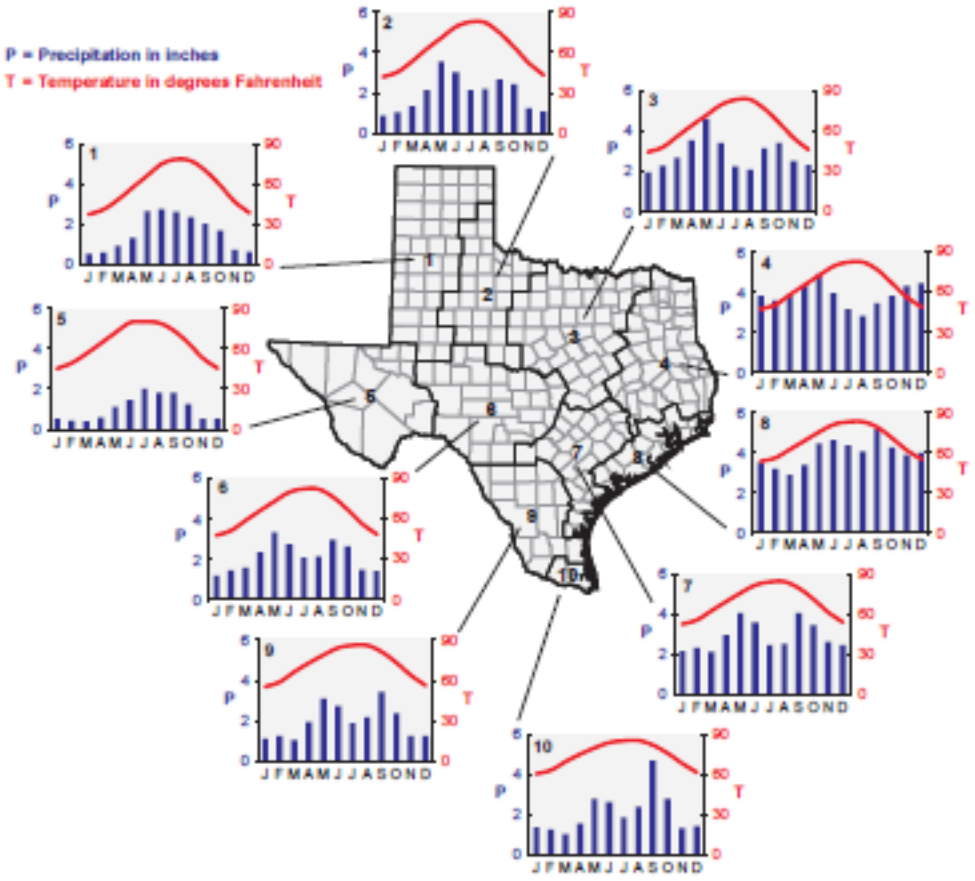
Although most of the state's precipitation occurs in the form of rainfall, small amounts of ice and snow become increasingly probable toward the north and west. Annual snowfall ranges from no snow to a record 65 inches in 1923-1924, at

Romero, located southwest of Dalhart in Hartley County, near the border of the state of New Mexico. The heaviest recorded snowfall in a 24-hour period was 24 inches at Plainview in February 1956. The greatest monthly accumulation was 36 inches at Hale Center in February 1956.

Climate Divisions

The National Climatic Data Center divides Texas into 10 climate divisions representing regions with similar climatic characteristics, such as vegetation, temperature, humidity, rainfall, and seasonal weather change.

FIGURE 4.2. CLIMATE DIVISIONS OF TEXAS WITH CORRESPONDING CLIMOGRAPHS (SOURCE DATA FROM NCDC, 2011).



Sources of information and contributions include the following:

Alvarez, E.C., ed, 2006. Texas Almanac; The Dallas Morning News, L.P. Dallas, Texas; Bomar, George @. 1995. Texas Weather. University of Texas Press, Austin, Texas. Jordan, Terry G. with J.L. Bean, Jr., and W.M. Holms, 1984. Texas: A Geography, Westview Press, Inc. Boulder, Colorado / Texas Parks and Wildlife / Texas Water Development Board / Texas Geographic Society / Texas General Land Office / Texas Geographic Society

TEXAS POPULATION

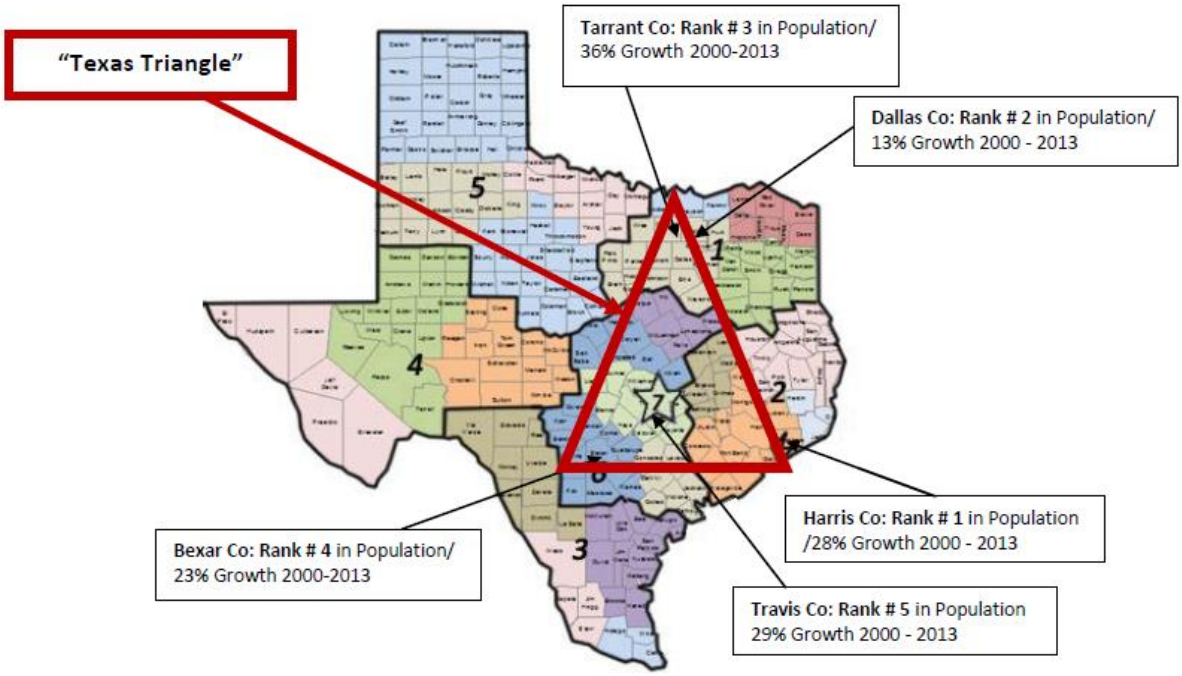
The regions depicted on the map reflect Department of Public Safety regions and are used throughout this section to delineate regions with similar features and concerns.

Recent Growth and Development

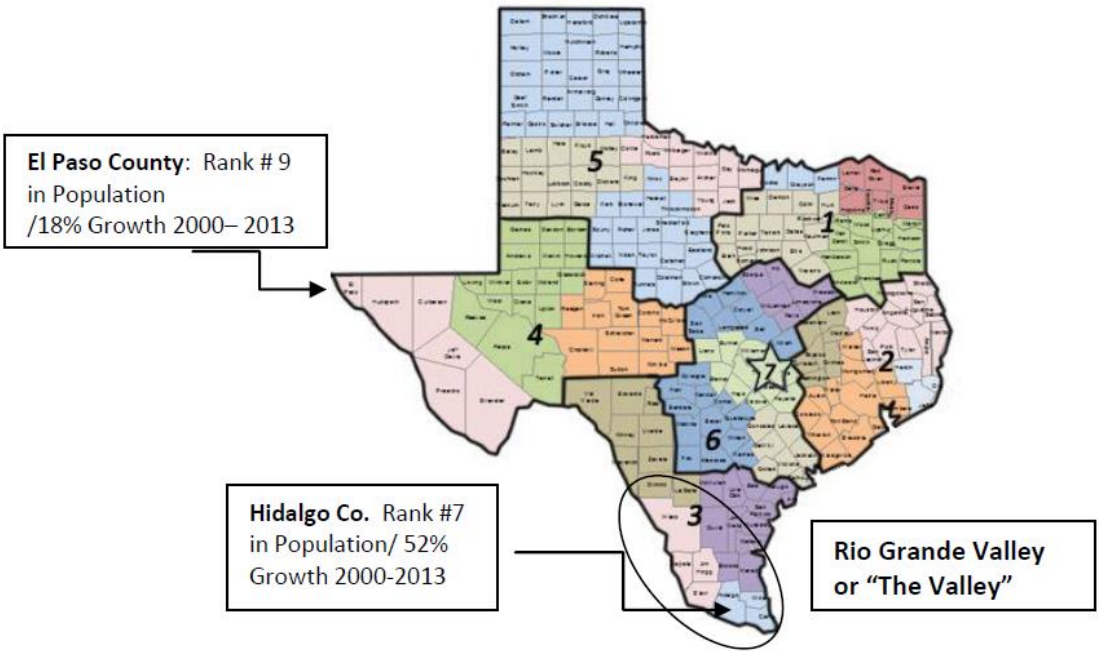
Most projections expect population growth in Texas to outpace the rest of the nation.

States with Highest Numeric Population Change 2011- 2012		
1	Texas	427,400
2	California	357,500
3	Florida	235,300
4	Georgia	107,500
5	North Carolina	101,000

The current highest density of population and the largest population *growth* from 2000 - 2013 is in and around what the plan is calling the "Texas Triangle", anchored at the vertices by Dallas-Fort Worth, San Antonio-Austin and Houston.



HIGHEST POPULATION AND POPULATION GROWTH AREAS

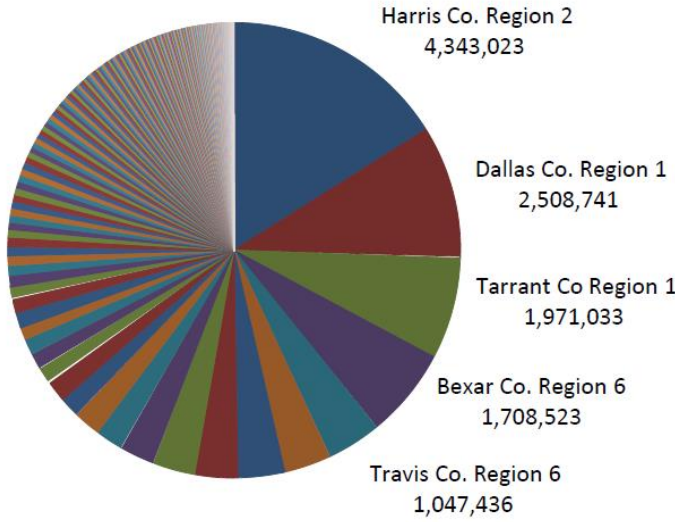


OTHER HIGH POPULATION AND POPULATION GROWTH AREAS

Though the high population and population growth occurs in metropolitan areas, Texas still has the second highest rural population in the country with 3.85 million or six percent of the nation's rural population. (2010 US Census).

A chart depicting the population distribution over the 254 state counties is shown at right. This chart further emphasizes the weighting of the population in the state's largest counties.

The combination of a large and dispersed population with the very high population in metropolitan areas presents challenges for mitigation planning. Population trends inherently represent development trends.



Highest and Lowest Population by County and DPS Region
(Source US 2010 Census and 2013 Projection)

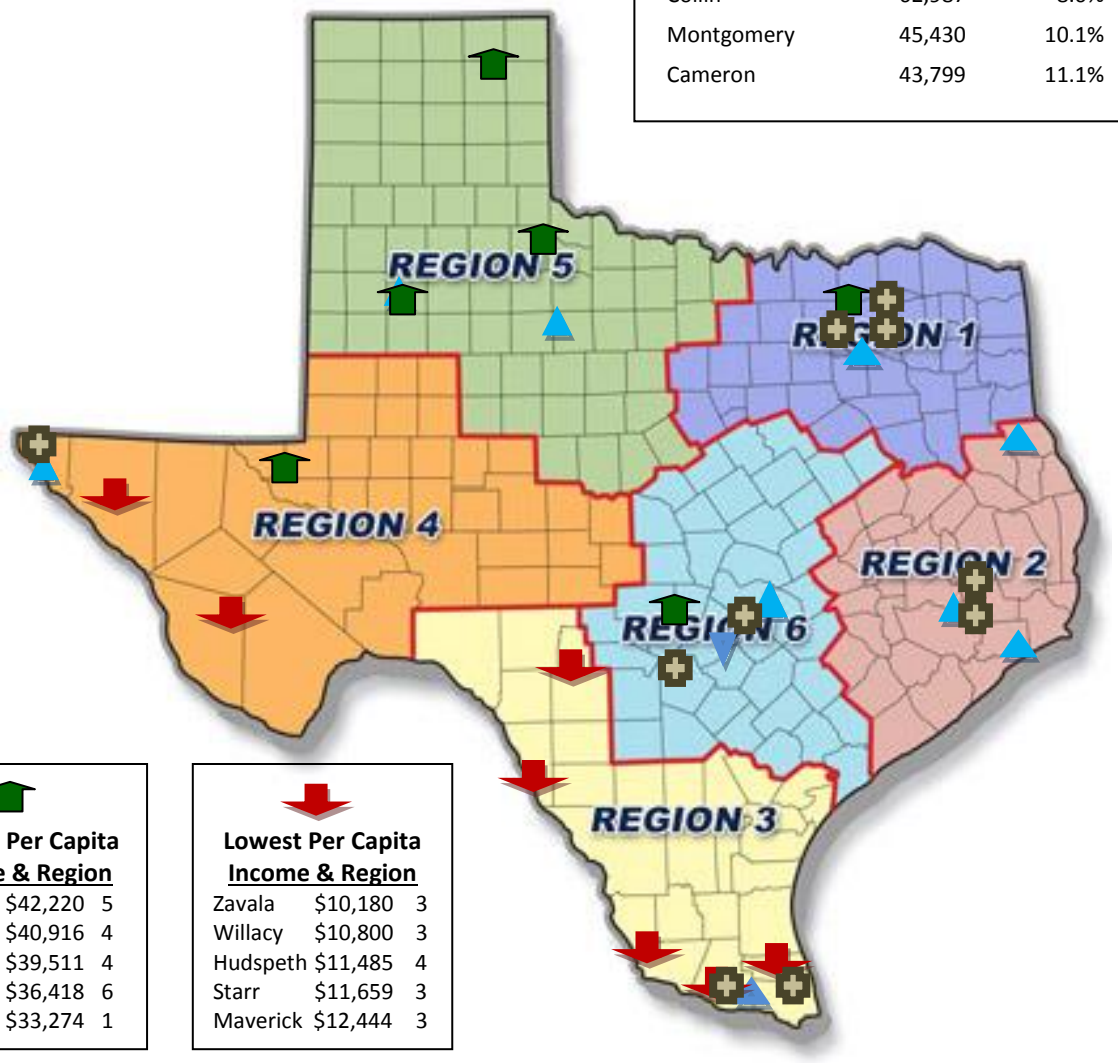
Counties with Highest 2013 Population				Counties with Lowest 2013 Population			
Rank	Sorted by Population	2013	Region	Rank	Sorted by Population	2013	Region
1	Harris County	4,343,023	2	234	Oldham County	2,362	5
2	Dallas County	2,508,741	1	235	Armstrong County	2,310	5
3	Tarrant County	1,971,033	1	236	Edwards County	2,216	3
4	Bexar County	1,708,523	6	237	Throckmorton County	1,885	5
5	Travis County	1,047,436	6	238	Cottle County	1,876	5
6	Collin County	972,237	1	239	Briscoe County	1,868	5
7	Hidalgo County	867,378	3	240	Irion County	1,811	4
8	Denton County	804,075	1	241	Stonewall County	1,617	5
9	El Paso County	799,976	4	242	Foard County	1,575	5
10	Fort Bend County	662,187	2	243	Glasscock County	1,563	4

Highest Disabled Populations

County	Reg.	# Disabled % State Total	# Disabled Below Poverty / % State Total
Grand Prairie	1	524K / 27.6%	106K / 6.2%
Houston	2	464K / 24.4%	111K / 19.6%
Austin	6	215K / 11.3%	56K / 9.9%
San Antonio	6	193K / 10.2%	57K / 10.0%
Edinburg	3	151K / 7.9%	83K / 14.7%
Abilene	5	85K / 4.5%	35K / 6.2%
Tyler	1	85K / 4.5	38K / 6.7%
Lubbock	5	63K / 3.3%	20K / 3.5%
Beaumont	2	60K / 3.2%	33K / 5.8&
El Paso	4	60K / 3.2%	26K / 4.6%

Highest 65+ Population

County	65+	% 65+
Harris	328,354	8.1%
Dallas	211,073	8.6%
Bexar	171,115	10.4%
Tarrant	155,996	8.7%
El Paso	79,541	10.6%
Travis	70,474	6.9%
Hidalgo	70,444	9.5%
Collin	62,987	8.0%
Montgomery	45,430	10.1%
Cameron	43,799	11.1%



Highest Per Capita Income & Region

Loving	$42,220	5
Borden	$40,916	4
King	$39,511	4
Kendall	$36,418	6
Rockwall	$33,274	1

Lowest Per Capita Income & Region

Zavala	$10,180	3
Willacy	$10,800	3
Hudspeth	$11,485	4
Starr	$11,659	3
Maverick	$12,444	3

First and foremost, there will be more people and more properties at risk in the state.

Most of the high growth is into high hazard regions.

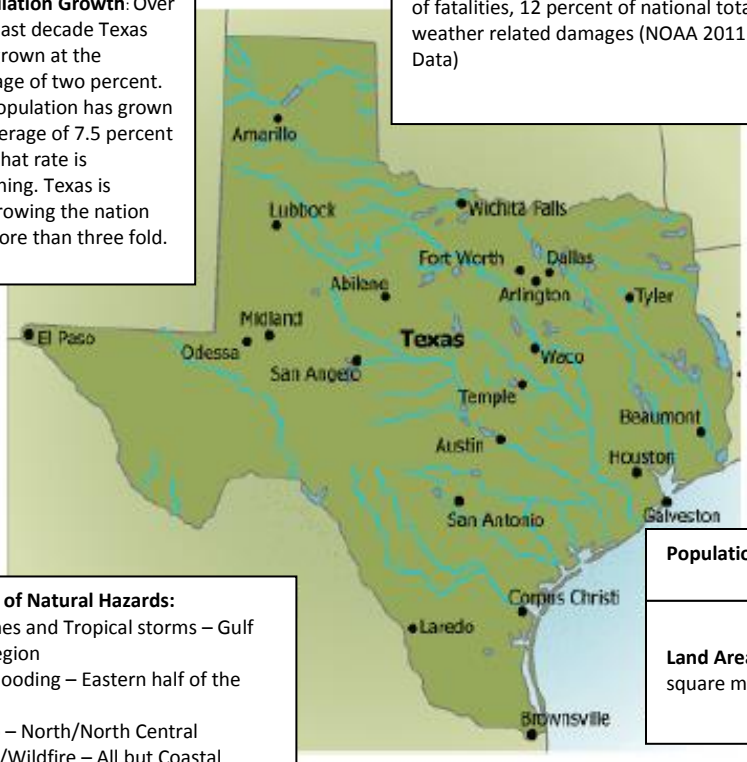
Higher state population and more development intensity water supply and land use issues.

Projections indicate that the numbers and percents of vulnerable populations (elderly, disabled, low income) will increase. These population groups typically live in less resilient housing, have lower mobility and are thus less likely to find cover, and they are less likely to be adequately covered by personal and property insurance.

TEXAS POPULATION GROWTH AND HAZARD MITIGATION PLANNING

Hazard Severity – Texas is third in fatalities, injuries and total damage representing 11 percent of national total of fatalities, 12 percent of national total weather related damages (NOAA 2011 Data)

Population Growth: Over the past decade Texas has grown at the average of two percent. US population has grown at average of 7.5 percent and that rate is declining. Texas is outgrowing the nation by more than three fold.



Population: 25,145,561

Land Area: 261,797 square miles

Breadth of Natural Hazards:
Hurricanes and Tropical storms – Gulf Coast Region
Inland Flooding – Eastern half of the state
Tornado – North/North Central
Drought/Wildfire – All but Coastal Region

A Large and Diverse Challenge

The state's hazard mitigation strategy is affected by these trends for many reasons including:

- Several trends from the 2010 plan remain problematic.
- The population exposed to storm surge and hurricane risks is increasing. Since 2000, all homes built in the coastal areas are supposed to be built to a much more substantial 130 mph wind code, but of course there is a huge percentage of the inventory that was built prior to that time and to less rigorous codes.

- The largest cities do an adequate job of building code enforcement and floodplain management, but governance is weak in small communities and in the county areas.
- The San Antonio and Austin area expects an increase in loss estimations from wildfire urban interface as those two cities continue to expand into undeveloped areas that contain a large amount of brush that could act as fuel for wildfires. However, both cities encourage the use of an interface between the brush and structures to reduce the chance of a damaged or destroyed building.
- Coastal development: Certain actions taken over time have modified or destroyed the effectiveness of these protective barriers and caused environmental damage in the process of developing the shoreline for various purposes. With the loss or reduction of the natural dunes and other human activities, less sediment is available to the beach/dune systems for the protection and recovery of the barrier island system. The result is an increase in erosion and a net loss of the shoreline.

On the flip side of the coin, Texas continues to make progress.

Good floodplain management is being practiced in Houston and Galveston. The large urban areas do better building code enforcement and better flood-plain management than small rural communities.

The net result is that a decreasing percentage of the population lives in the floodplain, and a decreasing percentage of the population lives in a home that was not built to code.

TEXAS HAZARDS

Through a assessment of the past federally declared disasters in Texas, an assessment of historical events and potential events, and a review of available local mitigation action plans, it was determined that the plan should address the risks associated with the following 15 natural hazards. Due to the frequency of occurrence and higher impact during this planning period, the ranking order has changed for the top five hazards since the 2010 plan.

Floods

Hurricanes/Tropical Storms

Wildfire

Tornado

Drought

Coastal erosion

Dam/Levee Failure

Earthquakes

Expansive soils

Extreme heat

Hailstorm

Land subsidence

Severe winter storms

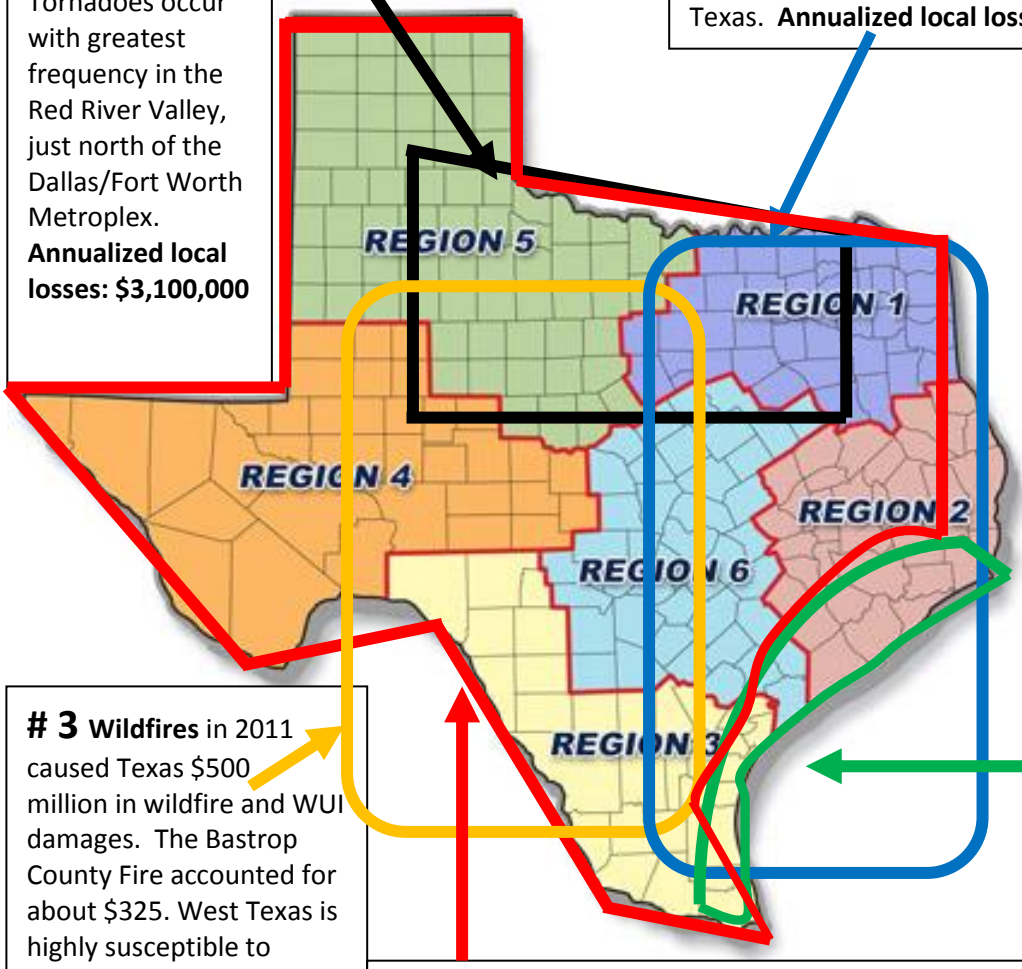
Windstorms

Lightning

TEXAS' TOP HAZARDS OF CONCERN FOR MITIGATION

#4 Tornado occurrences average about 125 a year. The annual total varies considerably, and certain areas are struck more often than others. Tornadoes occur with greatest frequency in the Red River Valley, just north of the Dallas/Fort Worth Metroplex. **Annualized local losses: $3,100,000**

#1 Floods are historically one of the most frequently occurring, destructive and costly natural hazards facing Texas, constituting over 90 percent of the disaster damage that has been experienced in the state, with few areas completely free from the threat. Besides real property damage or loss and drowning deaths, other consequences are river bank erosion and infrastructure damage or loss. On the average, Texas suffers approximately 400 floods annually, particularly along the coast and in Central Texas. **Annualized local losses: $5,574,820**



#2 Hurricanes and Tropical Storms are the most destructive of all weather phenomena, hurricanes, causing damages from high winds and surge. The risk to the Texas Gulf coast counties and inland adjacent counties (22 counties, 181 jurisdictions) covers 28 percent of the total state population. Since 1953, Texas has experienced 23 federal disaster declarations due to hurricane/tropical storm events, the most recent being Hurricane Dolly (DR1780); Hurricane Ike (DR-1791) and Hurricane Alex (DR-1931). **Annualized local losses: $1,488,691**

 # 3 Wildfires in 2011 caused Texas $500 million in wildfire and WUI damages. The Bastrop County Fire accounted for about $325. West Texas is highly susceptible to wildfire. Annualized local losses are not captured due to reporting standards. **Annualized local losses: n/a**

#5 Droughts typically produce few physical losses but the economic losses can be tremendous. Drought extended across most of Texas during 2011-2012. **Annualized local losses: $325,000,000**

ALIGNING LOCAL PLANS WITH THE STATE PLAN

The TDEM Mitigation Section developed a questionnaire designed to gather local hazard data from the EMCs of the county seats, of the 254 counties in Texas. The questionnaire was also distributed to the DPS Regional Coordinators. A summary of the questions is listed below:

Section 1 – Hazards

Top Four Local Natural Hazards
Top Four Technological Hazards
For Each Hazard Listed:

- Number of Structures at Risk
- Value of Structures at Risk
- Percent of Damage Expected for a Mid-Range Severity Event

Section 2 –Development and Risk Hazards

Indicate recent (last five years) Increase, Decrease or No Change, and the Magnitude of Change, in Local:

- Population
- Structure Inventory
- Severity of Damage &/or Hazard Frequency

Section 3 – Summary of Local Capability – Mitigation Policies, Programs and Capabilities

Specifically:

- *Building codes, Zoning, Land Use…etc. Policies that affect Property Vulnerability*
- *Programs and Policies that affect Mitigation of Vulnerable Properties*

Use and Effectiveness of the Following in Mitigating Damages:

- International Residential Code
- National Flood Insurance Program Compliance
- Fire Protection Compliance
- City Zoning, Building Codes, Upgraded NFIP Ordinances

Use and Effectiveness of the Following in Mitigating Damages:

- Local Budgets
- Local Administrative Staff
- Local Technical Staff
- Political Determination/Community Resolve

The results of the questionnaire can be used to compare local emergency management's current perceptions of the local risk situation against what is reported in the local mitigation plans or the state plan. It is obvious from the data set returned for analysis, the results of the questionnaire are at best, broad strokes. As more data is collected from local perspectives in future questionnaires the inevitable gaps can close and the state perspective on risk can be enriched through incorporation of a variety of sources.

There are two caveats as one supposes to capture and analyze loss data from the plans or the questionnaire. First, if the reporter of the data arrives at a perspective from the response perspective as opposed to the perspective of a detached planner, the approach to identifying hazards may be very different, one from firsthand knowledge of recent events, the other from a research based perspective. Either may or may not draw the same conclusion on risk. This difference in perception could have an impact on what type of mitigation projects locals select to implement based on the risk factors as they perceive them rather than what is documented in the plan or identified by the state. Second, the loss data reported in some plans is difficult to validate or corroborate. It is often unknown if data is flawed or incomplete. The data capturing methodology and reporting used from region to region is often different. Some plans report losses as annualized dollars over varying periods of time, some report losses on reports of incidents and others report on potential losses based on sophisticated computer applications. These losses, referred to as impact in mitigation planning, are also frequently described in qualitative terms narrating damages.

One must make the connection between reported losses, and what was damaged or harmed – in mitigation planning this is the vulnerability. Vulnerabilities are usually reported in terms of building stock, number of buildings and critical facilities, but vulnerability includes effects on people, particularly descriptions of high risk populations, and effects on other social and economic factors as identified at the local level.

Recent TDEM recent policy encourages smaller planning footprints such as county wide plans rather than regional plans, As a result of the two county maximum policy, TDEM anticipates there will be over 254 plans to review in the near future. The analysis of local plan data is an overview from each of the six main Texas DPS regions. A regional approach is more realistic for organization and evaluation of the state plan strategy. The six regions break down the state into regions that are largely congruent in hazard occurrence because of geographic similarity. Each region is a combination of one or more

urban areas and expansive rural areas.

The questionnaire results are summarized through a graphic on the following page. For each region, the hazards of most concern are identified, along with a rough estimate of damages. The source of the estimations is unknown.

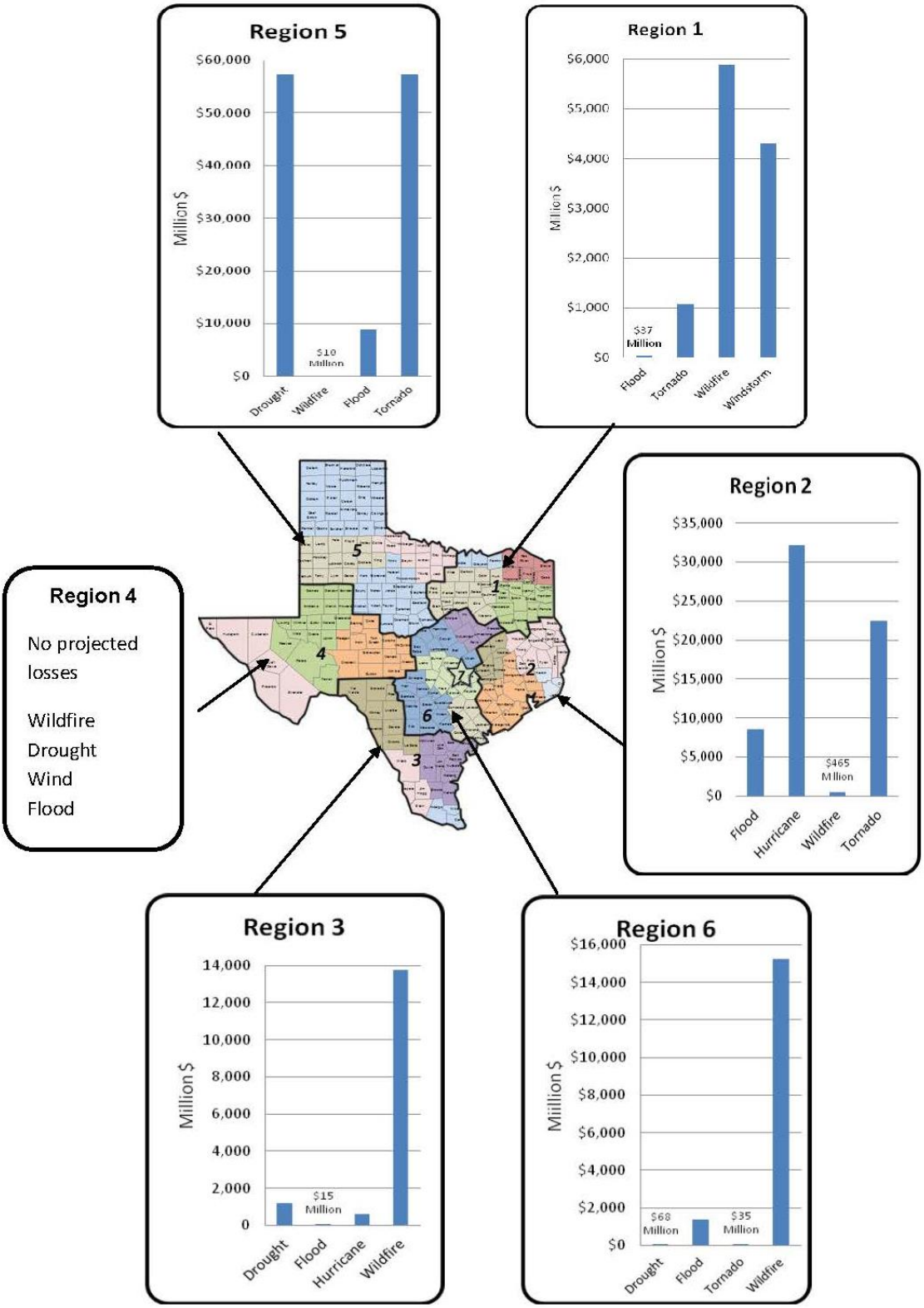
On the surface, the data collected from questionnaire responses is logically congruent with TDEM mitigation's perception of high risk areas for particular hazards. As such, the data does support observations made in the hazard profiles.

There are also some new trends. The respondents indicated an increased concern regarding drought and wildfires. Drought and wildfire have become a greater threat, more widespread, and more costly than many current plan rankings would suggest. This is likely due to the drought conditions most of the state has experienced in this planning cycle. The current trend has been affected by extensive destruction from the two previous wildfire seasons.. Another significant observation from the data analysis is that wildfire is in the top four hazard rankings in all six regions. Region 4, which did not provide detailed loss data, ranked wildfire as a major potential hazard.

The data and analysis also remained consistent with the historical patterns of:

- High tornado and windstorms in the north and central regions of the state
- High flood and hurricane in the coastal region

REGIONAL PROJECTED POTENTIAL LOSSES – BY HAZARD



The method used below to analyze impact in terms of monetary losses and vulnerabilities (populations and built environment at risk) based on reviewing local plans was to select a representative plan (or two) from each of the regions. Each plan was selected on the basis of information available within that plan to address the factors of vulnerability and impact in any depth. It was also necessary to select plans that included an urban area in order to identify risk in terms of highest vulnerability. The major hazards identified and described below for each region do not necessarily align with the loss estimates captured from local plans. Plans typically included loss estimates on those hazards that have readily data available, not necessary the hazards with the highest impact. Vulnerabilities are identified per relevant data in each plan based on reported vulnerability, impact and frequency. These are interpreted as major hazards.

REGION 1

#1 Plan selected: Dallas County; northern tip of the "Texas Triangle" growth pattern. This plan was approved in 2009. Dallas County is reported to have grown 13 percent in the last three years. The population is over 2.5 million. Although home to a large metropolitan area, rural farming communities exist. The county seat is City of Dallas, with a population of over 1.2 million out of 2.5 million residing countywide.

The following major hazards were extracted from the plan based on its vulnerability, impact, and frequency content:

Earthquake, flood, and dam/levee failure

Loss estimates are based on total amount over a period of time. Neither the Dallas County nor Tarrant County plans in this region reported loss estimates. Because each county worked closely with their Council of government, NCTCoG, who developed hazard profiles for their members, this plan references the NCTCoG figures supplied:

Summary of Loss Estimates For North Central Texas Council of Governments 1996-2012	
Hazard	Loss Estimate
Floods	$121,883,250
Hail	$1,445,420,550
Thunderstorm/Wind	$64,979,450
Tornado	$779,848,000
Wildfire	$49,632,000

Region 1 is dominated by the Dallas-Fort Worth Metroplex. It is the highest growth area, growing at the expense of the rural counties. Flood loss estimates are expected to be flat due to better code and permitting which offset the risk to the increasing

number of people and an aging levee system. Losses from tornado and hail may increase as the total population and number of real and personal property increases. The recent increase in earthquakes activity should not cause increase loss because the magnitude extent will remain below the damage threshold of magnitude 6. Loss of life from tornadoes should decrease due to better warning systems and the increasing public awareness and desirability of individual safe rooms for residences.

According to the local plan, much of the unincorporated areas of Dallas County lie within a designated **floodplain**, dependent on aging and unmaintained levees for protection. The risk is from systems being overtopped by rains that exceed the base flood event. According to a 1995 study by the U.S. Army Corp of Engineers referenced in the plan, 12,000 homes and 140 million square feet of commercial property are at risk.

This plan states that prior to October 2008, there was no historical evidence of **earthquakes** occurring in Dallas County and the rock foundation studies revealed no evidence of anomalous ground motion. Two consecutive days, October 31 and November 1 of 2008, saw seven earthquakes ranging from 2.5 to 3.0 on the Richter Scale. The plan states, "The most likely future risk is still associated to either a distant large quake in Missouri, Tennessee, or Oklahoma…The second likely occurrence for earthquakes is the large amount of hydrocarbon production occurring…Natural gas extractions has been responsible for creating small earthquakes…"

If earthquakes continue, building stock will be considered vulnerable to the hazard. As population increases, it would be advantageous for local planners to evaluate and address building code requirements for structural stability during an earthquake to address future development.

According to the plan, participants in the Dallas plan have city ordinances establishing a land development trend of building outside the floodplains. The plan states, "increasing development both upstream and downstream of the region's existing levees is likely to be reducing the flood protection capabilities of these levees even for the base flood event."

#2 Plan selected: Fort Worth Coalition Plan (includes Tarrant County); Tarrant County lies directly east of Dallas County and has seen more growth since 2000 than its neighbor, Dallas County, a 21 percent growth. Tarrant County is home to the cities of Fort Worth and Arlington. Fort Worth (population 688,000 plus) straddles three counties but is the lead participant in the Fort Worth Coalition plan. (Tarrant County is served by two plans: this and the Tarrant County Mid-Cities which includes six jurisdictions.)

The following major hazards were extracted from the plan based on its vulnerability, impact, and frequency content:

Flood, thunderstorms, and hailstorm

According to the coalition's plan, the topography of the area combined with the frequency of severe thunderstorms results in frequent flash **flood** events. There have been 17 deaths in the area due flash flooding on roadways since 1986. In contrast, there are only 39 repetitive loss properties reported. Unlike Dallas County, Tarrant County reports their levees to be a "well-maintained" system.

Tarrant County averages about 11 significant **thunderstorm** events (with hail and high winds) per year according NWS records but the plan reports that most structures can resist the effects of all but the most severe **hailstorms**. A number of mobile and manufactured home parks and, of course, vehicles remain vulnerable. Thousands of homes and vehicles can be damaged in a single storm causing millions of dollars in damages.

As development occurs along with growth, more property is exposed. In fact, due to the rapid development in the area, the planners have experienced problems determining building footprints within the floodplain and are working to accurately identify the number and types of buildings vulnerable to flooding.

REGION 2

Plan selected: The Harris County plan approved in 2010, includes 30 participants, does not include the City of Houston which has its own plan. The county plan was selected for its network of cities reaching across the county that encompasses over 1,778 square miles and is home to 1.8 million people outside of Houston.

The following major hazards were extracted from the plan based on its vulnerability, impact, and frequency content:

Flood, hurricanes, severe winter weather and drought

Loss data from the Harris County plan is older than preferred for a current analysis. The new data will be submitted with the upcoming Harris County update.

Total Property Damage Recorded for Harris County 1999-2009	
Hazard	Loss Estimate
Hail	$22,576,000,000
Flood	$44,278,000,000
Extreme Heat	Not Available
Hurricanes/Coastal Storms	Not Available
Ice	$560,221,000
Lightning	$355,000,000
Winter Storms	$123,001,000,000
Tornado	$6,504,000,000
Wildfire	Not Available
Thunderstorms	$32,473,000,000

Although the Houston metroplex and surround Harris County will continue to experience moderate growth, flood losses are expected to become static due to the offset of better code and zoning enforcement. Hurricane losses should be flat for the same reason – modern 120 mph wind code enforcement is enforced. Development in areas affected by surge is not expected to see increasing losses because the areas easily developed have been developed.

The area is drained by 22 major watersheds. According to the plan, riverine **flood** events happen every year with up to 31 percent of the properties being vulnerable. Impacts include displacement of residents and businesses, limited mobility, loss of life, and temporary closure of critical infrastructure. Hurricane surge can reach into Harris County on the easternmost boundary, and up to 23 percent of all properties are considered vulnerable. In addition to the vulnerabilities above, widespread power outages are likely to occur. There are over 4500 repetitive loss properties in Harris County and cities, excluding Houston.

Hurricane winds can cause damage to an estimated 52 percent of structures damaged.

The plan states **severe winter weather** with "even small accumulations of ice can cause a significant hazard, especially on power lines and trees…Communications and power can be disrupted for days, and even small accumulations of ice may cause extreme hazards to motorists and pedestrians."

According to the plan, the probability of drought is once every 4.33 to 19.6 years. Impacts due to **drought** include restrictions on water consumption and an increased risk of extreme heat and heat island effect.

Most of the land in Harris County has been developed. As population increases, the population density will increase. The plan states "The Harris County All Hazard Mitigation Plan…is a logical first step toward incorporating hazard mitigation principles and practices into the routine government activities and functions of the county planning area (including participating municipalities). The mitigation actions noted in this plan go beyond recommending structural solutions to reduce existing vulnerability. Local policies addressing community growth, incentives to protect natural resources and public awareness and outreach campaigns are examples of other measures than can be used to reduce future vulnerability of Harris County to identified hazards."

<u>REGION 3</u>

Plan selected: Cover the Border approved in 2008 and covers 13 counties and 53 jurisdiction stretching from the Gulf to the Rio Grande Valley area. This plan represents the variety of population densities.

The following major hazards were extracted from the plan based on its vulnerability, impact, and frequency content:

Hurricane, floods, drought, and dams and levees

The plan expressed losses in terms of annualized losses:

Summary of Annualized Loss Estimates for Cover the Border Region	
Hazard	Loss Estimate
Coastal Flooding	$32,456,000
Drought	$15,682,510
Hail	$1,032,396
Tornado	$1,525,797
Hurricane /Tropical Storm/ High Wind	$245,300,23

Moderate growth is indicated in this area of the state. Losses due to hurricanes should continue to increase as new development occurs in areas susceptible to hurricane surge. Zoning and code enforcement is less strong in this region than in other areas of the state. Losses from floods due to dam/levees will be decreasing due to recent, substantial federal investment in the upgrade of the levee system.

According to the plan, tropical storms and **hurricane**s were rated as the highest priority for the border region as a whole. A tropical event is expected to affect 50 percent or more of the people and property. Homes throughout the Rio Grande Valley are manufactured or light wood frames, which can be easily damaged by high wind,

especially greater than 73 mph. Electric lines are also susceptible. If residential, commercial, and critical facilities are not equipped with generators, continuity of operations is difficult.

Much like the Rio Grande Valley, arroyos natural or man-made creek beds) fill quickly after a flash **flood**. Local farmers often rely on channels and ditches for the distribution of water. Flash flooding causes cutting into the arroyo, lowering the groundwater level, making its use unsuitable for agriculture.

The possibility of decertification of **levee** systems poses an economic threat to the region. The International Boundary and Water Commission (IBAC) reports that levee systems in Cameron and Hidalgo Counties could be non-certifiable.

In case of levee breach, many communities have imposed freeboard into their floodplain ordinances, which can mitigate flood for future development.

REGION 4

#1 plan selected: El Paso County; 18 percent population growth in the last three years. The information below was extracted from the 2013 draft submittal. The city of El Paso, with a population of over 609,000 is the county seat and is the sixth largest city in Texas. El Paso County is at the westernmost tip of the Rio Grande Valley and includes mountains and desert vegetation. The second largest city in the county is Anthony, with a population of around 12,000. Other communities are much smaller.

The following major hazards were extracted from the plan based on its vulnerability, impact, and frequency content:

Flood, wildfire, extreme heat/cold, wind, dam/levee failure and earthquakes

The plan expressed losses in terms of loss estimates based on captured damages in 2012:

Greatest Single Amount of Damage to Structures and Infrastructure in 2012 Dollars for El Paso County	
Hazard	Loss Estimate
Hail	$107,310,627
Flood	$2,283,938
Extreme Cold	$149,669
Ice	$560,221
Lightning	$77,672
Snow	$560,221
Tornado	$4,102,300
Wildfire	Not Available
Wind	$215,160

The city of El Paso and the surrounding area is a relatively low population growth area. The reported enforcement of code and zoning in place should offset losses from growth in development. The only damaging quake to occur in Texas was reported in Jeff Davis County, at the city of Valentine, essentially a no growth area. Losses from earthquakes are expected to be flat, with little damage currently reported.

Flooding causes vulnerability to infrastructure and people from fast moving waters carrying mud, debris, or rocks along arroyos. As development increases, these shallow water channels fill up further causing more flooding and damage to structures and infrastructure.

According to their plan, "the impact of **dam or levee failure** would be flooding along the Rio Grande. Enforcement of local flood damage prevention ordinances s requires structures and infrastructure along the river to be designed and built to withstand the force of rising or moving water. The impact of dam failure would be roughly equivalent to the impact of flooding along the river." Dams upstream of the city of El Paso are the Caballo Lake and Elephant Butte Lake dams.

Areas of concern for **wildfire** are around the state parks, Franklin Mountains and Hueco Tanks. Wildfire is unlikely to occur in the incorporated areas.

Earthquakes (no loss estimates reported) have centered along fault line in the Franklin Mountains of El Paso County. Damages recorded in previous earthquakes include a building being badly cracked and some rocks sliding in the mountains.

Extreme cold has led to frozen water systems, low pressure in natural gas pipes and natural gas outages, problems with electricity generation and these negative effects on people.

A hail event in 2009 was unusual, but produced costly losses.

The city of El Paso reports adequate building codes for protection against many hazards.

#2 Plan selected: Ector County/City of Odessa Plan: This plan was approved in 2011. This area has seen around nine percent growth since 2000. The city of Odessa, with a population of around 96,000 is the county seat and straddles Ector and Midland Counties. The second largest city is West Odessa with a population around 19,000.

The following major hazards were extracted from the plan based on its vulnerability, impact, and frequency content**:**

Wildfire, flood, drought, hail, high wind

The plan expresses losses in terms of annualized losses:

Summary of Annualized Loss Estimates in Ector County	
Hazard	Loss Estimate
Drought	$410,168
Hail	$1,934,956
Flood	$21,311,000
Thunderstorm	$92,867
Tornado	$24,352
Lightning	$19,785
Hurricane Wind	$7,600

Ector County is not expected to see any increase in losses due to high wind due to reportedly good code enforcement. Hail damage losses are expected to increase due to increasing population and real and personal property increases.

The potential impact for **drought** as reported is “minor” even though 16 events have been recorded by the National Climactic Data Center (NCDC) during 1996-2006. Drought losses are based on agricultural products. Drought also increases the wildfire potential.

Unlike the El Paso County plan, this plan reports that **hail** events for the county are common, with several “super” hailstorm occurrences. A “super” hailstorm in 1999 involved a reported $85 million in property damages.

Flood damages show that over 49,000 buildings could be impacted, with the majority of the residential vulnerable being pre-FIRM structures. Because of the area’s terrain, there is a potential for flash flood events that have significantly damaged property and threatened lives, and escalated response costs.

According to the plan, no residential properties are known to have been destroyed as a result of **wildfire**. Even so, the plan reports that the severity of impact of a major wildfire event could be substantial with over 45,000 people at risk and parcels worth over$4,036,663,000 at risk.

Ector County is right on the border of Wind Zone II and III and can experience **wind** events up to 160 mph. The plan reports that high winds can be especially dangerous when it leads to wildfire. Strong winds from hurricane activity, as it moves inland, also has had a significant damage effect on the county and has resulted in disaster declarations after Hurricanes Rita and Katrina.

The plan reports that the economy and industry of Ector County continues to grow despite national economic downturn. Much of the economy is built around mining and construction to the plan. In order for the economy, and the inevitable development in its wake, to remain sustainable through an event and its aftermath, mitigating natural hazards and their cascading events will be imperative. As new building stock goes up, and old building stock is replaced, the percentage of pre-FIRM structures should decrease.

REGION 5

Plan selected: Lubbock County; Located in the South Plains region, Lubbock County has grown over 9 percent since 2000. The analysis was performed on the 2013 draft submittal. The city of Lubbock (population 218,300 plus) is the county seat but it is not a participant in the county's plan. The plan does include school districts, colleges and special districts. The unincorporated areas of the county make up the second highest population, accounting for 11.6 percent of the Lubbock County population. The county is mineral and agricultural country. Lubbock County grew by 67,180 between 1980 and 2010, a 31.7 percent jump. Population growth continues in most areas.

The following major hazards were extracted from the plan based on its vulnerability, impact, and frequency content:

Tornado and drought

The Lubbock County plan summarizes annualized losses:

Summary of Annualized Loss Estimates in Lubbock County	
Hazard	Loss Estimate
Drought	$41,700,000
Hail	$4,900,000
Flood	$2,800,000
Extreme Heat	$2,600
Thunderstorm	$407,000

Tornado	$25,500,000
Winter Storm	$214,000

Losses to property due to tornados are expected to increase along with the moderate population growth. Loss of life due to tornadoes should decrease due to vastly better warning and increasing public awareness and desirability of individual safe rooms for residences. Economic losses from drought could increase due to continued over-pumping of the existing aquifers. Losses from wildfire are not expected to increase due to declining population in rural areas.

Lubbock County experiences on average 1-1/2 **tornadoes** per year. An F5 magnitude (old Fujita extent scale measurement) has occurred. Most tornado occurrences in the county, though, are in the lower range. These tornadoes have downed utility poles and damaged structures.

The plan reports that "The economic impact of **droughts** can be significant as they produce a complex web of impacts that spans many sectors of the economy and reach well beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services. If droughts extend over a number of years, the direct and indirect economic impact can be significant."

The network of highways that run through the county has had an impact on its development as a distribution hub. Although the majority of land is farm and ranch land, a critical portion of the economy lays with the major industries and Texas Tech University. Hazards that affect transportation capabilities could affect future development or sustainability of the county's economy if not mitigated. The plan reports that the annual household earnings impact from Texas Tech University was nearly $604 million. Although university systems are not always participants in plans or have their own plans, the impact of a severe hazard on a campus could have substantial economic impact on the entire community.

<u>REGION 6</u>

#1 Plan selected: Alamo Area Council of Governments Regional plan approved in 2012 and includes 56 participants, of which 11 are counties. This plan was selected for its diversity of participants both rural and urban, covers over 10,000 sq. miles and includes Bexar County. The area has a population of about 1,622,900 with the city of San Antonio (at 1,336,000 of that total) being the county seat. The area has seen about 16 percent growth since 2000. Bexar County is at the boundary of the Balcones Escarpment and the Coastal Plain regions and is prone to a multitude of hazards because of the land characteristics.

The following major hazards were extracted from the plan based on its vulnerability, impact, and frequency content**:**

Flood and drought

Loss estimates are based on annualized figures:

Summary of Annualized Loss Estimates for Alamo Area Council of Governments	
Hazard	Loss Estimate
Drought	$1,307,000,000
Hail	$23,872,000
Flood	$978,540,000
Thunderstorm	$37,744,000
Tornado	$85,976,000

The growth concentration is in the San Antonio and Austin areas, while the rural areas remain flat. Flood losses are expected to decrease due to good zoning and recent regionalization of flood control efforts through the San Antonio River Authority (SARA). While agricultural losses due to drought are expected to increase, but this region is also the focus area for infrastructure upgrades per desalination and reclamation water projects.

The According to the plan, Bexar County has the greatest number of critical facilities, including schools, nursing homes, police stations and fire departments located in special **flood** hazard areas than any other participant. As of 2010, the County had 93 repetitive loss properties reporting 250 losses totally over $1.2 million. Bexar County also has a number of critical facilities within one mile of dams. Several mobile home parks are also vulnerable. The counties of Bandera, Bexar and Medina, and other counties in the plan have experienced flooding from the aftermath of hurricanes that hit the coast causing millions in property damages, significant crop damage, and injuries.

The agriculture industry in the surrounding area is most affected by **drought** but can also have impacts on people and property in the area. Emergency services that rely on water are compromised. Water-dependent industry is exposed to impact. The majority of the participants ranged drought as having a high or moderate impact.

According to the plan, the region “is proximal to the major Texas population centers and over two-thirds of the trade between the United States and Mexico moves through the area on its many interstate highways.” This type of economy drives development and the area is expected to grow by about 1.2 million people by 2040. As the plan states, “This means that not only will resources continue to diminish, but exposure to hazards and monetary damages due to hazard events will also increase over the years.” The plan goes to state that as more surface area becomes impervious this will affect the volume and rate of surface water runoff as well as ground water recharge.

#2 Plan selected: Guadalupe-Blanco River Authority. GBRA plan was selected because its boundaries and participants extend from the Central Texas area down to communities close to the Gulf coast covering 10 counties. It was approved in 2011.

The following major hazards were extracted from the plan based on statements about vulnerability, impact, and frequency:

Flooding and hurricane high winds

Annualized loss estimates are reported for the following events:

Summary of Annualized Loss Estimates For Guadalupe-Blanco River Authority	
Hazard	Loss Estimate
Drought	$315,349
Flood	$40,010,000
Thunderstorm	$549,104
Hail	$175,807
Tornado	$1,559,022
Hurricane	$595,000
Winter Storm	$14,703

The state expects to see increases in losses to hurricane hazards due to the increase in population along the coast. Code enforcement and zoning remain less stringent than in other areas of the state. Recent adoption of new NFIP flood maps should with significantly higher base flood elevations should reduce flood losses over time.

According to the plan, **flooding** was identified by most participants as a moderate or high risk with many communities citing lives loss or rescues at low-water crossings. Around 77,000 people are exposed to flood hazards and 37,000 properties totally over $222M in value. Coastal communities are vulnerable to hurricane surge and flooding. Areas of impact include Calhoun, Refugio and Victoria counties where low lying areas flood along with rivers, bays, and estuaries.

According to the plan's vulnerability assessment, "a flooding or storm surge event would have a substantial impact on vulnerable areas, which could result in multiple fatalities, a complete shutdown of facilities, or more than half of all property destroyed or substantially damaged."

In addition to flood, both hurricanes and thunderstorms present **high wind** risk to the counties exposing populations, structures and critical facilities. The plan notes that hurricane-force winds easily destroy poorly constructed buildings and mobile homes, as can the debris that gets blown about. Extensive damage to trees, towers, water and utilities cause civic disruption. High winds from thunderstorms cause structural damage to facilities, especially roofs and windows. Injuries occur as a result of falling or flying debris.

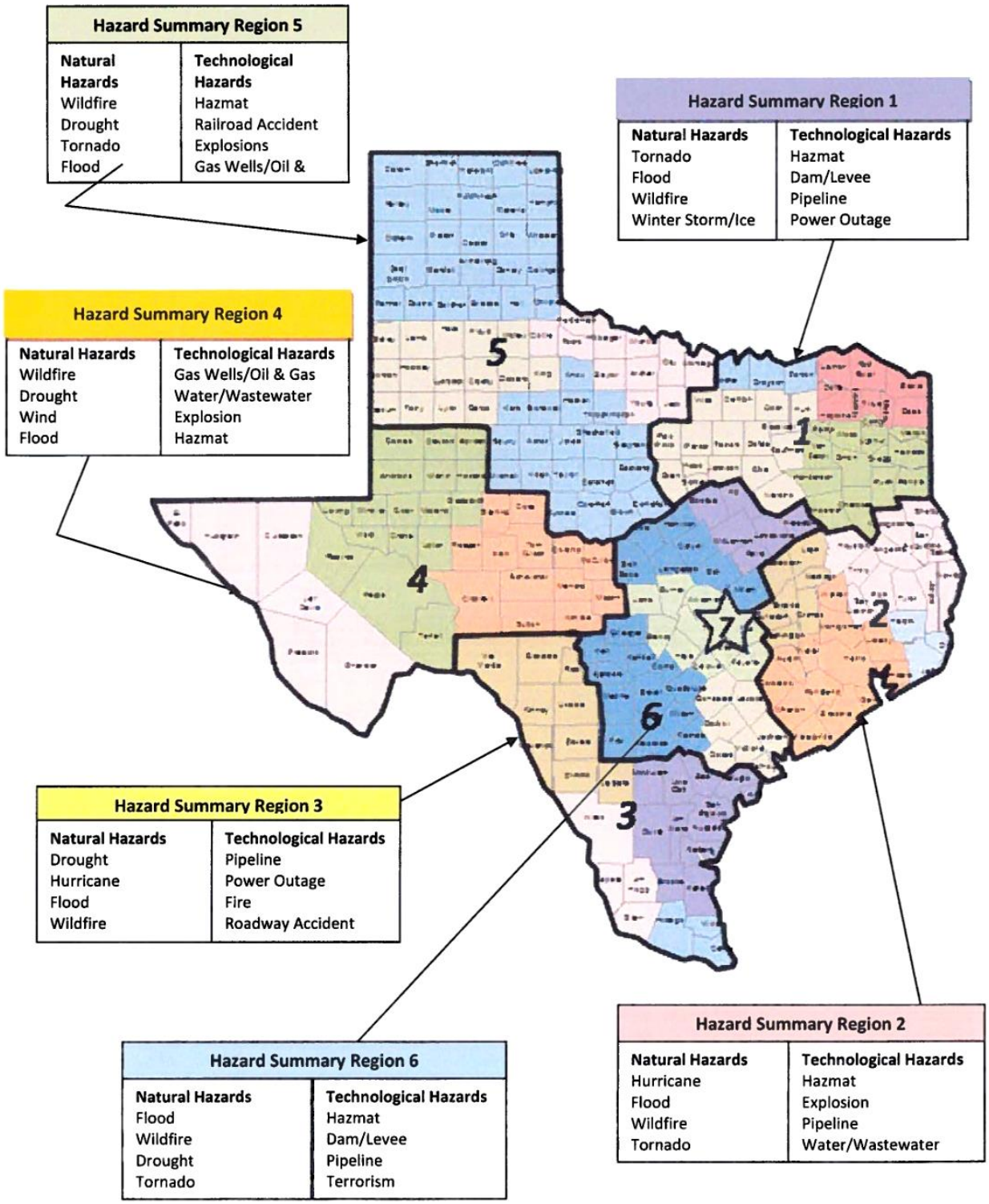
Development in this area partially depends on the tourist economy. Additionally, coastal industry economies are reported to be vibrant, for example, the Matagorda Ship Channel. The influx of transitional workers in the oil field industry has significantly added to the current population count. Overall population continues to grow, as does development but at higher construction costs and flood insurance costs than in the past.

Vulnerability and Loss Estimate Conclusions

Because regional plans were discouraged during this update period, most local plans that were submitted had significantly small footprints. Even for those plans with identical footprints, GBRA, AACoG, El Paso County, Harris County, vulnerability and loss estimates were reported and analyzed dissimilarity than done previously in the local plans and the state plan. Thus, it is difficult, if not impossible, to identify a from a data comparison how development changes the loss data from the last update to this one. Population growth is a considerable factor on development, and all data indicates that Texas has grown at a faster than average rate than the rest of the county. With increasing building stock and population, plus rising costs of materials due to demand, it can only be ascertained that losses due to any hazard would be higher in the future if mitigation does not lessen damages.

TECHNOLOGICAL HAZARDS AND MITIGATION PLANNING

The hazards questionnaire distributed to local emergency managers across the state asked the locals to report their perceived top natural and technological hazards within their DPS region. The summary of both results are summarized in graphic form.


Hazard Summary Region 5
Natural Hazards
Wildfire
Drought
Tornado
Flood
Technological Hazards
Hazmat
Railroad Accident
Explosions
Gas Wells/Oil &
Hazard Summary Region 1
Natural Hazards
Tornado
Flood
Wildfire
Winter Storm/Ice
Technological Hazards
Hazmat
Dam/Levee
Pipeline
Power Outage
Hazard Summary Region 4
Natural Hazards
Wildfire
Drought
Wind
Flood
Technological Hazards
Gas Wells/Oil & Gas
Water/Wastewater
Explosion
Hazmat
5
1
4
2
7
6
3
Hazard Summary Region 3
Natural Hazards
Drought
Hurricane
Flood
Wildfire
Technological Hazards
Pipeline
Power Outage
Fire
Roadway Accident
Hazard Summary Region 6
Natural Hazards
Flood
Wildfire
Drought
Tornado
Technological Hazards
Hazmat
Dam/Levee
Pipeline
Terrorism
Hazard Summary Region 2
Natural Hazards
Hurricane
Flood
Wildfire
Tornado
Technological Hazards
Hazmat
Explosion
Pipeline
Water/Wastewater

Note: *The Texas State Hazard Mitigation Plan is reviewed and FEMA approved solely on consideration of natural hazards. It is written and updated in a manner consistent with the methods and process used for current mitigation plan approval based on a review and approval of natural hazard profiles.*

TDEM and the team recognize the growing threat of technological hazards, both as primary and cascading event, and the importance of including these hazards for consideration in future mitigation planning. The West, Texas fertilizer plant explosion in 2013 further emphasizes this issue.

In December of 2012, the Department of Public Safety's State Administrative Agency (SAA) Division, which has oversight of Homeland Security grant programs, in conjunction (among other DPS divisions) with TDEM's Preparedness and Mitigation Sections, submitted its first Threat Hazard Identification and Risk Assessment (THIRA) for Federal approval. The THIRA exercise of identifying and prioritizing "worst case" natural, technological, and human-caused hazard scenarios is very different from the mitigation planning process. Nonetheless, the identification of natural and technological hazards identified and profiled as capable of occurring within the state should be consistent among planning mechanisms, regardless of the planning output and outcome. The team expects that greater inter- and intra-agency coordination, communication and collaboration will be required for assigning responsibilities, sharing information, and eliminating duplication of activities.

There will be challenges in constructing processes to incorporate technological risk into future plans in terms of hazard identification and profiling, as well as the assessment of federal, state and local capabilities for mitigation funding.

A THIRA serves as a foundation for hazard mitigation planning, especially in regards to the capability requirements of the Hazard Mitigation Plan.

A THIRA includes a comprehensive hazard catalogue of the threats and hazards of greatest concern, desired outcomes, a risk overview with hazard profiles and estimated impacts, and capability targets.

As with natural hazards, there are numerous state agencies involved with mitigation, preparedness, response and recovery from technological hazards, including TDEM, TCEQ, and TxDOT, all of which currently have representatives on the Mitigation Planning Team. A representative from the SAA Division should be considered. As the threat of technological hazard grows it would be advantageous for agencies to work together in a greater collaborative manner.

Below is a description of key natural and technological hazards identified in the THIRA per the state's perspective of identified risks related to mitigation planning:

THIRA IDENTIFIED WORST CASE SCENARIOS

NATURAL HAZARDS

- Category 5 **Hurricane** – Galveston Island, Labor Day Weekend
- Heavy Rains followed by Category **4 Hurricane & Tornado** – Rio Grande Valley, July 4th
- Multiple **Tornadoes** EF2 – EF4 – Dallas/Ft. Worth, Spring Weekend
- Extreme **Drought** conditions cause water reserves to fall to 1 percent- San Angelo ***or*** Drought and High Winds lead to widespread **Wildfires** – Travis County, August
- Heavy rainfall leads to **Flash Flooding** – El Paso area, Summer
- Widespread influenza virus **Pandemic** – Houston, February

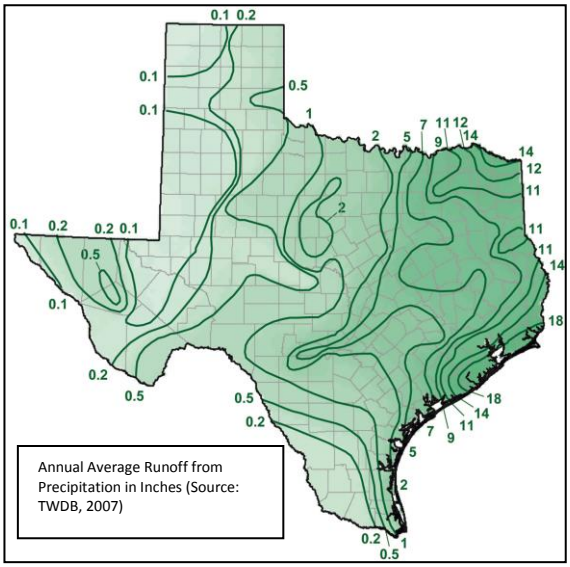
TECHNOLOGICAL HAZARDS

- Structural weakness leads to **Dam Failure** and interruption of utility/transportation systems. – Dallas-Ft. Worth
- **Railroad Chemical Spill** releasing toxic/corrosive sulfuric acid gas – Houston, Spring Rush Hour

HAZARD ASSESSMENTS

FLOODS

Floods are defined as the accumulation of water within a water body and the overflow of excess water into adjacent floodplain lands.



Annual Average Runoff from Precipitation in Inches (Source: TWDB, 2007)

In hydrologic analysis, runoff is that portion of rainfall which, in combination with other factors, contributes to the stream flow of any surface drainage way. When runoff exceeds the carrying capacity of the stream or drainage, flooding occurs. Runoff is a product of two major groups of factors, climate and physiographic. Climatic factors may include precipitation, evaporation, transpiration and interception. Physiographic factors would include the characteristics of the watershed such as size, shape and slope of the basin's drainage area, the general land use within the basin. Average annual runoff decreases unevenly moving east to west across Texas, the localized variations based on these factors listed above.

When surface water runoff enters into streams, rivers, or dry creek beds, riverine flooding conditions occurs whenever the water carrying capacity of the water channel is compromised by excess runoff.

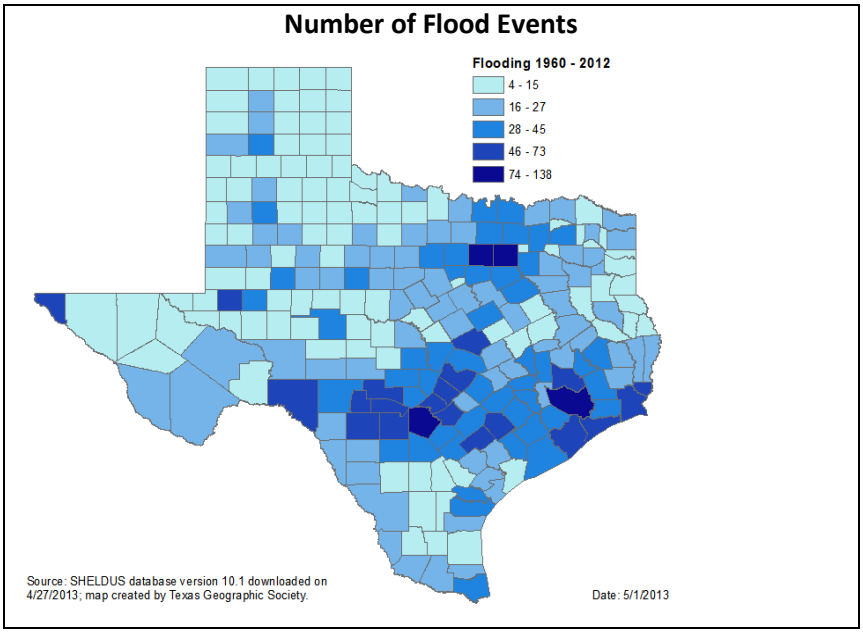
If the local basin drainage area is relatively flat, shallow, slow-moving floodwater can last for days. In drainage areas with substantial slope, or the channel is narrow and confined, rapidly moving and extreme high water conditions, called a flash flood, can occur.

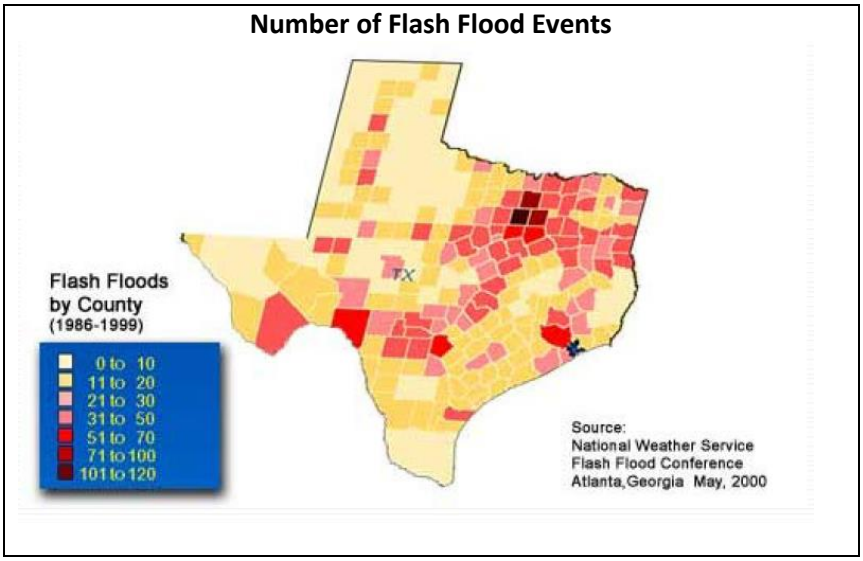
Location - Flood

The following maps indicate counties throughout Texas prone to runoff flooding from a various mixture of conditions. These areas include Central Texas, particularly Bexar County, Tarrant and Dallas County area, areas along the Rio Grande River and along the Texas coast.

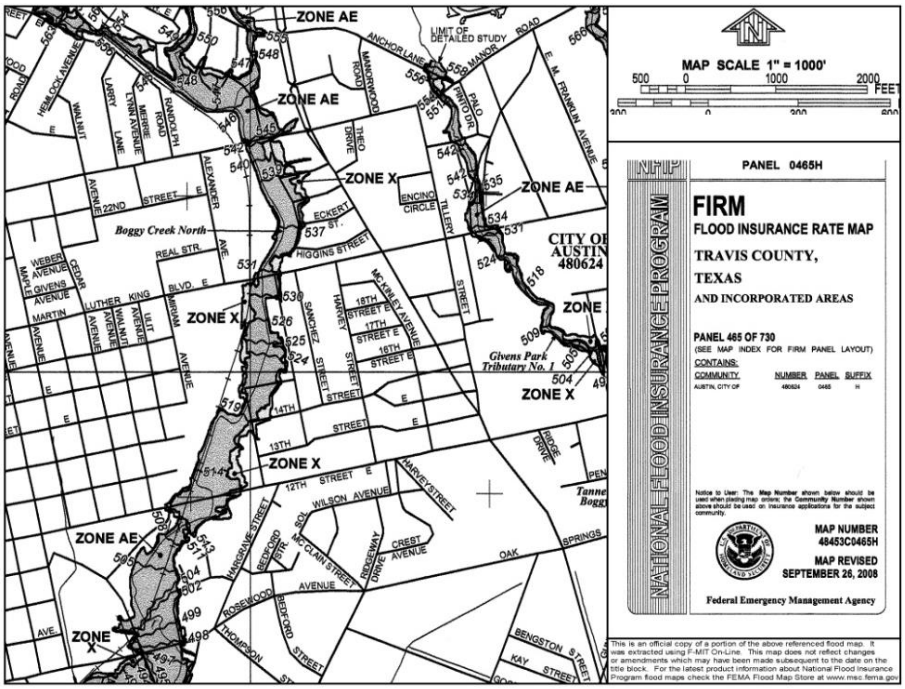
Properties that repetitively flood, according to flood insurance data, are located in 143 of the state's 254 counties, making the case that flooding events span across the state, basically skipping only west Texas, which tends to be a dry, desert climate. El Paso County and the areas along the border flood due to overtopping of the Rio Grande. The Rio Grande Valley floods due to flat terrain and slow runoff, causing surface water build-up that cannot flow quickly. An expansive, hilly central Texas area is prone to flash flooding. Various creeks and lakes in urbanized areas flood the

Tarrant County and Dallas County areas, and the Gulf coast floods from a perfect storm combination of multiple river basins, frequent regional rainfall flat terrain, and seasonal hurricane/tropical storm activity. Approximately 46 percent of these repetitively flooded properties are located in Harris County alone, and nearly 71 percent of occurs within Harris County and the three counties contiguous to Harris County, Galveston, Brazoria and Montgomery counties. The two maps show a similar pattern of events across the state and across time.





Another tool a local entity can utilize to assess the location of flood risk is to review the local Flood Insurance Rate Map (FIRM) to identify flood zones. Flood zones are geographic areas that FEMA has defined according to varying levels of flood risk. These zones are depicted on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map. Each zone reflects the severity or type of flooding in the area. Here is an example of a floodplain map:



Moderate to Low Risk Areas

In communities that participate in the NFIP, flood insurance is available to all property owners and renters in these zones:

ZONE	DESCRIPTION
B and X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods. Are also used to designate base floodplains of lesser hazards, such as areas protected by levees from 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.
C and X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level.

High Risk Areas

In communities that participate in the NFIP, mandatory flood insurance purchase requirements apply to all of these zones:

ZONE	DESCRIPTION
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.
AE	The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.
A1-30	These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).
AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
AO	River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
A99	Areas with a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.

High Risk - Coastal Areas

In communities that participate in the NFIP, mandatory flood insurance purchase requirements apply to all of these zones:

ZONE	DESCRIPTION
V	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. No base flood elevations are shown within these zones.
VE, V1 - 30	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.

Undetermined Risk Areas

ZONE	DESCRIPTION
D	Areas with possible but undetermined flood hazards. No flood hazard analysis has been conducted. Flood insurance rates are commensurate with the uncertainty of the flood risk.

Extent - Flood

Extent means the strength or magnitude of the hazard, either as a range or upper end measurement. For example, extent could be described in terms of measurement based on a scientific scale; or it can be based on other hazards factors, such as duration and speed of onset.

One method of documenting flood extent can be through noting a range or upper end of high water marks at specific flood prone locations. A high water mark is the line left by extreme high flows or levels of water from floods and shows how high the water rose, relative to the surrounding land. These are also referred to as debris lines because the line is visible because of the floating debris that sticks to a structure.

These marks provide unique insight into the dynamics of a flood and are of great value to engineers, who in the aftermath of an event can use these lines to calibrate their models and understand the extent and intensity of a flood. Some people even have extensive histories of high water marks carved into homes, barns, trees etc. complete with dates of the flood. These are extremely helpful in providing modern day understanding of historical events and also provide keys to

TNRIS' Floodplain Mapping Group has established an email address (highwatermarks@tnris.org) for people to send pictures, text and regular email to update the current inventory of high water marks in Texas. A highwater mark inventory for Texas can be found at: http://www.tnris.org/status-maps and click on the Floodplain Mapping tab.

understanding the history of a place. This is the people side of flooding and the power that stories play in communication of the past as a measure of the risk in the present.

Previous Occurrences - Flood

Documenting previous events reminds a community that "it can happen to them" and further understanding of potential risk. The sources can vary depending on the resources of the community and can include internet searches, media reporting, an operations center's situation reports (sitreps) and even firsthand accounts. The National Climatic Data Center (NCDC) is often the first source of information for mitigation planners. The following tables show search results for *recent* flooding and flash flooding occurrences across Texas for 2011-2012, even though Texas has been experiencing statewide drought conditions during this planning period.

Recent Flood Occurrences in Texas

LOCATION	COUNTY	DATE	DEATHS	PROPERTY DAMAGE	CROP DAMAGE
EDNA HILL	ERATH CO.	1/24/2012	0	1.00K	0.00K
LIPAN	HOOD CO.	1/24/2012	0	1.00K	0.00K
(GRK)GRAY AAF FT HOO	BELL CO.	1/25/2012	0	1.00K	0.00K
KOSSE	LIMESTONE CO.	1/25/2012	0	10.00K	0.00K
EAGLE	TARRANT CO.	1/25/2012	0	100.00K	0.00K
UNION VLY	HUNT CO.	1/25/2012	0	3.00K	0.00K
SULPHUR BLUFF	HOPKINS CO.	1/25/2012	0	3.00K	0.00K
BOLIVAR	DENTON CO.	1/25/2012	0	5.00K	0.00K
WHITT	PARKER CO.	1/25/2012	0	5.00K	0.00K
COPPELL	DALLAS CO.	1/25/2012	0	50.00K	0.00K
CELINA	COLLIN CO.	1/25/2012	0	50.00K	0.00K
LILAC	MILAM CO.	2/4/2012	0	50.00K	0.00K
BRIDGE CITY	ORANGE CO.	3/21/2012	1	1.00K	0.00K
JAMESTOWN	NEWTON CO.	3/21/2012	0	1.00K	0.00K
LUBBOCK CO.	LUBBOCK CO.	4/29/2012	0	0.50K	0.00K
GARZA CO.	GARZA CO.	4/29/2012	0	0.50K	0.00K
HOCKLEY CO.	HOCKLEY CO.	4/29/2012	0	10.00K	0.00K
FURGUSON STA	HALE CO.	6/6/2012	0	35.00K	0.00K
KRESS	SWISHER CO.	6/14/2012	0	0.00K	200.00K
PETTY	LYNN CO.	6/16/2012	0	0.00K	200.00K
LONG MOTT	CALHOUN CO.	7/11/2012	0	10.00K	100.00K
OAK RIDGE NORTH	MONTGOMERY CO.	7/12/2012	0	1.000M	5.00K
HOCKLEY	HARRIS CO.	7/12/2012	0	500.00K	5.00K
WESTLAND	TARRANT CO.	8/18/2012	1	0.00K	0.00K
BOBWYN	DALLAS CO.	8/18/2012	0	100.00K	0.00K

http://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=48%2CTEXAS

Historically, floods are one of the most frequent, destructive, and costly natural hazards facing Texas, constituting over 90 percent of the disaster experienced in the state. Texas averages $254 million in each year from flooding. The following chart represents more significant flooding that has occurred in Texas since 1900. While it is noted that extensive rainfall and subsequent flooding take place typically during the Spring and Fall months, the information illustrates how unpredictable weather change can affect the potential for heavy rains leading to hazardous conditions.

Significant Historical Flooding Occurrences in Texas		
Date	Affected Area	Remarks
April 5–8, 1900	Val Verde County on the Rio Grande, and over Swisher County on the High Plains, and converged in the vicinity of Travis County	Floods in the Colorado, Brazos and Guadalupe rivers. McDonald Dam on the Colorado River at Austin crumbled suddenly. A wall of water swept through the city taking at least 23 lives. Damage was estimated at $1.25 million.
May 22–25, 1908	North Texas and southern Oklahoma then to Central Texas	Heaviest floods were in the upper Trinity basin, but flooding was general as far south as the Nueces. Property damage exceeded $5 million and 11 lives were lost in the Dallas vicinity.
Dec. 1–5, 1913	Central	Floods caused loss of 177 lives and $8.54 million damage.
April 20–26, 1915	Central Texas	Floods in Trinity, Brazos, Colorado and Guadalupe rivers. More than 40 lives lost and $2.33 million damage.
Sept. 8–10, 1921	Entered Mexico as a hurricane from the Gulf then moved northeasterly across Texas.	Record floods occurred in Bexar, Travis, Williamson, Bell and Milam counties, killing 215 persons, with property losses over $19 million. Five to nine feet of water stood in downtown San Antonio. A total of 23.98 inches was measured at the U.S. Weather Bureau station at Taylor during a period of 35 hours, with a 24-hour maximum of 23.11 on September 9-10. The greatest rainfall recorded in United States history during 18 consecutive hours (measured at an unofficial weather-monitoring site) fell at Thrall, Williamson County, 36.40 inches fell on Sept. 9.
April 23–28, 1922	Storm entered Texas from the west and	Rains up to 12.6 inches over Parker, Tarrant and Dallas counties caused

	moved from the Panhandle to North Central and East Texas.	severe floods in the Upper Trinity at Fort Worth; 11 lives were lost; damage was estimated at $1 million.
May 24–31, 1929	Beginning over Caldwell County, a storm spread over much of Central and Coastal Texas.	Maximum rainfall of 12.9 inches, causing floods in Colorado, Guadalupe, Brazos, Trinity, Neches and Sabine rivers. Much damage at Houston from overflow of bayous. Damage estimated at $6 million.
June 30–July 2, 1932	Upper watersheds of the Nueces and Guadalupe rivers.	Seven persons drowned; property losses exceeded $500,000.
Sept. 15–18, 1936	North Concho and Middle Concho rivers caused a sharp rise in the Concho River	San Angelo business district and 500 homes were flooded. Four persons drowned and property losses estimated at $5 million. Four-day storm rainfall at San Angelo measured 25.19 inches; 11.75 inches fell on the 15th.
Sept. 8–10, 1952	Colorado and Guadalupe River watersheds in southwestern Texas	From 23 to 26 inches fell between Kerrville, Blanco and Boerne. Highest stages ever known occurred in the Pedernales River; five lives lost, three injured; 17 homes destroyed, 454 damaged. Property loss several million dollars.
April–May, 1957	Excessive flooding occurred throughout the area east of the Pecos River to the Sabine River	17 lives were lost, and several hundred homes were destroyed. Over 4,000 persons were evacuated from unprotected lowlands on the West Fork of the Trinity above Fort Worth and along creeks in Fort Worth. Twenty-nine houses at Christoval were damaged or destroyed and 83 houses at San Angelo were damaged. Five persons were drowned in floods in South Central Texas.
Oct. 28, 1960	South Central Texas	11 died from drowning in flash floods. In Austin about 300 families were driven from their homes. Damage in Austin was estimated at $2.5 million.
Sept. 7, 1962	Big Fossil and Denton Creek	Extensive damage from flash flooding occurred in Richland Hills and Haltom City.
June 11, 1965	Sanderson, Terrell County.	Rains of up to eight inches in two hours near Sanderson caused a major flash flood that swept through the

		town. As a result, 26 persons drowned and property losses were estimated at $2.72 million.
April 22–29, 1966	Northeast Texas	Twenty to 26 inches of rain fell in portions of Wood, Smith, Morris, Upshur, Gregg, Marion and Harrison counties. Nineteen persons drowned in the rampaging rivers and creeks that swept away bridges, roads and dams, and caused an estimated $12 million damage.
April 28, 1966	Dallas County	Flash flooding from torrential rains in Dallas County resulted in 14 persons drowned and property losses at $15 million.
May 11–12, 1972	South Central Texas	Seventeen drowned at New Braunfels, one at McQueeney. New Braunfels and Seguin hardest hit. Property damage $17.5 million.
June 12–13, 1973	Southeastern Texas	Ten drowned. Over $50 million in property and crop damage. From 10-15 inches of rain recorded.
Nov. 23–24, 1974	Central Texas	Over $1 million in property damage. Thirteen people killed, 10 in Travis County.
Jan. 31–Feb. 1, 1975	Nacogdoches County	Widespread heavy rain caused flash flooding here, resulting in three deaths; damage over $5.5 million.
May 23, 1975	Austin area	Heavy rains, high winds and hail resulted in over $5 million property damage; 40 people injured. Four deaths caused by drowning.
June 15, 1976	Harris County	Rains in excess of 13 inches caused damage estimated at near $25 million. Eight deaths were storm-related, including three drownings.
Aug. 1–4, 1978	Edwards Plateau, Low Rolling Plains	As much as 30 inches of rain fell near Albany in Shackelford County, where six drownings were reported. In Bandera, Kerr, Kendall and Gillespie counties, 27 people drowned and the damage total was at least $50 million.
Sept. 18–20, 1979	Coastal flooding	18 inches in 24 hours at Aransas Pass, and 13 inches at Rockport.
Oct. 17-18, 1998	Austin/San Antonio	Torrential rains fell over south and southeast Texas. Up to 22 inches of rain fell which first resulted in deadly

		flash flooding from San Antonio to Austin followed by record breaking river floods along several south Texas rivers the following week. Based on provisional data from the USGS , the flood peak for this event was the highest known peak stage at 15 locations. Tragically, a total of 31 people died during the event (26 drownings, 2 tornado deaths, 2 heart attacks, and 1 electrocution/drowning). At least 17 of the drowning victims were in vehicles which were either driven into water or were swept away by rapidly rising water. Preliminary property damage estimates approached three quarters of a billion dollars. (Source: www.nws.noaa.gov. South Texas Floods, 10/98)
June – Aug 2007	Statewide	Severe prolong flooding, across Texas results in a federal disaster declaration.

Probability - Flood

Probability means the likelihood of the hazard occurring and may be defined in terms of general descriptors (likely, highly likely, unlikely - with each category defined) historical frequencies, statistical probabilities and /or on hazard probability maps.

On average, Texas suffers approximately 400 floods annually, more than double the average of the second-highest state. Because flooding events have been documented to occur even in times of widespread drought, the probability of flood has been raised to Highly Likely for this planning period.

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.

More Information on repetitive flood conditions and losses in Texas are addressed in Appendix A – Severe Repetitive Loss Strategy.

HURRICANES/TROPICAL STORMS

Tropical storms are areas of disturbed weather in the tropics with closed isobars and a distinct rotary circulation. The highest wind speed ranges from 39 - 73 mph. Heavy rain, localized flooding, high tides, localized coastal erosion, and minor wind damage can be associated with tropical storms.

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

Urban flooding occurs because of the inability of the storm management systems to remove runoff at a level needed to eliminate excess surface water from heavy rains.

Battering wave action refers abnormally destructive breaking waves at the shoreline. Breaking waves dissipate their energy by generating turbulence in the water and by transporting sediment lifted off the bottom and tossed around by the turbulent water. Wave action more fully defined and profiled separately in the Coastal Erosion hazard profile.

Storm surge is a rapid rise of offshore water elevation primarily caused by the combination of extremely high winds over a large stretch of open water and low barometric pressure which accompany a hurricane, together working to create a dome of water near the eye of the hurricane. As the hurricane nears land, its winds push the dome toward the shore while the slope of the sea floor blocks the water's escape and it comes ashore as a rising surge.

Location – Hurricane & Tropical Storms

For hurricane the wind component, location is often referred to in terms of Tier I and II counties, designated by TDI for windstorm insurance purposes, to represent differing levels of loss exposure to coastal counties and adjacent counties. Tier I are those counties adjacent to the Gulf of Mexico and Tier II are those counties adjacent to Tier I counties.

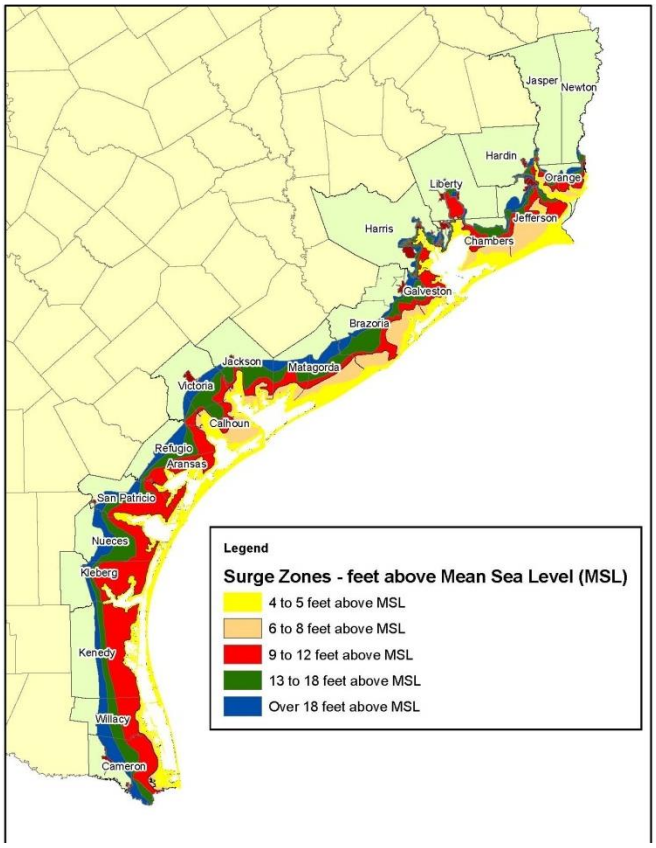
Tier I counties include:

Newton, Orange, Hardin, Liberty, Jefferson, Harris, Chambers, Galveston, Brazoria, Matagorda, Jackson, Calhoun, Refugio, Aransas, San Patricio, Nueces, Kleberg, Kenedy, Willacy and Cameron counties.

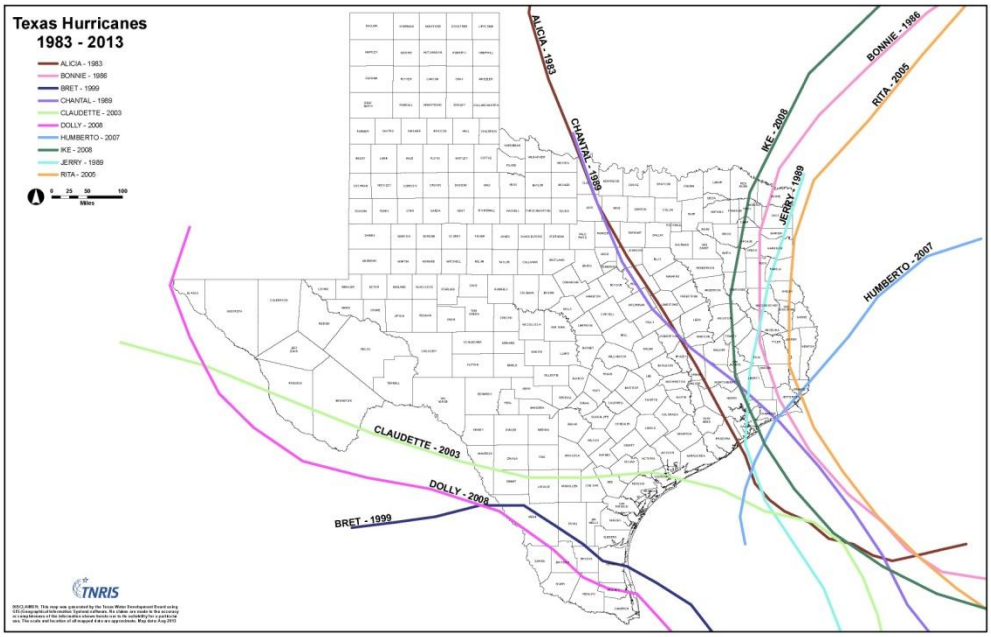
Tier II counties include:

Jasper, Fort Bend, Wharton, Victoria, Goliad, Bee, Live Oak, Jim Wells, Brooks and Hidalgo counties.

Surge zones are depicted on the following map.



Urban flooding can be assumed to be an occurrence in any populated area along a hurricane's path once it reaches close to the coastline. The following map depicts potential hurricane flooding from hurricanes occurring since 1983:



Extent – Hurricane & Tropical Storms

For hurricanes, extent can be expressed separately for flood, wind and surge.

Extent for urban flooding resulting from hurricane be measured in terms of number of inches or feet above the ground surface elevation. During Tropical Storm Allison, June 2001, 28 inches of rain fell within 12 hours in the City of Houston area.

For hurricane wind extent, the Saffir-Simpson Hurricane Wind Scale (SSHWS) scale is the scientific scale of choice for hurricane winds. The SSHWS underwent a minor modification for 2012 in order to resolve awkwardness associated with conversions among the various units used for wind speed in advisory products. The change broadens the Category 4 wind speed range by one mile per hour (mph) at each end of the range, yielding a new range of 130-156 mph. This change does not alter the category assignments of any storms in the historical record, nor will it change the category assignments for future storms.

Saffir-Simpson Hurricane Wind Scale - *http://www.nhc.noaa.gov/aboutsshws.php*		
1	74-95 mph 64-82 kt 119-153 km/h	**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:**

Saffir-Simpson Hurricane Wind Scale - *http://www.nhc.noaa.gov/aboutsshws.php*		
	83-95 kt 154-177 km/h	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 96-112 kt 178-208 km/h	**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 113-136 kt 209-251 km/h	**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 137 kt or higher 252 km/h 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.

Previous Occurrences – Hurricane & Tropical Storms

Tropical storms are an annual event occurring from May through November in either the Gulf of Mexico or the Atlantic Ocean. As of August 2013, Texas has not experienced an event since Tropical Storm Hermine in 2010, which made landfall in Mexico in September 2010, but impacted Texas and resulted in a state disaster declaration.

Hurricanes occur less frequently and residents along the Texas coast have a good chance of living many years without experiencing a hurricane.

The following table shows events during this planning period: Hurricane Alex on June 30, and Tropical Storm Hermine in September 2010.

Recent Tropical Storm and Hurricane Occurrences in Texas 2010-2012					
HAZARD DATE	COUNTY	INJURIES	FATALITIES	PROPERTY DAMAGE	CROP DAMAGE
6/30/2010	Cameron	0	0	$100,000.00	$
6/30/2010	Cameron	0	0	$25,000.00	$
9/6/2010	Cameron	0	0	$10,000,000.00	$
9/6/2010	Cameron	0	0	$2,000,000.00	$
9/6/2010	Willacy	0	0	$2,000,000.00	$
9/6/2010	Willacy	0	0	$50,000.00	$
9/7/2010	Bee	0	0	$25,000.00	$
9/7/2010	Jim Wells	0	0	$150,000.00	$1,000,000.00
9/7/2010	Kleberg	0	0	$100,000.00	$
9/7/2010	Live Oak	0	0	$100,000.00	$
9/7/2010	Nueces	0	0	$50,000.00	$500,000.00
9/7/2010	San Patricio	0	0	$50,000.00	$500,000.00
http://webra.cas.sc.edu/hvriapps/sheldus_setup/sheldus_results.aspx					

Texas Hurricane Alex – DR-1931

Individual Assistance

(Assistance to individuals and households)

Cameron County, Hidalgo County, Jim Hogg County, Lubbock County, Maverick County, Starr County, Val Verde County, Webb County and Zapata County.

Public Assistance

(Assistance to State, Local, Tribal and Territorial governments and certain private-non-profit organizations for emergency work and the repair or replacement of disaster-damaged facilities)

Calhoun County, Cameron County, Cottle County, Dawson County, Floyd County, Foard County, Garza County, Hidalgo County, Jim Hogg County, Jim Wells County, Lamb County, Lubbock County, Lynn County, Maverick County, Motley County, Starr County, Terry County, Webb County, Willacy County and Zapata County.

Since 1953, Texas has experienced 23 federal disaster declarations due to hurricane/tropical storm events, the most recent event being Hurricane Alex.

Historically Significant Hurricane Occurrences in Texas		
Date	Affected Area	Remarks
Sept. 8, 1900	Galveston, Texas	Known as "the Galveston Hurricane," the deadliest hurricane disaster in U.S. history occurred on September 8. More than 8,000 people died when hurricane storm tides (the surge plus the astronomical tide) of 8-15 feet inundated the entire island city of Galveston, Texas. More than half of all the homes and buildings were destroyed. Property damage is estimated at $700 million in 1990 dollars.
July 20, 1909	Velasco, Texas	The calm center lasted 45 minutes, and was followed by devastating winds on the other side which destroyed one-half of the town.
Aug. 16, 1915	Galveston, Texas	Despite the 10-foot-high seawall built after the 1900 hurricane, storm tides 12 feet above normal flooded the business district to a depth of six feet. 275 people lost their lives from a combination of high water and strong winds.
Sept. 14, 1919	Corpus Christi, Texas	This unnamed storm was fourth most intense and deadly storm of the 20th century. It passed near Key West, Florida, on September 9-10. The hurricane continued slowly westward and on September 14, the center went inland south of Corpus Christi. There, tides rose 16 feet above normal and another 287 lives were lost.
July 25-29, 1943	Harris County	A Category 1 storm, but it caused major disruptions of war production. World War II censorship of weather information increased the death toll. This storm is also famous as the storm that Col. Joseph Duckworth and Lt. Ralph O'Hair flew into in an AT-6, single-engine training airplane to

		become the first people to fly into a hurricane's eye.
June 27, 1957	Texas-Louisiana border	Hurricane Audrey made landfall near the Texas-Louisiana border on June 27th with devastating effects. There were 390 deaths as the result of a storm surge in excess of 12 feet, which inundated the flat coast of Louisiana as far as 25 miles inland in some places. Damages were estimated at about $700 million.
Sept. 10, 1961	Gulf Coast	Hurricane Carla was the largest and most intense Gulf Coast hurricane in decades. An estimated one-half million residents of low coastal areas and islands off Texas and Louisiana were evacuated to higher ground. As the center approached Texas on the 10th, winds near the center were estimated at 150 mph. Only 46 lost their lives because of early warnings. Severe damage along a wide expanse of the Texas coast was caused by unusually prolonged winds, high tides and flooding from torrential rains. Damage was about $2 billion dollars.
Sept. 20, 1967	Texas Gulf Coast	Hurricane Beulah made landfall between Brownsville, TX and the mouth of the Rio Grande about daybreak on September 20. Beulah's strength was seen in the impact the storm's surge had along Padre Island, Texas. A total of 31 cuts were observed through the island in the portion extending south from a point 30 miles south of Corpus Christi, Texas. Beulah also spawned an unsurpassed number of tornadoes, but most were small and occurred in rural areas. The death toll from Beulah reached 15 in Texas – five from tornadoes and ten from flooding. Damage is estimated at about $900

		million dollars.
Aug. 3, 1970	Corpus Christi, Texas	Hurricane Celia was one of the most destructive storms to ever hit Texas, with damages estimated at $1.6 billion. The extreme winds raked across the residential and business areas in less than half an hour. It was estimated that winds reached as high as 160 mph for several seconds. During those disastrous seconds, incredible damage occurred at the airport and an adjacent mobile home park which was completely demolished. Fortunately, only 11 died in the Corpus Christi area due to the state of preparedness by its disaster prevention agencies.
Aug. 9-10, 1980	South Texas Coast	Hurricane Allen was one of the most intense hurricanes ever. Allen reached Category 5 status three times. The center of Allen did not cross any land until it moved inland north of Brownsville, on the 9th. Only two deaths were directly attributed to Allen. The strongest measured winds were gusts to 129 mph at Port Mansfield, Texas. A storm surge up to 12 feet along Padre Island caused numerous barrier island cuts and washouts.
August 18, 1983	Middle Texas Coast	Hurricane Alicia was a small- to medium-size hurricane. It reached a minimal Category 3 status as it hit land. The center of Alicia moved over the Texas coast about 25 miles southwest of Galveston on August 18. Aircraft observations indicated that only a 60 mile section of the coast, extending northeastward from Freeport, Texas, experienced hurricane force winds. Despite its small size, Alicia caused over $2.4 billion in damage.
Sept. 16, 1988	South, Central and Southwest Texas	Hurricane Gilbert brought 5 to 10 inches of rain over coastal sections and more in mountainous areas.

		The weakening storm passed south of Monterrey, Mexico, bringing massive flooding to the area. The storm then tracked north into western Texas and Oklahoma as a heavy rain storm on the 18th. The 3 U.S. deaths occurred in San Antonio, from tornadoes spawned from Gilbert's remnants. At least 29 tornadoes were observed across south Texas, and they caused between $40-50 million in damages. In the area of Brownsville, wind gusts from Gilbert of 67 mph to 83 mph were measured by an observer with a truck mounted anemometer, before the storm made landfall in Mexico.
Aug. 23, 1999	Lower Texas Coast	Hurricane Bret made landfall on the 23rd on Padre Island with 115 mph winds. Bret's strong winds were confined to a small area and only affected a sparsely populated region. Bret caused about $60 million in damage, but no deaths. It was the first hurricane to affect south Texas since Hurricane Allen in 1980.
Sept. 24, 2005	Upper Texas Coast	Hurricane Rita weakened from a Category 5 to a Category 3 hurricane when it arrived east of the Texas/Louisiana border between Sabine Pass and Johnson's Bayou. Devastating storm surge flooding and wind damage occurred in southwestern Louisiana and extreme southeastern Texas, with some storm surge damage occurring in the Florida Keys. Rita was responsible for seven deaths, and it caused damage estimated at $10 billion in the United States.
Sept. 13, 2008	Upper Texas Coast	Hurricane Ike made landfall over the north end of Galveston Island in the early morning hours of September 13 as a Category 2

		hurricane with maximum sustained winds of 110 mph. Ike's storm surge devastated the Bolivar Peninsula of Texas, and storm surge, winds, and flooding from heavy rains caused widespread damage in other portions of southeastern Texas, western Louisiana, and Arkansas. Twenty people were killed in these areas, with 34 others still missing. Property damage from Ike as a hurricane is estimated at $19.3 billion.

Probability - Hurricanes & Tropical Storms

Hurricanes appear to be less frequent during La Niña periods and more prevalent during strong El Niño periods. El Niño, and La Niña, its counterpart, refer to climate conditions in the Pacific Ocean that influence weather patterns in Texas. El Niño is associated with warmer sea surface temperatures and high air pressure systems, while La Niña is associated with cooler ocean temperatures and low air pressure systems. These changes in water temperature and air pressure systems occur in somewhat regular intervals, with El Niño periods having longer durations. Hurricane/tropical storm frequency as experienced over the last 60 years indicates Texas has a likelihood of a storm hitting the coast every three years.

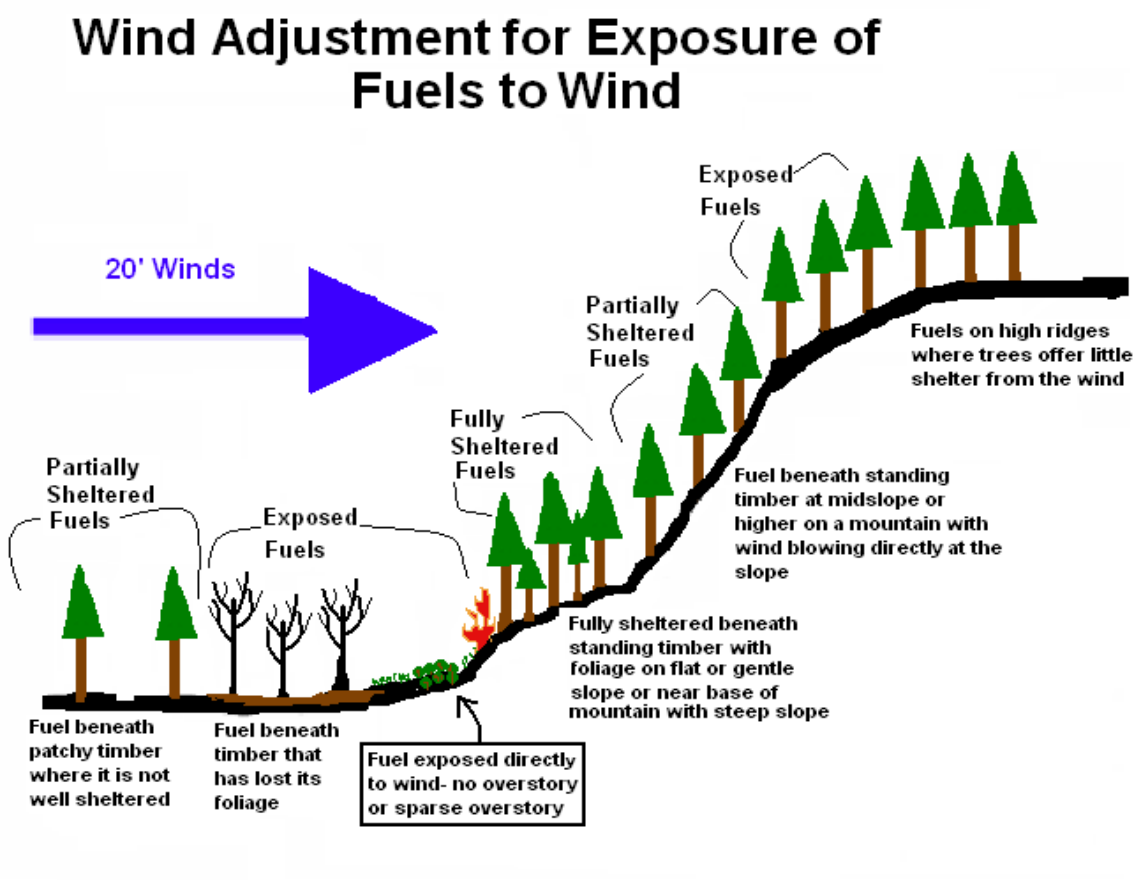
Frequency Of Occurrence:
- ☐ Highly likely: Event probable in next year.
- ☒ Likely: Event probable in next 3 years.
- ☐ Occasional: Event possible in next 5 years.
- ☐ Unlikely: Event possible in next 10 years.

WILDFIRE

Wildfire is defined as a sweeping and destructive conflagration and can be further categorized as wildland, interface, or intermix fires.

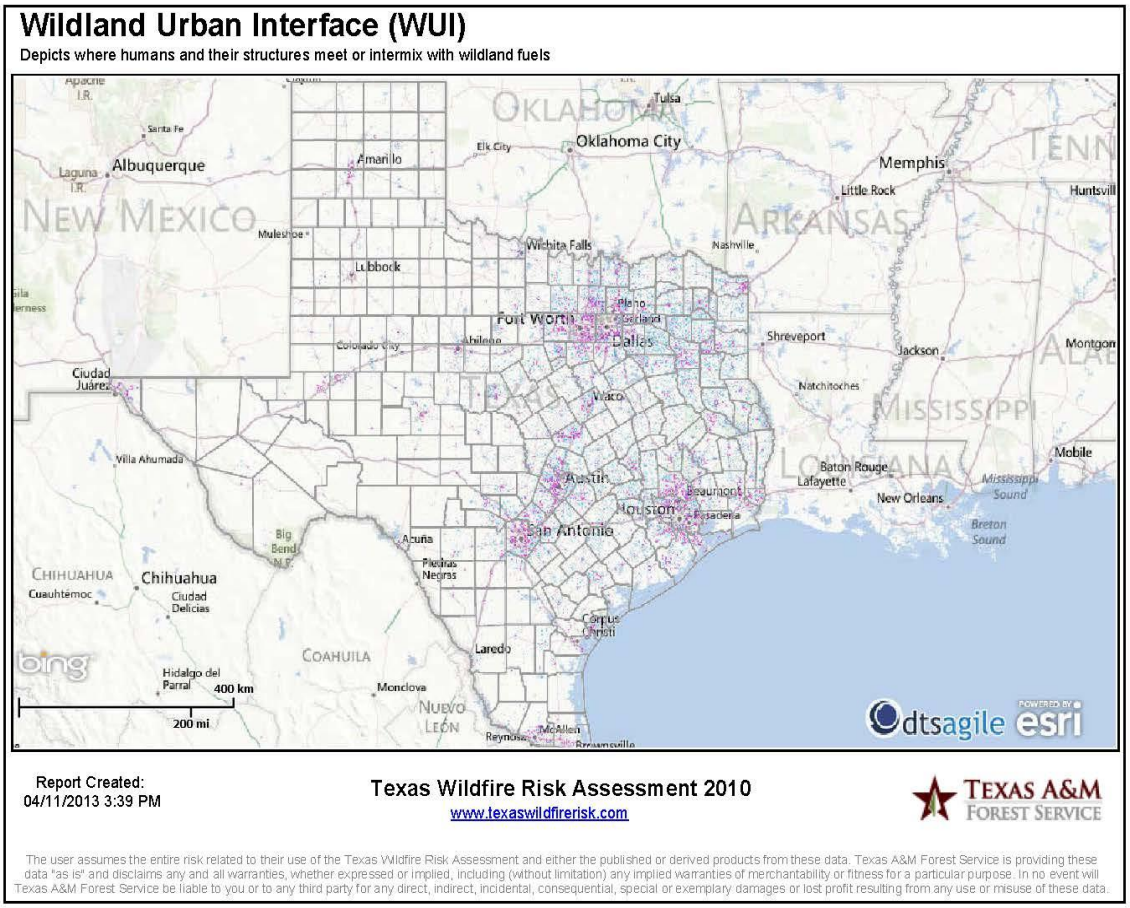
Wildland fires are fueled almost exclusively by natural vegetation wildland/urban interface (WUI) fires include both vegetation and the built-environment. The wildfire disaster cycle begins when homes are built adjacent to wildland areas. When what would have been rural wildfires occur, they advance through all available fuels, which can include homes and structures.

Other factors that affect wildfire behavior include fuel to wind exposure:



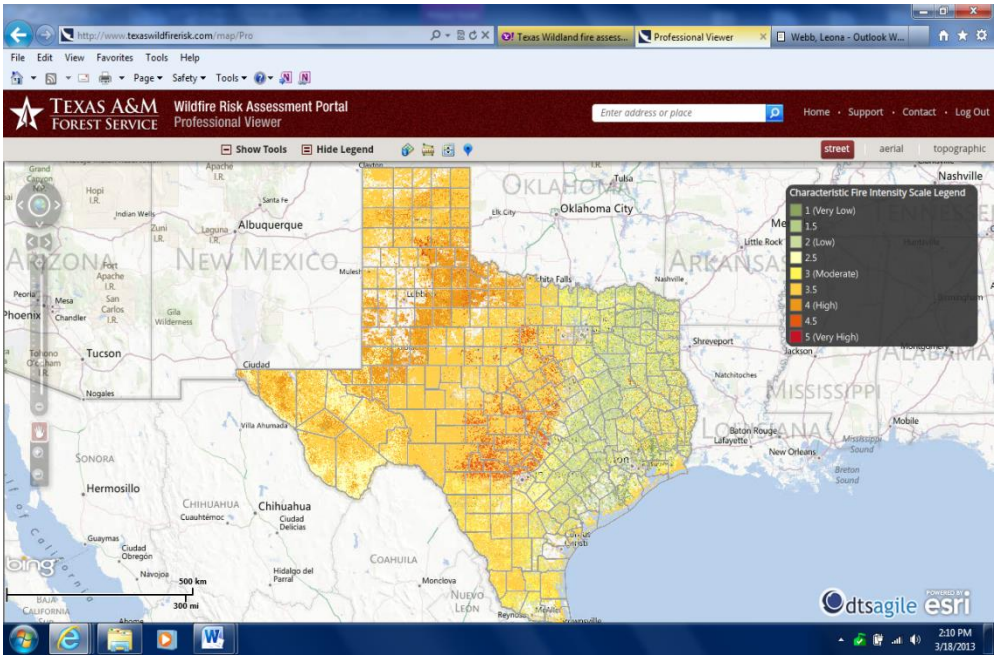
Location - Wildfire

With the semi-arid climate of the western, southern and panhandle counties of the state, wildland fires are most common in the spring and summer months, but can occur at any time during the year. The eastern part of the state, also known as the Piney Woods, contains the most hazardous fuels in the state: pine plantations. Fires burning in this fuel type under drought conditions are extremely hard to contain, require multiple fire-fighting resources, and threaten all homes in its vicinity. The "Hill Country" located in the central part of the state has the potential for future damaging wildfires due to a combination of rapid population growth, topography and densely covered, highly volatile, ash-juniper trees. This is especially true during extended and prolonged drought conditions. Some regions within the state can be expected to experience wildland fires whenever localized drought conditions are in place.



Extent - Wildfire

There appears to be no dominant extent scale for wildfire. Local mitigation planners use various representations including number of contiguous acreage burned; length of flame; fire severity (the degree of damage on the landscape); or fire intensity. Fire intensity is the reported scale on the Texas A&M Forest Service TxWRAP portal http://www.texaswildfirerisk.com/



Characteristic Fire Intensity Scale (FIS) specifically identifies areas where significant fuel hazards and associated dangerous fire behavior potential exist based on a weighted average of four percentile weather categories. Similar to the Richter scale for earthquakes, FIS provides a standard scale to measure potential wildfire intensity. 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. Refer to descriptions below.

Class 1 Very Low	Very small, discontinuous flames, usually less than one foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized 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 possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property.

Class 5 Very High	Very large flames up to 150 feet in length; profuse short-range spotting, frequent long-range spotting; strong fire-induced winds. Indirect attack marginally effective at the head of the fire. Great potential for harm or damage to life and property.

Previous Occurrences - Wildfire

The wildfire disaster cycle begins when homes are built within wildland/urban interface areas. Wildland fires have occurred before and will occur again in these areas. Threats to improved structures are a growing across the state.

The State received emergency declarations due to disastrous wildfires during the years 1996, 1998, 1999, 2000, 2006, 2009, 2011, and 2012, resulting in eligibility for Fire Management Assistance Grants (FMAG). Federal disaster declarations occurred in 2006 (DR-1624) and 2011 (DR-1999 and DR-4029). The following tables demonstrate the sheer volume of wildfire occurrences, widespread occurrence, and damages during this planning period.

Fire Occurrences 2011-2012
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms list

COUNTY	DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
DEAF SMITH (ZONE)	1/2/2011	0	1	15.00K	0.00K
DUVAL (ZONE)	1/21/2011	0	0	50.00K	0.00K
MILLS (ZONE)	1/28/2011	0	0	0.00K	5.00K
LUBBOCK (ZONE)	2/14/2011	0	0	20.00K	0.00K
MOORE (ZONE)	2/17/2011	0	0	4.00K	0.00K
JACK (ZONE)	2/22/2011	0	0	0.00K	15.00K
MOORE (ZONE)	2/23/2011	0	1	0.00K	0.00K
EASTLAND (ZONE)	2/24/2011	0	0	0.00K	2.00K
COMANCHE (ZONE)	2/24/2011	0	0	0.00K	5.00K
POTTER (ZONE)	2/27/2011	0	0	10.000M	0.00K
DICKENS (ZONE)	2/27/2011	0	0	15.00K	0.00K
POTTER (ZONE)	2/27/2011	0	0	18.00K	0.00K
GARZA (ZONE)	2/27/2011	0	0	2.000M	0.00K
LIPSCOMB (ZONE)	2/27/2011	0	0	25.00K	0.00K
RANDALL (ZONE)	2/27/2011	0	0	25.500M	0.00K
HOCKLEY (ZONE)	2/27/2011	0	0	450.00K	0.00K
LUBBOCK (ZONE)	2/27/2011	0	0	570.00K	0.00K
MOTLEY (ZONE)	2/27/2011	0	1	200.00K	0.00K
EASTLAND (ZONE)	2/27/2011	0	1	350.00K	7.00K

WHEELER (ZONE)	2/27/2011	0	3	40.00K	0.00K
HUTCHINSON (ZONE)	2/27/2011	0	5	200.00K	0.00K
PARKER (ZONE)	3/1/2011	0	0	60.00K	0.00K
SOMERVELL (ZONE)	3/11/2011	0	0	0.00K	2.00K
HOOD (ZONE)	3/11/2011	0	0	0.00K	4.000M
WISE (ZONE)	3/11/2011	0	0	120.00K	5.00K
JACK (ZONE)	3/11/2011	0	0	333.00K	7.00K
WISE (ZONE)	3/11/2011	0	0	60.00K	0.00K
HOOD (ZONE)	3/11/2011	0	1	250.00K	0.00K
BOSQUE (ZONE)	3/11/2011	0	2	7.00K	5.00K
HUNT (ZONE)	3/12/2011	0	0	75.00K	0.00K
HIDALGO (ZONE)	3/17/2011	0	0	5.00K	0.00K
HALE (ZONE)	3/23/2011	0	0	20.00K	0.00K
TERRY (ZONE)	4/3/2011	0	0	100.00K	0.00K
HOCKLEY (ZONE)	4/3/2011	0	0	200.00K	0.00K
GARZA (ZONE)	4/3/2011	0	0	25.00K	0.00K
MONTAGUE (ZONE)	4/6/2011	0	0	0.00K	3.00K
KING (ZONE)	4/6/2011	0	0	1.000M	0.00K
STONEWALL (ZONE)	4/6/2011	0	0	1.540M	0.00K
HIDALGO (ZONE)	4/7/2011	0	1	0.00K	0.00K
TERRELL (ZONE)	4/8/2011	0	1	0.00K	0.00K
MIDLAND (ZONE)	4/9/2011	0	0	2.700M	0.00K
PALO PINTO (ZONE)	4/9/2011	0	0	20.000M	0.00K
GARZA (ZONE)	4/9/2011	0	0	200.00K	0.00K
CROSBY (ZONE)	4/9/2011	0	0	200.00K	0.00K
TERRY (ZONE)	4/9/2011	0	0	350.00K	0.00K
DAVIS / APACHE MOUNTAINS AREA (ZONE)	4/9/2011	0	0	5.000M	0.00K
MOORE (ZONE)	4/9/2011	1	3	155.00K	0.00K
TOM GREEN (ZONE)	4/10/2011	0	0	100.00K	0.00K
KENT (ZONE)	4/11/2011	0	0	1.000M	0.00K
HIDALGO (ZONE)	4/11/2011	0	2	50.00K	0.00K
STEPHENS (ZONE)	4/12/2011	0	0	0.00K	120.00K
CARSON (ZONE)	4/12/2011	0	0	1.00K	0.00K
HARDIN (ZONE)	4/13/2011	0	0	0.00K	100.00K
STEPHENS (ZONE)	4/13/2011	0	0	100.000M	50.00K
STONEWALL (ZONE)	4/14/2011	0	0	258.00K	0.00K
STEPHENS (ZONE)	4/15/2011	0	0	0.00K	50.00K

WISE (ZONE)	4/15/2011	0	0	300.00K	0.00K
EASTLAND (ZONE)	4/15/2011	0	0	40.00K	0.00K
PARKER (ZONE)	4/15/2011	0	0	70.00K	0.00K
EASTLAND (ZONE)	4/15/2011	0	6	0.00K	50.00K
YOUNG (ZONE)	4/16/2011	0	0	0.00K	30.00K
JACK (ZONE)	4/16/2011	0	0	0.00K	75.00K
HARDIN (ZONE)	4/16/2011	0	0	100.00K	1.000M
EASTLAND (ZONE)	4/16/2011	0	0	900.00K	0.00K
TRAVIS (ZONE)	4/17/2011	0	0	2.000M	0.00K
PALO PINTO (ZONE)	4/17/2011	0	0	200.00K	120.00K
TYLER (ZONE)	4/18/2011	0	0	0.00K	15.00K
STEPHENS (ZONE)	4/19/2011	0	0	0.00K	30.00K
NEWTON (ZONE)	4/21/2011	0	0	0.00K	15.00K
JASPER (ZONE)	4/22/2011	0	0	0.00K	40.00K
ECTOR (ZONE)	4/26/2011	0	0	100.00K	0.00K
SWISHER (ZONE)	4/26/2011	0	0	100.00K	0.00K
HALE (ZONE)	4/26/2011	0	0	250.00K	0.00K
MITCHELL (ZONE)	4/26/2011	0	0	300.00K	0.00K
KIMBLE (ZONE)	4/26/2011	0	0	350.00K	0.00K
ARMSTRONG (ZONE)	4/26/2011	0	0	5.00K	0.00K
HOCKLEY (ZONE)	4/28/2011	0	0	50.00K	0.00K
LUBBOCK (ZONE)	4/29/2011	0	1	100.00K	0.00K
DICKENS (ZONE)	5/6/2011	0	0	20.00K	0.00K
DAVIS / APACHE MOUNTAINS AREA (ZONE)	5/8/2011	0	0	60.00K	0.00K
HOWARD (ZONE)	5/9/2011	0	0	240.00K	0.00K
RANDALL (ZONE)	5/24/2011	0	0	1.500M	0.00K
DEAF SMITH (ZONE)	5/24/2011	0	0	150.00K	0.00K
GARZA (ZONE)	5/24/2011	0	0	20.00K	0.00K
ANDREWS (ZONE)	5/24/2011	0	0	220.00K	0.00K
SWISHER (ZONE)	5/24/2011	0	0	40.00K	0.00K
LUBBOCK (ZONE)	5/24/2011	0	0	50.00K	0.00K
HALE (ZONE)	5/25/2011	0	0	5.00K	0.00K
POTTER (ZONE)	5/25/2011	0	0	80.00K	0.00K
WINKLER (ZONE)	5/25/2011	0	1	0.00K	0.00K
NEWTON (ZONE)	5/28/2011	0	0	100.00K	100.00K
RANDALL (ZONE)	5/29/2011	0	0	800.00K	0.00K
POTTER (ZONE)	5/29/2011	0	3	800.00K	0.00K

JASPER (ZONE)	6/4/2011	0	0	10.00K	0.00K
JIM WELLS (ZONE)	6/12/2011	0	0	10.00K	0.00K
PALO PINTO (ZONE)	6/13/2011	0	0	200.00K	0.00K
CARSON (ZONE)	6/13/2011	0	0	85.00K	0.00K
RANDALL (ZONE)	6/16/2011	0	0	8.00K	0.00K
BROWN (ZONE)	6/16/2011	0	2	0.00K	0.00K
CROCKETT (ZONE)	6/16/2011	0	2	0.00K	0.00K
BROOKS (ZONE)	6/18/2011	0	0	250.00K	5.00K
ELLIS (ZONE)	6/18/2011	0	0	461.00K	0.00K
PALO PINTO (ZONE)	6/18/2011	0	0	5.00K	0.00K
JASPER (ZONE)	6/18/2011	0	0	50.00K	2.000M
BELL (ZONE)	6/18/2011	0	0	9.40K	0.00K
STERLING (ZONE)	6/18/2011	0	2	0.00K	0.00K
PARKER (ZONE)	6/19/2011	0	0	10.00K	0.00K
KENDALL (ZONE)	6/19/2011	0	0	500.00K	0.00K
THROCKMORTON (ZONE)	6/19/2011	0	2	0.00K	0.00K
YOUNG (ZONE)	6/20/2011	0	0	5.00K	0.00K
HASKELL (ZONE)	6/20/2011	0	2	0.00K	0.00K
TOM GREEN (ZONE)	6/20/2011	0	2	0.00K	0.00K
CROCKETT (ZONE)	6/20/2011	0	2	0.00K	0.00K
TOM GREEN (ZONE)	6/20/2011	0	2	0.00K	0.00K
ARMSTRONG (ZONE)	6/30/2011	0	0	7.00K	0.00K
JOHNSON (ZONE)	7/3/2011	0	0	2.00K	0.00K
PALO PINTO (ZONE)	7/4/2011	0	0	30.00K	0.00K
PALO PINTO (ZONE)	7/5/2011	0	0	2.00K	0.00K
SMITH (ZONE)	7/8/2011	0	0	120.00K	0.00K
JACK (ZONE)	7/12/2011	0	0	2.00K	0.00K
JOHNSON (ZONE)	7/13/2011	0	0	72.00K	0.00K
ATASCOSA (ZONE)	7/14/2011	0	0	150.00K	0.00K
ROBERTSON (ZONE)	7/16/2011	0	0	5.00K	0.00K
POTTER (ZONE)	7/16/2011	0	0	8.00K	0.00K
LAMPASAS (ZONE)	7/20/2011	0	0	5.00K	0.00K
DEAF SMITH (ZONE)	7/20/2011	0	0	8.00K	0.00K
STEPHENS (ZONE)	7/26/2011	0	0	250.00K	0.00K
EASTLAND (ZONE)	7/26/2011	0	0	40.00K	0.00K
EASTLAND (ZONE)	7/27/2011	0	0	10.00K	0.00K
GRAYSON (ZONE)	7/28/2011	0	0	4.00K	0.00K
TARRANT (ZONE)	7/28/2011	0	1	1.000M	0.00K

JACK (ZONE)	8/1/2011	0	0	2.00K	3.00K
STEPHENS (ZONE)	8/1/2011	0	0	230.00K	0.00K
LAMPASAS (ZONE)	8/3/2011	0	0	10.00K	0.00K
LAMPASAS (ZONE)	8/3/2011	0	0	100.00K	0.00K
HIDALGO (ZONE)	8/3/2011	0	0	15.00K	0.00K
TITUS (ZONE)	8/3/2011	0	1	0.50K	0.00K
FRANKLIN (ZONE)	8/4/2011	0	0	0.00K	5.00K
FRANKLIN (ZONE)	8/4/2011	0	0	20.00K	0.00K
MILLS (ZONE)	8/5/2011	0	0	1.100M	4.00K
BELL (ZONE)	8/5/2011	0	0	100.00K	0.00K
KAUFMAN (ZONE)	8/5/2011	0	0	150.00K	0.00K
BOWIE (ZONE)	8/6/2011	0	0	300.00K	0.00K
JACK (ZONE)	8/7/2011	0	0	50.00K	3.00K
LAMPASAS (ZONE)	8/7/2011	0	0	75.00K	0.00K
GRAYSON (ZONE)	8/8/2011	0	0	20.00K	10.00K
ERATH (ZONE)	8/10/2011	0	0	175.00K	0.00K
LEON (ZONE)	8/12/2011	0	0	150.00K	0.00K
EASTLAND (ZONE)	8/12/2011	0	0	2.00K	2.00K
FRANKLIN (ZONE)	8/12/2011	0	0	200.00K	0.00K
ANDERSON (ZONE)	8/12/2011	0	0	75.00K	0.00K
WILLIAMSON (ZONE)	8/15/2011	0	0	500.00K	0.00K
ANDERSON (ZONE)	8/15/2011	0	1	750.00K	0.00K
ROBERTSON (ZONE)	8/16/2011	0	0	100.00K	0.00K
SMITH (ZONE)	8/16/2011	0	0	250.00K	0.00K
DALLAS (ZONE)	8/16/2011	0	0	300.00K	0.00K
TARRANT (ZONE)	8/17/2011	0	0	0.00K	1.00K
BOWIE (ZONE)	8/17/2011	0	2	400.00K	0.00K
CHEROKEE (ZONE)	8/17/2011	0	2	75.00K	0.00K
JOHNSON (ZONE)	8/18/2011	0	0	0.00K	2.50K
HUNT (ZONE)	8/18/2011	0	0	100.00K	0.00K
NAVARRO (ZONE)	8/18/2011	0	0	5.00K	0.00K
JOHNSON (ZONE)	8/18/2011	0	0	500.00K	0.00K
TARRANT (ZONE)	8/18/2011	0	0	700.00K	0.00K
VAN ZANDT (ZONE)	8/21/2011	0	0	5.00K	0.00K
JACK (ZONE)	8/23/2011	0	0	3.00K	0.00K
CORYELL (ZONE)	8/26/2011	0	0	10.00K	0.00K
HANSFORD (ZONE)	8/27/2011	0	0	20.00K	0.00K
LAMPASAS (ZONE)	8/28/2011	0	0	10.00K	0.00K

CORYELL (ZONE)	8/28/2011	0	0	2.00K	10.00K
HENDERSON (ZONE)	8/28/2011	0	0	7.00K	0.00K
LAMPASAS (ZONE)	8/29/2011	0	0	100.00K	0.00K
CORYELL (ZONE)	8/30/2011	0	0	0.50K	0.00K
PALO PINTO (ZONE)	8/30/2011	0	0	12.000M	0.00K
ANDERSON (ZONE)	8/30/2011	0	0	400.00K	0.00K
WISE (ZONE)	8/31/2011	0	0	800.00K	6.00K
MONTAGUE (ZONE)	9/1/2011	0	0	7.00K	0.00K
HENDERSON (ZONE)	9/2/2011	0	0	7.00K	0.00K
CASS (ZONE)	9/2/2011	0	1	6.000M	0.00K
GRAYSON (ZONE)	9/3/2011	0	0	2.00K	0.00K
BOSQUE (ZONE)	9/3/2011	0	0	5.00K	0.00K
HENDERSON (ZONE)	9/3/2011	0	0	50.00K	0.00K
FREESTONE (ZONE)	9/4/2011	0	0	1.100M	0.00K
TRAVIS (ZONE)	9/4/2011	0	0	10.000M	0.00K
HARRISON (ZONE)	9/4/2011	0	0	100.00K	0.00K
RUSK (ZONE)	9/4/2011	0	0	100.00K	0.00K
GREGG (ZONE)	9/4/2011	0	0	125.00K	0.00K
MILAM (ZONE)	9/4/2011	0	0	139.00K	0.00K
ANDERSON (ZONE)	9/4/2011	0	0	15.00K	10.00K
HOPKINS (ZONE)	9/4/2011	0	0	2.00K	0.00K
NAVARRO (ZONE)	9/4/2011	0	0	215.00K	0.00K
LIMESTONE (ZONE)	9/4/2011	0	0	3.00K	0.00K
LEON (ZONE)	9/4/2011	0	0	3.100M	0.00K
LIMESTONE (ZONE)	9/4/2011	0	0	30.00K	0.00K
HUNT (ZONE)	9/4/2011	0	0	30.00K	400.00K
CALDWELL (ZONE)	9/4/2011	0	0	500.00K	0.00K
HAYS (ZONE)	9/4/2011	0	0	6.000M	0.00K
TRAVIS (ZONE)	9/4/2011	0	0	6.000M	0.00K
NAVARRO (ZONE)	9/4/2011	0	0	60.00K	0.00K
RUSK (ZONE)	9/4/2011	0	0	65.00K	0.00K
KAUFMAN (ZONE)	9/4/2011	0	0	75.00K	0.00K
UPSHUR (ZONE)	9/4/2011	0	1	350.00K	0.00K
BASTROP (ZONE)	9/4/2011	2	0	250.000M	0.00K
GREGG (ZONE)	9/4/2011	2	2	2.250M	0.00K
FAYETTE (ZONE)	9/5/2011	0	0	1.000M	0.00K
WILLIAMSON (ZONE)	9/5/2011	0	0	1.700M	0.00K
HENDERSON (ZONE)	9/5/2011	0	0	2.00K	0.00K

BOWIE (ZONE)	9/5/2011	0	0	20.00K	0.00K
ANDERSON (ZONE)	9/5/2011	0	0	25.00K	0.00K
UPSHUR (ZONE)	9/5/2011	0	0	300.00K	0.00K
COLLIN (ZONE)	9/5/2011	0	0	50.00K	0.00K
GRIMES (ZONE)	9/5/2011	0	0	7.000M	0.00K
BELL (ZONE)	9/5/2011	0	0	75.00K	0.00K
KAUFMAN (ZONE)	9/6/2011	1	2	100.00K	0.00K
RED RIVER (ZONE)	9/7/2011	0	0	200.00K	0.00K
ERATH (ZONE)	9/8/2011	0	0	0.00K	1.00K
HENDERSON (ZONE)	9/8/2011	0	0	10.00K	0.00K
HILL (ZONE)	9/8/2011	0	0	975.00K	0.00K
ROBERTSON (ZONE)	9/9/2011	0	0	10.00K	5.00K
HUNT (ZONE)	9/9/2011	0	0	12.00K	0.00K
HUNT (ZONE)	9/9/2011	0	0	24.00K	0.00K
CORYELL (ZONE)	9/9/2011	0	0	3.00K	0.00K
HENDERSON (ZONE)	9/9/2011	0	0	400.00K	0.00K
TARRANT (ZONE)	9/9/2011	0	0	50.00K	0.00K
TARRANT (ZONE)	9/9/2011	0	0	7.00K	0.00K
HENDERSON (ZONE)	9/11/2011	0	0	10.00K	0.00K
HARRISON (ZONE)	9/11/2011	0	0	300.00K	0.00K
BELL (ZONE)	9/13/2011	0	0	1.00K	0.00K
UPSHUR (ZONE)	9/13/2011	0	0	1.200M	0.00K
MARION (ZONE)	9/13/2011	0	0	200.00K	0.00K
ELLIS (ZONE)	9/13/2011	0	0	30.00K	0.00K
MONTAGUE (ZONE)	9/13/2011	0	0	5.00K	3.00K
NAVARRO (ZONE)	9/13/2011	0	0	60.00K	0.00K
HAMILTON (ZONE)	9/14/2011	0	0	60.00K	0.00K
NUECES (ZONE)	11/4/2011	0	0	100.00K	0.00K
KLEBERG (ZONE)	3/27/2012	0	0	5.00K	0.00K
DEAF SMITH (ZONE)	5/5/2012	0	3	80.00K	0.00K
MILAM (ZONE)	5/19/2012	0	0	0.00K	6.00K
COLLIN (ZONE)	5/23/2012	1	0	0.00K	0.00K
DENTON (ZONE)	5/23/2012	0	0	40.00K	15.00K
HUNT (ZONE)	6/28/2012	0	0	0.00K	5.00K
JOHNSON (ZONE)	8/2/2012	0	0	15.00K	0.00K
PALO PINTO (ZONE)	8/7/2012	0	0	0.00K	0.50K
PALO PINTO (ZONE)	8/9/2012	0	0	1.00K	0.00K
LAMPASAS (ZONE)	8/13/2012	0	0	20.00K	0.00K

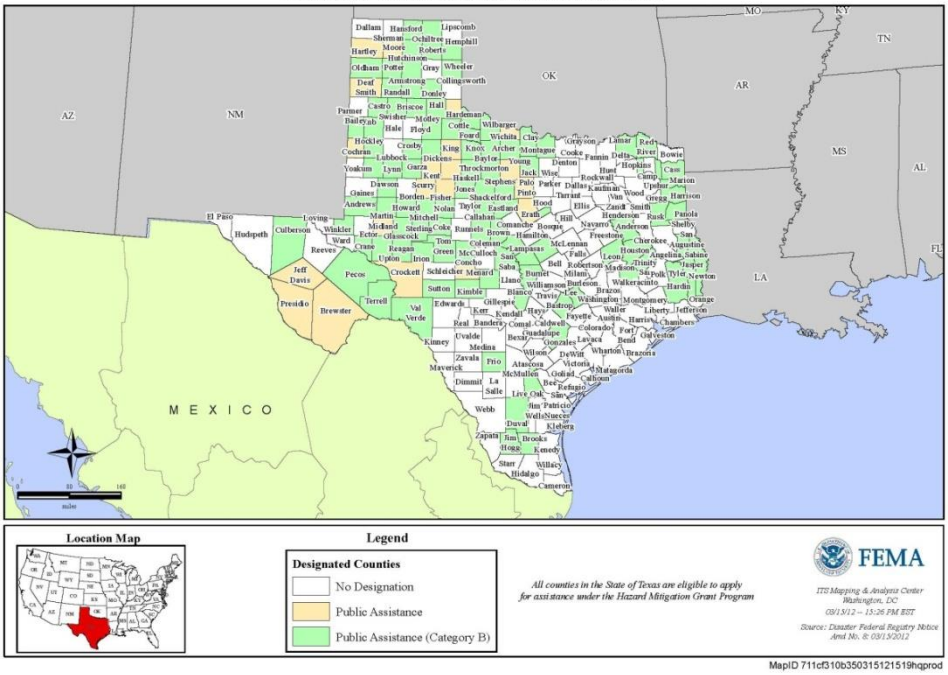
PARKER (ZONE)	8/13/2012	0	0	350.00K	0.00K
LAMPASAS (ZONE)	9/10/2012	0	0	10.00K	0.00K
RANDALL (ZONE)	12/3/2012	0	0	25.00K	0.00K
BELL (ZONE)	12/20/2012	0	0	13.00K	0.00K
MCLENNAN (ZONE)	12/20/2012	0	1	75.00K	0.00K
PARKER (ZONE)	12/22/2012	0	0	0.00K	50.00K
LIVE OAK (ZONE)	12/25/2012	0	0	250.00K	0.00K

The planning period resulted in a particularly destructive wildfire season with two federal disaster declarations:

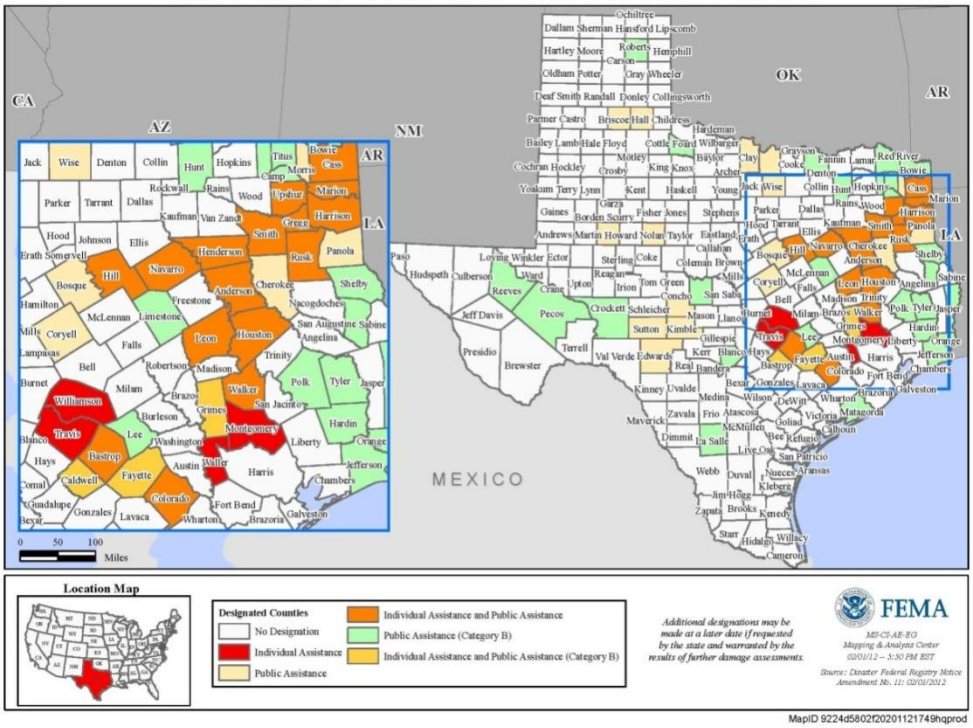
Federal Disaster Declarations for Wildfire Hazard

Since 2010

FEMA-1999-DR, Texas
Disaster Declaration as of 3/15/2012



FEMA-4029-DR, Texas Disaster Declaration as of 02/01/2012



Historically Significant Wildfire Occurrences in Texas		
Date	Affected Area	Remarks
Dec. 27, 2005	Callahan County	$11 million in property damages. The fire started just west of Cross Plains and quickly moved east, fanned by winds gusting near 40 mph.
Dec. 29, 2005	Walnut Bend, Texas	There were at least 10 to 20 buildings destroyed, plus more outbuildings. At least 5,000 acres of land were scorched. One person was killed in the area due to the fires.
Jan. 1, 2006	North Texas	Fires were reported in Montague, Eastland and Palo Pinto counties. Five injuries were reported as well as $10.8 million in property damage.
March 12–18, 2006	Hutchinson County	The wildfire burned a total of 479,500 acres. In all, seven people were killed and 28 structures were lost with total property damages at $49.9 million and crop damages at $45.4 million. A second wildfire burned 427,696 acres. The Texas A&M Forest Service named the two wildfires the East Amarillo Complex. In all, 12 people were killed, total property damages were $49.9 million and crop damages was $45.4 million.
April 11–13, 2006	Hemphill County	A wildfire 10 miles north of Canadian, Hemphill County, burned 18,000 acres and destroyed crops. Two injuries were reported. Total crop damage was estimated at $90 million.
Jan. 19, 2009	Hidalgo County	A wildfire spread across Hidalgo County and consumed four buildings at the Moore Air Force Base. By the time the wildfire had been contained, it had spread to 2,560 acres, and the damage at the air force base was estimated at $10 million.
March 26, 2010	Hale County	The renewed wind-driven fire

		destroyed a home. A total of 528 acres were consumed, and no injuries were reported. Property damage was estimated at $150,000.
May 10, 2010	Bailey County	High winds contributed to spreading wildfire over 16,000 acres. The fire destroyed an abandoned home and several vehicles. A second wildfire destroyed 600 acres. Total losses estimated at $265,000.
Aug. 25, 2010	Jasper County	Two large wildfires consumed 100 acres near Sam Rayburn dam. Five houses, a storage shed, an old boat storage facility, and a front-end loader were destroyed in the fire. Total damages reached $1 million.
Dec. 1-2, 2010	Brooks County	Sparks from a tractor set off high grass that quickly spread over 2,000 acres. Damage estimates totaled $780,000.
April 9, 2011	Possum Kingdom Complex	Over 126,734 acres burned in Palo Pinto county and resulted in over $34,840,000 million in damages.
May 6, 2011	Dickens Complex	In Dickens County, 89,200 acres were destroyed at a cost of $ 45,752,650 million.
May 24, 2011	Sierra Blanca Fire	Over 7,600 acres were destroyed, resulting in damages over $38 million.
Sept. 4, 2011	Bastrop County Complex	Over $224,100,000 million in property and 34, 068 acres were damaged or destroyed. 1,660 homes were lost. The Labor Day weekend fire ranked as the worst in Texas history.
Sept. 4, 2011	Bear Creek Fire	As much as 41,050 acres in Cass County burned. The damage total was at least $ 27 million.
Sept. 5, 2011	Riley Road Fire	In Montgomery County, 19,960 acres were destroyed at a cost of $ 30,928,600 million.
April 21, 2012	Jeff Davis County	Spring Mountain wildfire burned 10,576 acres.
April 24, 2012	Jeff Davis County	Livermore Ranch wildfire consumed 13,541 acres.

Aug. 9-10, 2012	Palo Pinto County	Lightning strikes cause wildfire near Possum Kingdom Lake. Over 2,000 acres burned.

Probability - Wildfire

Due to development within urban communities that have further encroached into wildlands, the probability of wildfire-urban interface incidences has increased.

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.

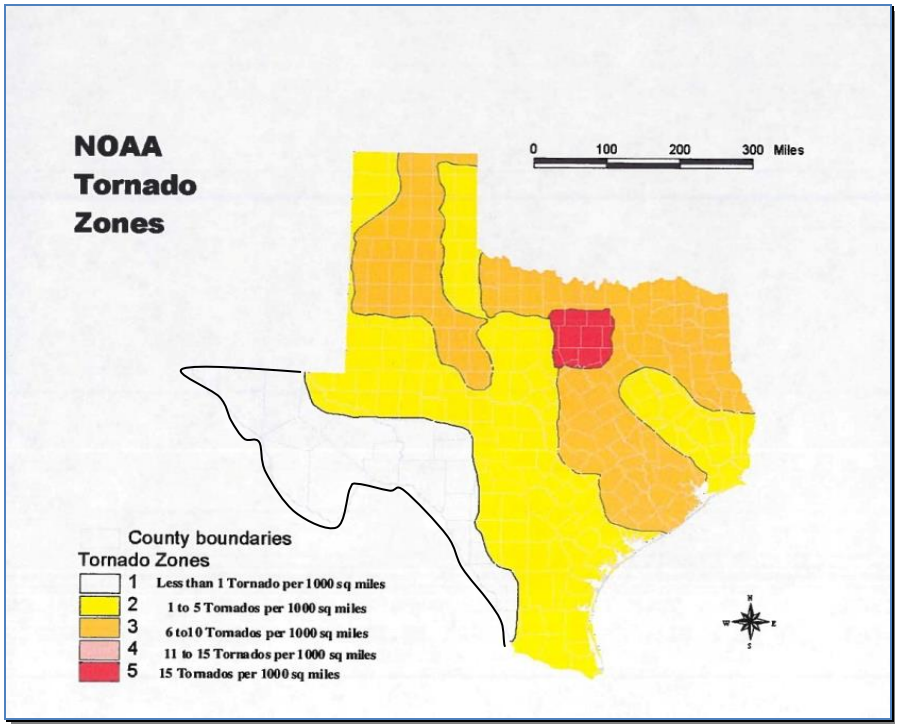
TORNADOES

A tornado is defined as a rapidly rotating vortex or funnel of air extending ground-ward from a cumulonimbus cloud. Most of the time, vortices remain suspended in the atmosphere and are visible as a funnel cloud. However, when the lower tip of a vortex touches the ground, the tornado becomes a force of destruction.

Location - Tornadoes

Tornadoes are not equally distributed across Texas but appear to occur more frequently in what is referred to as "Tornado Alley", a line of activity that stretches from Central Texas, north into Oklahoma and beyond.

Tornadoes occur annually and frequently in the northern two-thirds of the state, caused by frontal systems that enter from the north and west. In the remainder of the state primarily caused as a cascading hazard from tropical storms.



Extent - Tornadoes

The Enhanced Fujita Scale, or EF Scale, is the scale for rating the strength of tornadoes via the damage they cause. Six categories from zero to five represent increasing degrees of damage. The scale takes into account how most structures are designed, and is thought to be an accurate representation of the surface wind speeds in the most violent tornadoes.

Enhanced Fujita (EF) Scale		
Enhanced Fujita Category	**Wind Speed (mph)**	**Potential Damage**
EF0	65-85	**Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	86-110	**Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	**Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.

EF3	136-165	**Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	**Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	>200	**Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.

http://en.wikipedia.org/wiki/Enhanced_Fujita_Scale

Previous Occurrences - Tornadoes

Tornadoes occur annually and occur most frequently in the northern two-thirds of the state. In 2012 and 2013, tornadoes damaged much of North Texas, in the greater Dallas Metropolitan area.

The following table highlights the frequency of sighted tornado occurrences 2011-2012.

RECENT TORNADO OCCURRENCES 2011-2012

http://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=48%2CTEXAS

LOCATION	COUNTY	DATE	MAGNITUDE	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
(ALI)ALICE INTL ARPT	JIM WELLS CO.	1/9/2011	EF0	0	10.00K	0.00K
AGUA DULCE	NUECES CO.	1/9/2011	EF1	0	5.000M	0.00K
KURTH LAKE	RUSK CO.	2/1/2011	EF1	0	60.00K	0.00K
HIGH	LAMAR CO.	3/8/2011	EF0	0	20.00K	0.00K
BAGWELL	RED RIVER CO.	3/8/2011	EF1	0	400.00K	0.00K
ALVARADO	JOHNSON CO.	4/11/2011	EF1	2	100.00K	0.00K
LAKE PAT CLEBURNE	JOHNSON CO.	4/11/2011	EF1	0	150.00K	0.00K
CASH	HUNT CO.	4/11/2011	EF1	0	250.00K	0.00K
FORNEY	KAUFMAN CO.	4/11/2011	EF1	0	60.00K	0.00K
HONEY GROVE	FANNIN CO.	4/14/2011	EF0	0	35.00K	0.00K
(P07)SANDERSON	TERRELL CO.	4/21/2011	EF2	0	100.00K	0.00K

MIXON	CHEROKEE CO.	4/25/2011	EF1	0	0.50K	0.00K
ONALASKA	POLK CO.	4/25/2011	EF0	0	1.00K	0.00K
FOREST	CHEROKEE CO.	4/25/2011	EF1	0	100.00K	0.00K
CLAWSON	ANGELINA CO.	4/25/2011	EF0	0	2.00K	0.00K
AVALON	ELLIS CO.	4/25/2011	EF0	0	25.00K	0.00K
CENTRALIA	TRINITY CO.	4/25/2011	EF1	0	30.00K	0.00K
POLLOK	ANGELINA CO.	4/25/2011	EF1	0	300.00K	0.00K
CROCKETT	HOUSTON CO.	4/25/2011	EF1	0	50.00K	0.00K
STEWART	RUSK CO.	4/26/2011	EF1	0	10.00K	0.00K
GROESBECK	LIMESTONE CO.	4/26/2011	EF1	0	150.00K	0.00K
BEN WHEELER	VAN ZANDT CO.	4/26/2011	EF1	1	200.00K	0.00K
MABANK	KAUFMAN CO.	4/26/2011	EF0	0	30.00K	0.00K
GILL	HARRISON CO.	4/26/2011	EF2	0	300.00K	0.00K
TOLOSA	KAUFMAN CO.	4/26/2011	EF0	0	5.00K	0.00K
HUGHES SPGS	CASS CO.	4/30/2011	EF0	0	5.00K	0.00K
BURNS	COOKE CO.	5/11/2011	EF0	0	18.00K	0.00K
(FWH)CARSWELL AFB FT	TARRANT CO.	5/11/2011	EF0	0	30.00K	0.00K
ANDICE	WILLIAMSON CO.	5/21/2011	EF0	0	100.00K	0.00K
EAGLE MTN LAKE	TARRANT CO.	5/24/2011	EF0	0	1.00K	0.00K
LA JUNTA	PARKER CO.	5/24/2011	EF0	0	10.00K	0.00K
SOWERS	DALLAS CO.	5/24/2011	EF1	0	150.00K	0.00K
BRYAN	WISE CO.	5/24/2011	EF0	0	2.00K	0.00K
ARGYLE	DENTON CO.	5/24/2011	EF2	0	750.00K	0.00K
KENEFICK	LIBERTY CO.	5/25/2011	EF0	0	5.00K	0.00K
LIPSCOMB CO.	LIPSCOMB CO.	6/11/2011	EF0	0	15.00K	0.00K
LIPSCOMB CO.	LIPSCOMB CO.	6/11/2011	EF0	0	5.00K	0.00K
HIDALGO CO.	HIDALGO CO.	6/30/2011	EF1	1	500.00K	0.00K
HARTBURG	NEWTON CO.	8/14/2011	EF0	0	1.00K	0.00K
MAGNOLIA BEACH	CALHOUN CO.	8/25/2011	EF0	0	30.00K	0.00K

ALFRED	JIM WELLS CO.	9/17/2011	EF1	0	20.00K	0.00K
LACKLAND AFB	BEXAR CO.	10/9/2011	EF1	0	1.000M	0.00K
CLEVELAND MUNI ARPT	LIBERTY CO.	10/12/2011	EF0	1	25.00K	0.00K
CALL	NEWTON CO.	11/8/2011	EF1	0	10.00K	0.00K
HUFFMAN	HARRIS CO.	11/8/2011	EF1	0	100.00K	0.00K
TEXAS CITY GULF ARPT	GALVESTON CO.	11/8/2011	EF0	0	50.00K	0.00K
BONNEY	BRAZORIA CO.	1/9/2012	EF0	0	10.00K	0.00K
OTEY	BRAZORIA CO.	1/9/2012	EF0	0	15.00K	0.00K
CHENANGO	BRAZORIA CO.	1/9/2012	EF0	0	20.00K	0.00K
FULSHEAR	FORT BEND CO.	1/9/2012	EF0	0	5.00K	0.00K
HITCHCOCK VOLK ARPT	GALVESTON CO.	1/9/2012	EF0	0	50.00K	0.00K
CLODINE	FORT BEND CO.	1/9/2012	EF1	0	500.00K	0.00K
VILLAGE MILLS	HARDIN CO.	1/25/2012	EF0	0	10.00K	0.00K
COTTONWOOD	MADISON CO.	1/25/2012	EF0	0	10.00K	5.00K
MT ENTERPRISE	RUSK CO.	1/25/2012	EF1	1	100.00K	0.00K
PEARLAND	BRAZORIA CO.	1/25/2012	EF0	0	15.00K	0.00K
FRED	TYLER CO.	1/25/2012	EF0	0	20.00K	0.00K
DEANVILLE	BURLESON CO.	1/25/2012	EF1	0	200.00K	0.00K
BRENHAM MUNI ARPT	WASHINGTON CO.	1/25/2012	EF0	0	30.00K	0.00K
HUNTSVILLE	WALKER CO.	1/25/2012	EF0	0	30.00K	30.00K
STRING PRAIRIE	BASTROP CO.	1/25/2012	EF0	0	5.00K	0.00K
MAGNOLIA SPGS	JASPER CO.	1/25/2012	EF0	0	5.00K	0.00K
HUNTSVILLE ARPT	WALKER CO.	1/25/2012	EF0	0	50.00K	0.00K
KIRBYVILLE	JASPER CO.	1/25/2012	EF1	0	50.00K	0.00K
SNOOK	BURLESON CO.	2/3/2012	EF1	0	150.00K	0.00K
LAKETON	GRAY CO.	2/3/2012	EF1	0	250.00K	0.00K
SNOOK	BURLESON CO.	2/3/2012	EF2	0	500.00K	0.00K
BLAND LAKE	SAN AUGUSTINE CO.	3/11/2012	EF0	0	10.00K	0.00K
GARDENDALE	ECTOR CO.	3/18/2012	EF2	3	1.000M	0.00K

ATASCOSA	BEXAR CO.	3/19/2012	EF2	4	0.00K	0.00K
NEWTON CO.	NEWTON CO.	4/2/2012	EF1	0	200.00K	0.00K
DENTON CO.	DENTON CO.	4/3/2012	EF0	0	0.00K	10.00K
HUNT CO.	HUNT CO.	4/3/2012	EF0	0	0.00K	10.00K
HOPKINS CO.	HOPKINS CO.	4/3/2012	EF0	0	0.00K	10.00K
JOHNSON CO.	JOHNSON CO.	4/3/2012	EF0	0	0.00K	2.00K
HUNT CO.	HUNT CO.	4/3/2012	EF0	0	0.00K	20.00K
KAUFMAN CO.	KAUFMAN CO.	4/3/2012	EF3	7	100.000M	0.00K
DALLAS CO.	DALLAS CO.	4/3/2012	EF0	0	100.00K	0.00K
ROCKWALL CO.	ROCKWALL CO.	4/3/2012	EF2	3	15.000M	0.00K
DALLAS CO.	DALLAS CO.	4/3/2012	EF0	0	150.00K	0.00K
TARRANT CO.	TARRANT CO.	4/3/2012	EF2	7	200.000M	0.00K
ELLIS CO.	ELLIS CO.	4/3/2012	EF0	0	3.00K	3.00K
DALLAS CO.	DALLAS CO.	4/3/2012	EF0	2	300.00K	0.00K
DALLAS CO.	DALLAS CO.	4/3/2012	EF0	0	4.00K	0.00K
DALLAS CO.	DALLAS CO.	4/3/2012	EF2	10	400.000M	3.00K
HUNT CO.	HUNT CO.	4/3/2012	EF2	0	500.00K	0.00K
TARRANT CO.	TARRANT CO.	4/3/2012	EF0	0	55.00K	0.00K
HOPKINS CO.	HOPKINS CO.	4/3/2012	EF0	0	6.00K	0.00K
JOHNSON CO.	JOHNSON CO.	4/3/2012	EF1	0	600.00K	0.00K
SAN PATRICIO CO.	SAN PATRICIO CO.	4/16/2012	EF0	0	15.00K	0.00K
SAN PATRICIO CO.	SAN PATRICIO CO.	4/16/2012	EF1	0	2.000M	0.00K
SAN PATRICIO CO.	SAN PATRICIO CO.	4/16/2012	EF0	0	50.00K	0.00K
(CRP)CORPUS CHRISTI	NUECES CO.	5/10/2012	EF0	0	100.00K	0.00K
HOLIDAY BEACH	ARANSAS CO.	5/10/2012	EF0	0	2.00K	0.00K
BONNIE VIEW	REFUGIO CO.	5/10/2012	EF0	0	30.00K	0.00K
WHITSETT	LIVE OAK CO.	5/10/2012	EF0	0	50.00K	0.00K
WOODWARD	LA SALLE CO.	5/10/2012	EF0	2	50.00K	0.00K
SODVILLE	SAN PATRICIO CO.	5/10/2012	EF1	0	500.00K	0.00K

WEIMAR	COLORADO CO.	5/10/2012	EF2	8	500.00K	0.00K
SAN BENITO MUNI ARPT	CAMERON CO.	5/11/2012	EF0	0	15.00K	0.00K
FRANKEL CITY	ANDREWS CO.	6/12/2012	EF1	0	6.00K	0.00K
RANDOLPH	FANNIN CO.	6/13/2012	EF0	0	50.00K	5.00K
PORT LAVACA	CALHOUN CO.	9/29/2012	EF0	0	100.00K	0.00K
SWEET HOME	LAVACA CO.	9/29/2012	EF0	0	5.00K	0.00K
LEXINGTON	LEE CO.	10/13/2012	EF0	0	5.00K	0.00K
LELIA LAKE	DONLEY CO.	12/14/2012	EF0	0	0.00K	10.00K
LELIA LAKE	DONLEY CO.	12/14/2012	EF0	0	0.00K	20.00K
FODICE	HOUSTON CO.	12/25/2012	EF3	0	700.00K	0.00K

The following table identifies the unlikely but deadly and destructive F5 (older extent scale before EF-5) occurrences in Texas.

Historically Significant Tornado Occurrences in Texas							
Location	Date	Time	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
McLennan	5/11/53	1610	F5	114	597	25.0 M	0
Wichita	4/3/64	1435	F5	7	111	25.0 M	0
Lubbock	5/11/70	2035	F5	26	500	250.0 M	0
McLennan	5/6/73	1925	F5	0	0	0	0
Brown	4/19/76	1730	F5	0	11	2.5 M	0
Jarrel	5/27/97	1440	F5	27	12	40.0 M	100 K

Probability - Tornadoes

Though Texas averages 123 tornadoes annually, most are from EF0 to EF2. The catastrophic tornado event occurs at a much slighter chance. An average of damaging tornadoes across the state provides the probability. The frequency of an event is:

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.

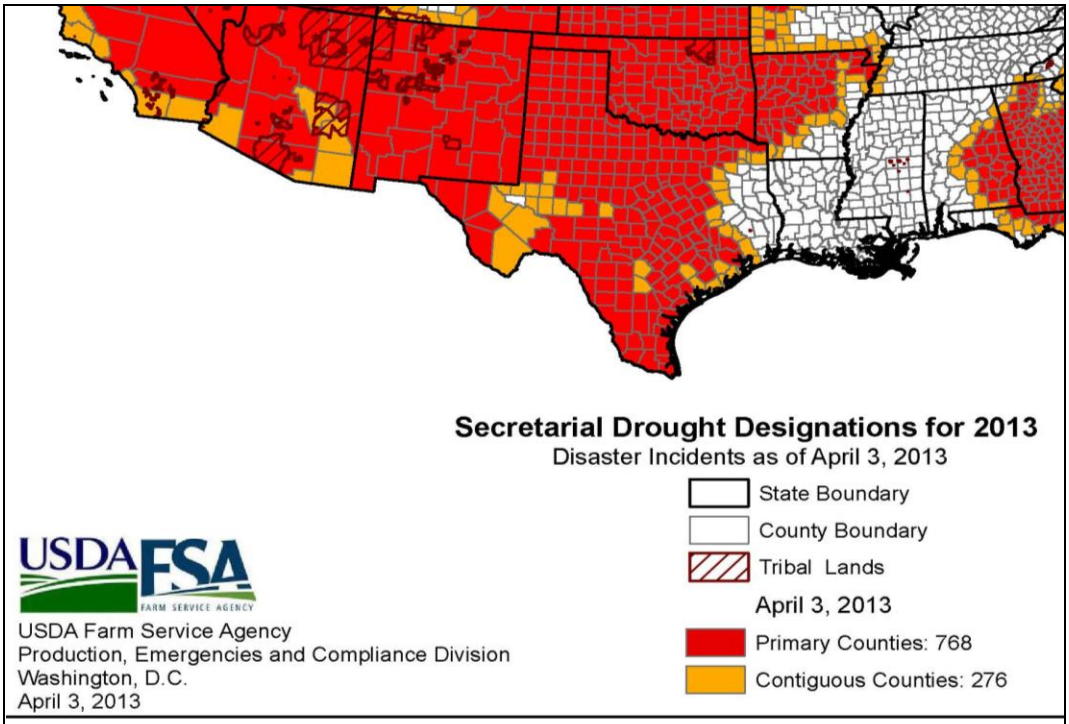
DROUGHT

Drought is defined as the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. The geographic location of two-thirds of Texas counties are located either in an arid or semi-arid climate (roughly those west of a North-South line formed by Interstate Highway 3), and these counties are almost always in varying stages of drought. These counties normally are watered by infrequent large tropical systems that move westward out of the Gulf of Mexico in late summer and early fall or by strong springtime Pacific systems that move easterly over these counties.

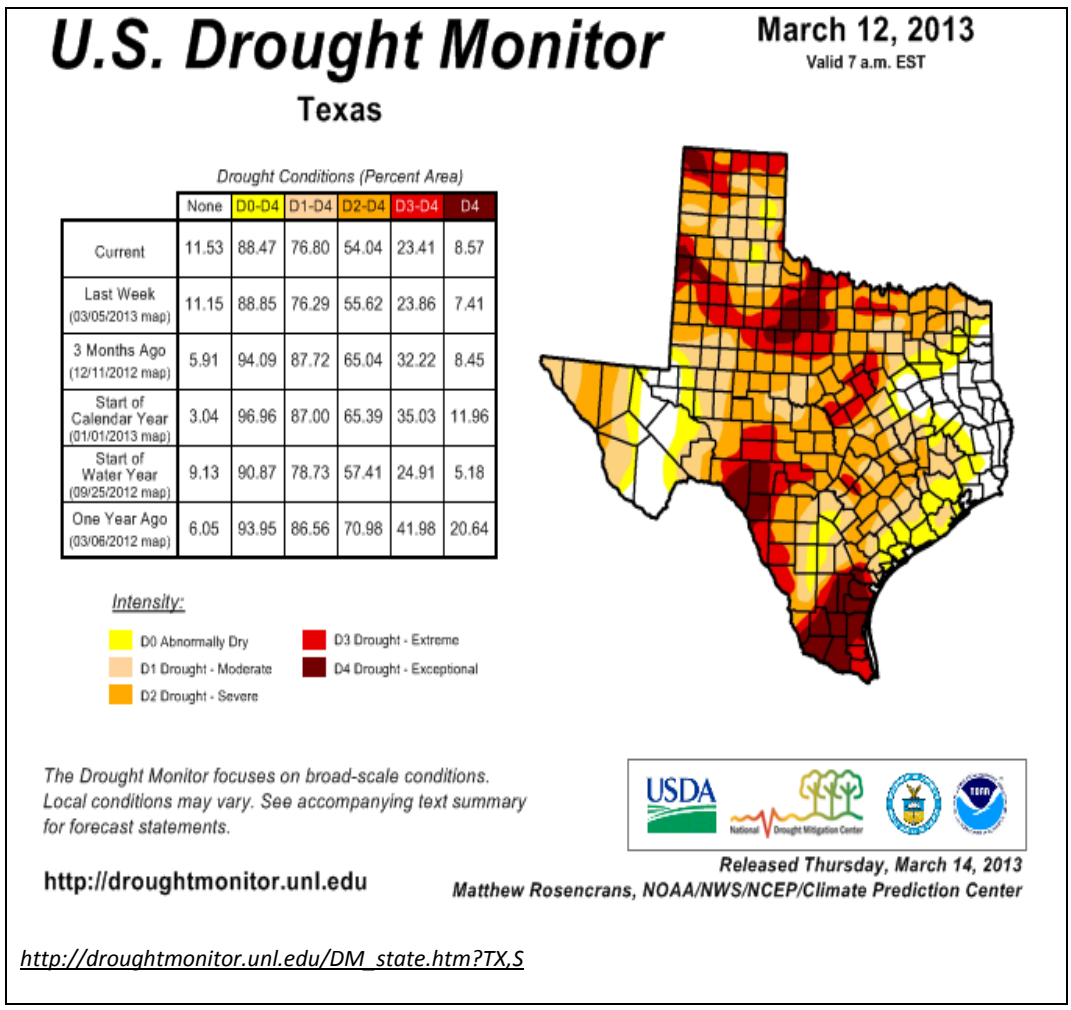
Location - Drought

The 2011-2012 drought extended across the entire state.

All of Texas is vulnerable to droughts. However, the areas of Texas most vulnerable to droughts are in West Texas, around the cities of Amarillo, Lubbock, Midland, Odessa, Fort Stockton, San Angelo; and in South Texas, around Laredo, Harlingen, and McAllen.



http://www.usda.gov/documents/usda-drought-fast-track-designations-040313.pdf



http://droughtmonitor.unl.edu/DM_state.htm?TX,S

Extent - Drought

In 1965, meteorologist Wayne Palmer developed an index to "measure the departure of the moisture supply." Palmer based his index on the supply-and-demand concept of the water balance equation, taking into account more than only the precipitation deficit at specific locations. The objective of the Palmer Drought Severity Index (PDSI), as this index is now called, was to provide a measurement of moisture conditions that were "standardized" so that comparisons using the index could be made between locations and between months. Droughts develop over an extended period of time and thus, it is difficult to identify the start of prolonged drought conditions.

The PDSI is based on precipitation and temperature. The PDSI can therefore be applied to any site for which sufficient precipitation and temperature data is available.

The PDSI varies roughly between -4.0 and +4.0. Weekly PDSI values are calculated for the Climate Divisions during every growing season and are on the Internet from the Climate Prediction Center.

The PDSI can be combined with other indices to create a more fully picture of what the severity of drought is, based on other related factors.

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

Ranges of Drought							
Category	Description	Possible Impacts	Palmer Drought Index	CPC Soil Moisture Model %	USGS Weekly Stream flow %	Standardized Precipitation Index (SPI)	Objective Short and Long-term Drought Indicator Blends %
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	21-30	21-30	-0.5 to -0.7	21-30
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	11-20	11-20	-0.8 to -1.2	11-20
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9	6-10	6-10	-1.3 to -1.5	6-10
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9	3-5	3-5	-1.6 to -1.9	3-5
D4	Exceptional Drought	Exceptional and widespread Crop/pasture losses; Shortages of water in reservoirs, streams, and Wells creating water Emergencies	-5.0 or less	0-2	0-2	-2.0 or less	0-2

Previous Occurrences - Drought

Drought is a recurring event in Texas. Since it is frequently widespread and can cover several regional climatic areas, the state may incur inconsistent levels of drought intensity from one region to another on a statewide basis.

Historically Significant Drought Occurrences in Texas		
Date	Affected Area	Remarks
1917-1918	Central and West Texas	1917 considered driest year on record
1932-1935	Texas Panhandle	The Dust Bowl stretches from Panhandle to Great Plains. In 1935, Amarillo engulfed by dust storms from January to March with a complete blackout of 11 hours
1938-1940	Texas Panhandle	Period considered one of the driest on record in Amarillo. Longest period of heat in Panhandle and U.S. Plains resulted in migration of families from the region
1947-1948	High Plains, South Texas, Lower Valley	On August 30, 1947, Throckmorton recorded a high of 119 degrees. Dry weather continued to dominate the state well into December of 1948
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
1960-1967	Lubbock, Texas	Wind reaches up to 75 mph with dust rising to 31, 000 feet. Reese AFB records up to 3 inches of sand with visibility reduced to 100 yards
1970-1971	Low Rolling Plains, Edwards Plateau, North and South Texas	January 1971 is the driest month on record for Austin, Dallas and Houston
1988-1990	Statewide	Drought brought on by massive heat wave was extremely brutal in the Pecos River Valley
1995-1996	Statewide	Agricultural losses of more than $5 billion statewide exceed previous record
1999-2002	Dallas – Fort Worth area	16 reported deaths during 26

		consecutive 100 degree days. In 2000, the statewide death toll rises to 34 with a 10 day average 103.3 degrees. The Rio Grande ceases to flow into the Gulf with extensive crop losses recorded in South Plains
2005	South, East, Central and Northeast Texas	The state records only 4.93 inches average rainfall as the third driest period in 110 years
2011 – Present	Majority of the State	Most of the state is still in extreme drought. The current drought may end up being the worst ever recorded.
(Sources: Texas Historical Association, Texas Water Foundation, Texas Department of Agriculture, John-Gammon, Texas' state climatologist)		

Probability - Drought

After the summer floods of 2007, most of Texas was declared drought free for the first time since 1996. In a briefing packet to the Legislature in October 2011, the State Climatologist stated, "it is known that Texas is in a period of enhanced susceptibility due to global ocean temperature patterns and has been since at least 2000. The good news is that these global patterns tend to reverse themselves over time, probably leading to an extended period of wetter weather for Texas, though this may not happen for another three to fifteen years."

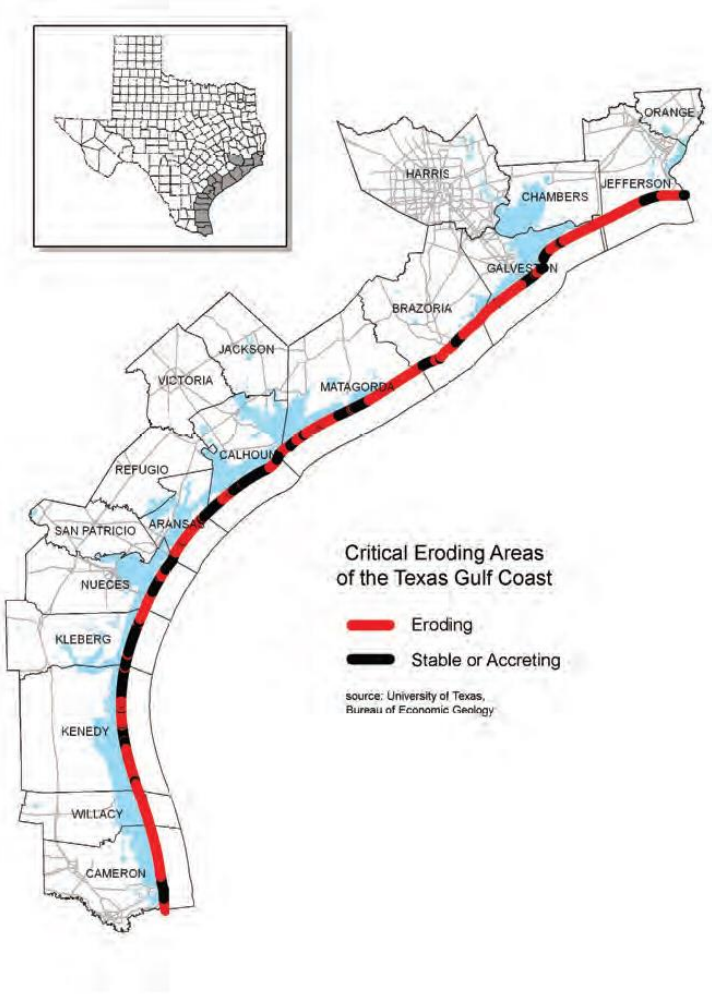
Frequency Of Occurrence:
- ☐ Highly likely: Event probable in next year.
- ☒ Likely: Event probable in next 3 years.
- ☐ Occasional: Event possible in next 5 years.
- ☐ Unlikely: Event possible in next 10 years.

COASTAL EROSION

Coastal erosion is a hydrologic hazard defined as the wearing away of land and loss of beach, shoreline, or dune material because of natural coastal processes or manmade influences. Erosion along the Texas Gulf Coast is measured as an historical shoreline change rate, averaged over a 90-year period.

Texas has one of the longest coastlines in America coupled with some of the highest rates of coastal erosion in the nation.

www.glo.texas.gov-what-we-do-caring-for-the-coast-_publications-cepra-report-2011.pdf.url



Several processes contribute to chronic (long-term) or episodic (storm-induced) shoreline erosion of the Texas Gulf Coast. These processes include climate, tides, relative sea-level rise, subsidence, tropical storms, and the amount and rate of sediment supply. Coastal erosion affects both Gulf and bay shorelines, resulting in the loss of agricultural, industrial, residential land, critical infrastructure, and wetlands. Erosion is attributable to relative sea level rise and to the fact that sediment removal by wave energy exceeds that supplied to the beach by currents. Climatic changes (from wetter to drier) have decreased the volume of sediments carried to the Texas coast by rivers.

Location - Coastal Erosion

The following maps shows location of coastal erosion in eroding (negative) values.

Coastal County Population at Risk, Shoreline Distance, and Gulf Erosion Data

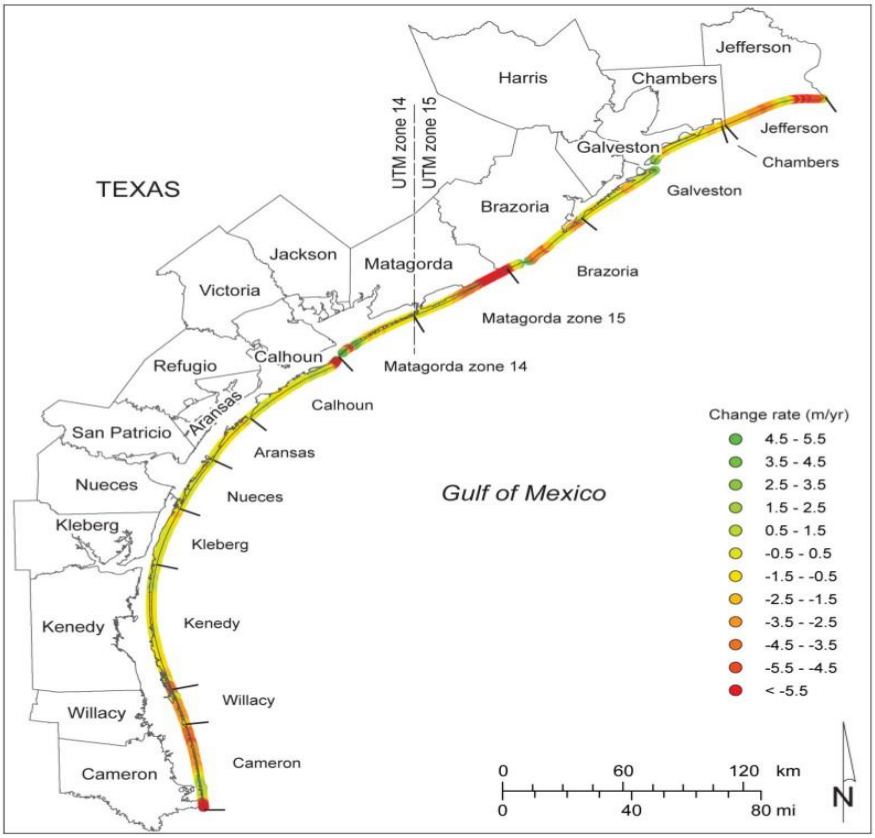


Figure 16. Net rates of long-term change for the Texas Gulf shoreline between Sabine Pass and the Rio Grande calculated from shoreline positions through 2007 (table 3). Change rates at 11,731 individual measurement sites are available on the accompanying data CD in GIS-compatible format.

http://en.es-static.us/upl/2012/08/Net-rates-of-long-term-change-for-the-Texas-Gulf-shoreline-between-Sabine-Pass.jpg

Extent - Coastal Erosion

Approximately 64 percent of the Gulf shoreline is considered critical erosion area with 235 acres of Texas Gulf shoreline lost to erosion annually. That is equivalent to 178 football fields lost each year.

Previous Occurrences - Coastal Erosion

Some coastal areas are in need of beach nourishment and dune restoration. A healthy beach/dune system can minimize damage to homes and critical infrastructure by absorbing energy from storm surge and waves, and providing sediment to the beach. Wide beaches and high continuous dunes are the best defense against coastal storms. The significance of sand dunes to coastal protection is highlighted in studies by the U.S. Geological Survey.

The priority areas for restoring the beach/dune system are those dune complexes severely damaged or destroyed by Hurricane Ike in September 2008 along the Gulf shorelines of Galveston Island, Bolivar Peninsula, and Brazoria County. There were locations along the Gulf shoreline at Bolivar Peninsula and Galveston Island where Geotextile tube projects were destroyed during Hurricane Ike. Some of these Geotextile tubes are being replaced with an alternative project consisting of a natural dune.

In 2008, 100,000 cubic yards of beach-quality sand was placed on 4,600 feet of shoreline within Cameron County Isla Blanca Park and the City of South Padre Island due to erosion associated with Hurricane Dolly as well as long-term chronic erosion. Subsequently, in 2010, 2011 and 2012, beach nourishment through the beneficial use of dredged material has placed approximately 795,000 cubic yards of sand on Cameron County and the City of South Padre Island beaches. These restoration projects have reduced the vulnerability of homes and critical infrastructure to the impacts of storm surge.

The table below depicts recent occurrences of coastal erosion:

Locations of critical erosion using 2010 data from the Texas General Land Office					
County	Population*	Gulf Shoreline	Bay Shoreline	Critical Erosion (Gulf)	Erosion Rates (Gulf)
Orange	84,966	0	0	0	0
Jefferson	252,051	168,960 ft. (32.0 mi.)	327,360 ft. (62 mi.)	142,560 ft. (27 mi.)	-2 to -50 ft/yr
Chambers	26,031	5,280 ft. (1.0 mi.)	865,920 ft. (164 mi.)	5,280 ft. (1.0 mi)	-6 to -8 ft/yr
Harris	3,400,578	0	459,360 ft. (87 mi.)	0	0
Galveston	250,158	290,400 ft. (55.0 mi.)	1,536,480 ft. (291 mi.)	253.440 ft. (48 mi.)	-2 to -11 ft/yr
Brazoria	241,767	153,120 ft. (29.0 mi.)	924,000 ft. (175 mi.)	105,600 ft. (20 mi.)	-2 to -17 ft/yr

Matagorda	37,957	321,024 ft. (60.8 mi.)	2,170,080 ft. (411 mi.)	179,520 ft. (34 mi.)	-2 to -30 ft/yr
Jackson	14,391	0	147,840 ft. (28 mi.)	0	0
Victoria	84,088	0	15,840 ft. (3 mi.)	0	0
Calhoun	20,647	190,080 ft. (36.0 mi.)	2,381,280 ft. (451 mi.)	58,080 ft. (11 mi.)	-2 to -34 ft/yr
Refugio	7,828	0	285,120 ft. (54 mi.)	0	0
Aransas	22,497	100,320 ft. (19.0 mi.)	1,879,680 ft. (356 mi.)	84,480 ft. (16 mi.)	-2 to -7 ft/yr
San Patricio	67,138	0	390,720 ft. (74 mi.)	0	0
Nueces	313,645	108,768 ft. (20.6 mi.)	2,148,960 ft. (407 mi.)	31,680 ft. (6 mi.)	-2 to -6 ft/yr
Kleberg	31,549	115,104 ft. (21.8 mi.)	1,172,160 ft. (222 mi.)	10,560 ft. (2 mi.)	-2 to -6 ft/yr
Kenedy	414	246,576 ft. (46.7 mi.)	1,209,120 ft. (229 mi.)	168,960 ft. (32 mi.)	-2 to -15 ft/yr
Willacy	20,082	71,808 ft. (13.6 mi.)	601,920 ft. (114 mi.)	63,360 ft. (12 mi.)	-2 to -15 ft/yr
Cameron	335,227	166,320 ft. (31.5 mi.)	1,145,760 ft. (217 mi.)	147,840 ft. (28 mi.)	-2 to -25 ft/yr
TOTALS	5,211,014	1,937,760 ft. (367.0 mi.)	17,661,600 ft. (3,345 mi.)	1,251,360 ft. (237 mi.)	-2 to -50 ft/yr

** Source: 2000 Census*

The following table references coast erosion events over time:

Coastal Erosion Projects for Significant Occurrences in Texas		
Project	Affected Area	Remarks
Galveston Seawall Emergency Beach Nourishment	Galveston County	Beach Nourishment: This project included the design and construction of a beach nourishment project placing beach-quality sand on the gulf beach in front of the seawall from 10th to 61st street in the City of Galveston, due to erosion caused by Hurricane Ike.
Jamaica Beach Dune Restoration Repair	Galveston County	Dune Restoration: FEMA funds used to restore engineered dune complex back to original project specifications pre-Hurricane Ike.
Surfside Beach	Brazoria County	Shoreline Protection: Project led to final

Revetment Project		design and construction of approximately 3,500 feet of rock revetment to withstand a two-year storm. It actually withstood the 30 year storm impact of Hurricane Ike and protected Beach Drive, infrastructure, and houses on landward side. Completed in 2010.
Surfside Beach Emergency Beach Nourishment	Brazoria County	Beach Nourishment: Funds utilized to renourish the pedestrian beach adjacent to Beach Drive, which suffered historical erosion and loss of elevation due to ongoing erosion and various tropical storm events.
Town of Quintana Beach/Dune Restoration Repair	Brazoria County	Beach Nourishment/Dune Restoration: FEMA and local funds will repair damages caused by Ike and Rita to beach and dune system in Quintana.
Indian Point Shoreline Stabilization & Habitat Protection	Nueces and San Patricio County	Shoreline Protection: Project will construct offshore breakwaters to provide shoreline protection for the southern portion of Indian Point.
Nueces River Delta Stabilization & Habitat Protection	Nueces and San Patricio County	Shoreline Protection: Project will provide an alternatives analysis to construct shoreline protection structures along the eastern portion of the Nueces River Delta.
CR 257 Dune Restoration	Brazoria County	Dune Restoration: Hurricane Ike caused major damage to the beach and dune system on Follett's Island. The beach elevation on most of the 14-mile length eroded by 3 to 4 vertical feet on average. Some of this elevation may recover, but most is likely permanent, especially in the dune system. Areas along CR257 eroded at or below the elevation of CR257 while other areas eroded to mean sea level. Approximately 3.25 miles of CR257 was partially breached and needed repair and an additional 2.3 miles of CR257 was completely breached and impassible. Project to permit and restore

		approximately five miles of a dune system along the seaward edge of a nine-mile stretch of CR 257 to replace dunes decimated by Hurricane Ike.
Galveston Island	Galveston County	Beach Nourishment, Dune Restoration: Episodic erosion from storm surge and wave action following Hurricane Ike resulted in the natural dune system being severely damaged or destroyed. The lack of a healthy beach and dune system leaves property and public infrastructure vulnerable to future storms.
Bolivar Peninsula	Galveston County	Beach Nourishment/Dune Restoration: Hurricane Ike caused an estimated 130 to 300 feet of Gulf shoreline retreat along Bolivar Peninsula, including over three feet of vertical erosion, while destroying over 3,500 homes. The result of this elevation loss increased Bolivar Peninsula's vulnerability to inundation even with a small storm event, threatening State Highway 87.
McFaddin National Wildlife Refuge Beach Ridge Restoration	Chambers and Jefferson County	Shoreline Protection: Project will provide nourishment of a beach ridge and adjacent beach along the Gulf of Mexico shoreline in the McFaddin National Wildlife Refuge.
Green's Lake Shore Protection and Marsh Restoration Phase I	Galveston County	Shoreline Protection: Alternatives analysis phase of a shoreline protection project for the design and permitting of 9,200 linear feet of shoreline protection along the Gulf Intracoastal Waterway near West Galveston Bay.
Sargent Beach Nourishment Construction	Matagorda	Beach Nourishment: A result of the continuing long-term erosion of the shoreline, along with some localized effects from the upland granite revetment on the nearshore profile and periodic storms, the sandy soils at Sargent Beach have eroded the nearshore, leaving an exposed clay substrate seaward of the granite revetment. Hurricane Ike further exposed the clay substrate exposing the

		revetment to the Gulf in several locations. Exposed to direct wave impacts, the integrity of the granite revetment may be compromised, placing the Gulf Intracoastal Waterway West (GIWW) at risk. Loss of the GIWW to the open Gulf of Mexico would result in a severe economic impact to the State of Texas. Beach nourishment project along approximately 2,500 feet of highly eroding beach.
Beach Monitoring and Maintenance Plan Monitoring Surveys	Coast Wide	Study: Project will provide surveys of engineered beaches as required by the Beach Monitoring and Maintenance Plan.
BEG Erosion Rate Update	Coast Wide	Study: Project to update long-term shoreline change rates incorporating 2012 data.
Shoreline Change-Hurricane Ike Shoreline Assessment-LIDAR Study	Coast Wide	Study: The University of Texas Bureau of Economic Geology will build on work conducted in previous Coastal Erosion Planning and Response Act (CEPRA) cycles to determine shoreline change rates and develop digital elevation modules using aerial photography and light detection and ranging (LIDAR) surveys to assess Hurricane Ike-induced shoreline change. The CEPRA statute mandates this work for reporting to the legislature.
Nueces Bay Portland Causeway Marsh Restoration	Nueces and San Patricio County	Marsh Restoration: The project will construct and reinforce a breakwater to prevent further erosion of restored marsh on the northern portion of Indian Point Peninsula.
Town of South Padre Island Beach Nourishment with Beneficial Use of Dredged	Cameron County	Beach Nourishment: Cameron County's Gulf shorelines are retreating from two to 25 feet per year, with the highest rates of erosion occurring at the mouth of the Rio Grande River and just south of the Willacy and Cameron County border. This project, under a cooperative agreement with the U.S. Army Corps of Engineers

		beneficially used material dredged from the Brazos Santiago Pass to nourish the Gulf beach in front of the Town of South Padre island. The project also involved the placement of sand truck-hauled from park Road 100 to the Gulf beach north of the beneficial-use placement area.
Restore and Protect Coastal Wetlands and Marshes	Coast Wide	Study: Wetlands enhance water quality and serve as buffers for reducing both the severity of storm surges, floods and shoreline erosion. Coastal marshes are complexes of multiple species of marine-adapted vegetation within wetlands subject to frequent and continuous flooding. Floods are a major hazard in many coastal regions. Tropical cyclones often generate high waves eroding away sand dunes, wetlands, and marshes, which protect inland areas. Committee will identify various issues of concern along four regions of the Texas coast.
U.S. Army Corps of Engineers Erosion Response Feasibility Study	Galveston County	Study: The US Army Corps of Engineers conducted scientific and engineering studies designed to understand the erosion processes affecting the upper Texas Gulf Coast from Sabine pass to San Luis Pass and developed applicable erosion response project alternatives.
South Padre Island CEMS Beach Stabilization Demonstration	Cameron County	Study funded to test stabilization of gulf facing shoreline adjacent to a one-mile portion of the pedestrian beach from the City of South Padre Island to Andy Bowie County Park. Phase 2 will construct low profile submerged erosion-textile groins perpendicular to the beach to slow erosion. Study completed in 2012.

Probability - Coastal Erosion

As noted by the Disaster News Network, "Texas has some of the highest coastal erosion rates in the country. Research shows that 64 percent of the Texas Gulf Coast is eroding at an average rate of about 6 feet per year with some locations losing more

than 30 feet per year. As a whole the Texas coast is eroding at an average rate of 2.3 feet per 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.

DAM AND LEVEE FAILURE

A dam failure is defined as a systematic failure of the dam structure resulting in the uncontrolled release of water, often resulting in floods that could exceed the 100-year flood plain boundaries. A dam failure could cause mass fatalities, mass structural damage and/or a cascading potential if a populated area is located below the dam structure.

There are currently 1,031 dams in Texas, including Federal dams, which are classified as high hazard, meaning if failure occurs, it is likely there will be loss of life. This classification does not necessarily mean that these dams are in need of repair -- these dams could be in excellent condition or they could be in poor condition. The term "high-hazard" reflects the dam's potential for doing damage downstream should it fail, which is termed "dam inundation". In addition, there are 737 dams which are classified as significant hazard, meaning that there could possibly be loss of life if the dam should fail.

There is an increasing number of these high-hazard structures -- not because more high-hazard dams are being built, but because more development is occurring downstream. Owners of dams that were built as low hazard dams are finding that the hazard classification has changed due to the increase in population downstream of the dams.

Hazard Classification:

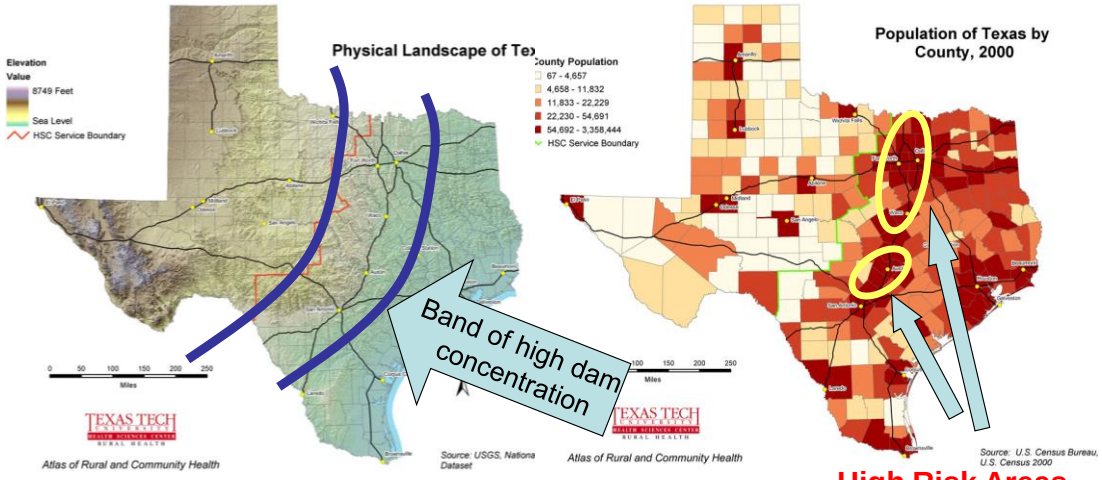
Category	Loss of Life	Economic Loss
Low	None Expected	Minimal
Significant	Possible, but not expected	Appreciable
High	Expected	Excessive

Levees have been constructed in Texas for over 100 years to protect farm and ranch land and populated areas from flood flows. There is no state levee safety program. An entity under the National Flood Insurance Program requirements is required to approve new levee construction, or modifications to existing levees; However, there is no state inspection program and limited owner maintenance. In addition, there is no database identifying and locating the levee systems in Texas. Therefore, populated areas behind levees could be at risk during major flood events

Location – Dam and Levee Failure

In terms of loss of life and property to residents located close to dams, the area downstream at a lower elevation is most affected. This is referred to in mitigation planning as the inundation or impacted area. It is assumed that dam breaks happen at the time of maximum capacity and that the location of the released water would inundate a downstream area proportional to the maximum capacity of the dam.

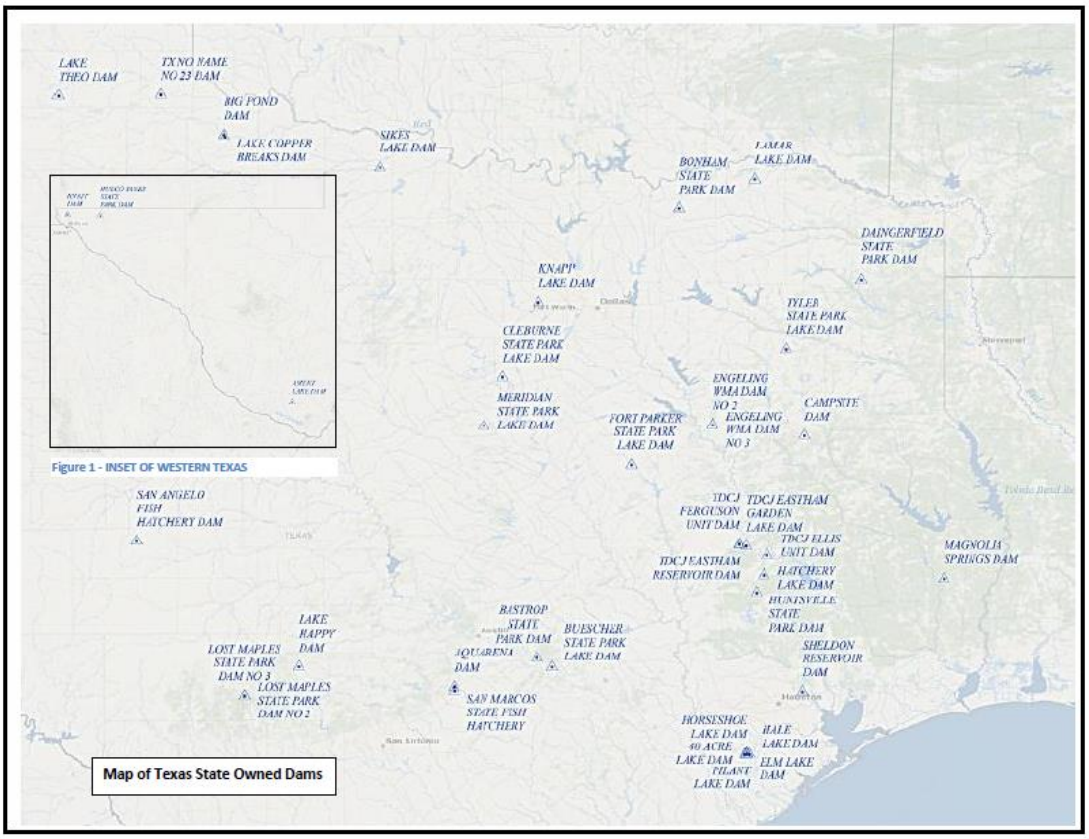
Inundation maps require resources similar to floodplain mapping and are for the most cost prohibited and not produced by private dam owners.



The best location for major dams is the lowest portion of the watershed, combined with a narrow channel which reduces dam construction costs. In Texas, this combination of factors is best met where the drainage off the Llano uplift meets the coastal plains. Indeed, the highest concentration of major reservoirs occurs in this band.

High Risk Areas

High Hazard dams occur where many reservoirs are located in the vicinity of dense populations. Overlaying population density on high dam concentration results in areas of high risk.



Location of Levees

In lieu of a map of levees, the presence and location of levees are identified through the existence of levee-improvement districts. Many districts are on the Trinity River, beginning in Dallas County and extending downstream. Other districts are found on the West Fork of the Trinity and on the Sulphur and Brazos Rivers. In 1992 forty-eight levee-improvement districts were registered:
.http://www.tshaonline.org/handbook/online/articles/mwl02

Location of Dam Impact Area

Mapping of impacted areas can be accomplished through the use of online map services and an additional program to electronically draw in the area or a planner can use Google Earth and download a FEMA provided floodplain.

The following map is provided as an example of demarcating a dam inundation area by shading out the potential impact area:

Grimes County Local Mitigation Plan

Another way to document an impacted area is to use the storage capacity behind the dam to estimate the ground surface that would be covered with a foot of water.

An acre-foot is 325,851 gallons and would cover one acre of land with a foot of water. A 1,000 acre-foot body of water could cover 40 acres with an average depth of 25 feet, and the volume of 1,000 acre-feet is approximately 326 million gallons of water.

Sources: U.S. Geological Survey, Texas Water Development Board, the Handbook of Texas, Texas Parks & Wildlife, U.S. Army Corps of Engineers, previous Texas Almanacs, various river basin authorities, website of the owners of reservoirs.

Extent – Dam and Levee Failure

Extent for dam inundation is recorded in terms of the area impacted by number of feet of water and documentation of what is vulnerable and the loss that can occur.

Previous Occurrences – Dam and Levee Failure

Historically, Texas has had over 136 documented dam failures. At least two of those failures resulted in loss of life. In 1900, 25 people were killed when the Lake Austin Dam on the Colorado River at Austin failed. In 1989, one man was killed when the Nix Lake Dam in Rusk County failed. The most recent dam failures in Texas occurred in 2009 as a result of a severe rainfall event in Northeast Texas, Montgomery and McLennan Counties. There were seven earthen dams that failed or partially failed. Due to the rural nature of the area, there was no danger to human life.

Considering the serious dam failure problems other states have experienced, Texas is extremely fortunate that no more lives have been lost. The majority of the recent dam failures were small dams classified as low hazard. Texas has more dams listed in the National Inventory of Dams (NID) than any other state.

Historically Significant Dam and Levee Incidents in Texas		
Date	Affected Area	Remarks
April 6, 1900	Austin, Texas	In 1900, a dam at the site of what is now Tom Miller Dam, which forms Lake Austin, gave way. Seven to 10 people -- accounts vary – were killed while watching the flood from a hydroelectric powerhouse atop the dam.
March 29, 1989	Rusk County, near Henderson, TX	Nix Club Lake dam overtopped and caused flooding on roads that backed up water along a railroad trestle. One fatality was reported.
Sept 27, 1997	Near Woodville, Texas	In the past year, 10 dams collapsed near Woodville, two failed in the Nueces River watershed. Heavy rains measured 13 inches in four hours.
April 4, 2004	Toyah, Texas	Levee system failure. State dam safety program did not visit that area. Forty homes were lost
April 4, 2004	Fort Stockton, Texas	Dam overtopped due to

		extensive rainfall causing heavy damages.
May 13, 2004	Near Hearne, Texas	Callaway Dam was overtopped by about 1.5 feet before it failed. No fatalities reported.
May 13, 2004	Near Hearne, Texas	McGuire Dam is located downstream of Callaway Dam. It was overtopped by at least 3 feet before failure. The sequence of failure is not known. The stream does not go through Hearne so the flooding in Hearne was not from the failures.
Sept. 23, 2005	East Texas	Lake Livingston Dam sustained heavy damage due to rain and winds from Hurricane Rita. Lake level was lowered 4 feet to prevent further erosion. Cost of repairs totaled $9.6 million.
Jan. 1, 2008	Van Zandt County, East TX (near Van)	350-acre lake. Dam failed at spillway. No fatalities reported.
March 12, 2009	Northeast Texas	Earthen dam failed after a beaver tunneled into the 14 foot-high dam following a heavy rain. Property damage was minimal.
April 2009	Young County	Newcastle implemented their emergency action plan (EAP) and monitored rising lake levels due to heavy flow through the spillways of two area dams. No further action was needed.
October 13, 2009	Wood County	Heavy rains caused water to breach the Victory Lake Dam. Residents were evacuated but allowed to return home after dam was fortified with sandbags.
June 9, 2010	South Bexar County	Retaining pond dam breaks causing 30 people to evacuate their homes. No fatalities reported.

Frequency of Occurrence – Dam and Levee Failure

Because of the ageing of dams, this the potential of dam inundation due to dam failure has risen.

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.

EARTHQUAKES

Earthquakes are defined as a shaking or trembling of the earth that is volcanic or tectonic in origin.

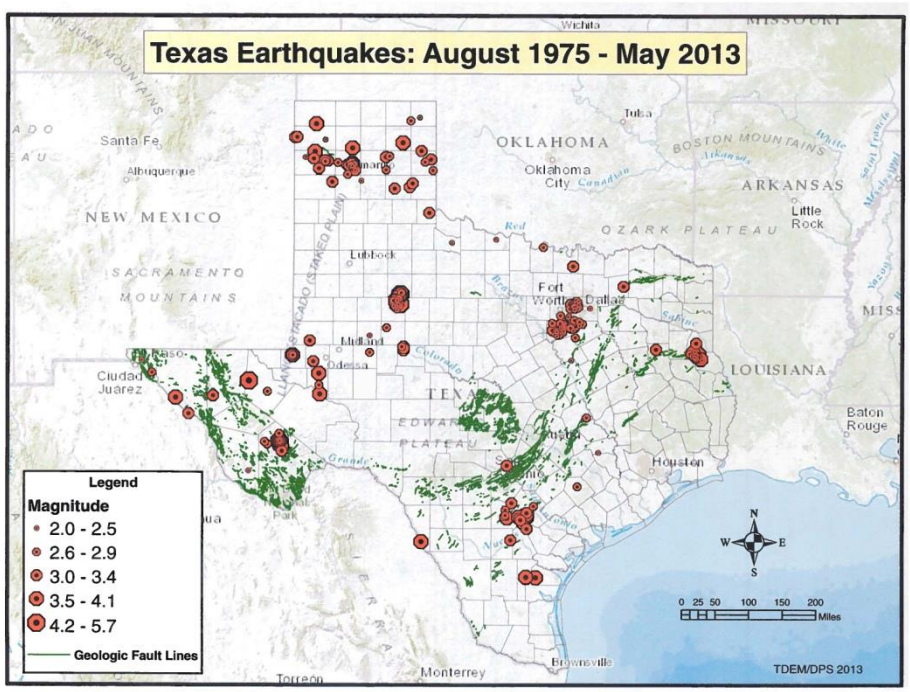
A quake with magnitude 3 (see magnitude extent scale below) may do no more than startle people and rattle dishes within a one-square mile region. However, a magnitude 7 would be felt by people over the entire State of Texas, and could do significant damage to buildings, bridges, and dams over a considerable region.

While Texas does face some earthquake hazard, this hazard is very small in comparison to many other states, including California, Missouri, Montana, South Carolina and Washington. Our biggest threat appears to be from the New Madrid fault system in Missouri, a system powerful enough to pose a risk to the north Texas area.

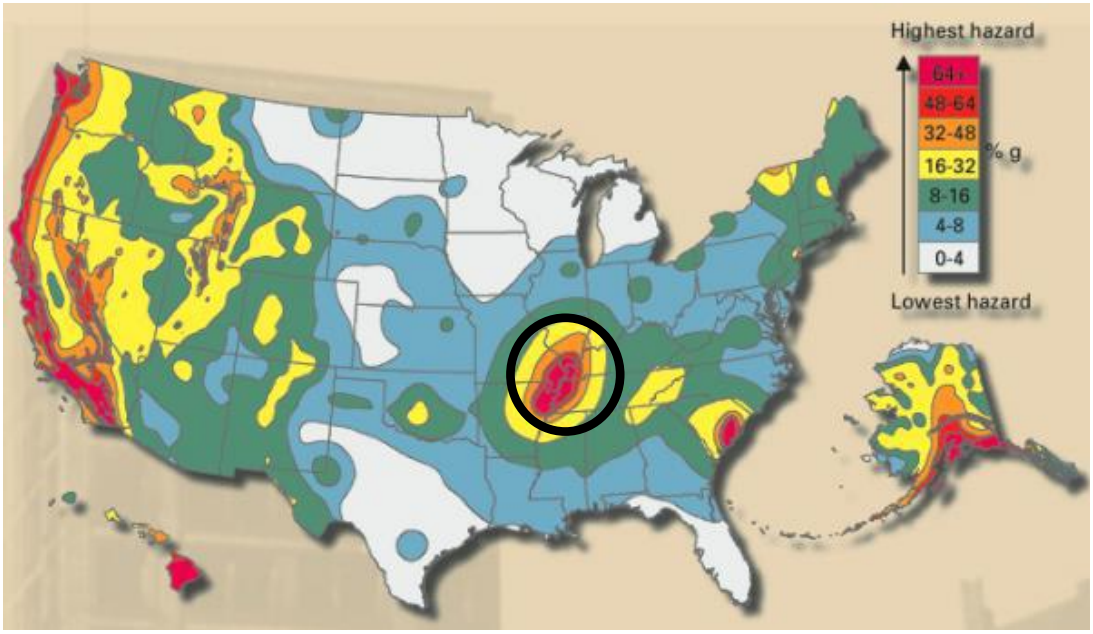
Location - Earthquake

Two regions, near El Paso and in the Panhandle, should expect earthquakes with magnitudes of about 5.5-6.0 to occur every 50-100 years, and even larger earthquakes are possible. The largest earthquake occurred in 1931 in in Jeff Davis County near the City of Valentine (magnitude 5.8/MM Intensity-VIII). In northeastern Texas the greatest hazard is from very large earthquakes (magnitude 7 or above) which might occur outside of Texas, particularly in Oklahoma or Missouri-Tennessee although smaller earthquake activity is reported and fault lines do run through the area. In south-central Texas the hazard is generally low, but residents should be aware that small earthquakes can occur, including some which theoretically are triggered by oil or gas production. Elsewhere in Texas, earthquakes are exceedingly rare. However, the hazard level is not zero anywhere in Texas; small earthquakes are possible almost anywhere, and all regions face possible ill effects from very large, distant earthquakes.

The following map illustrates the location of fault lines overlaid with previous earthquake occurrences:



The following map denotes the location of the New Madrid fault line system in the black circled area:



http://www.hsdl.org/?view&did=8324

Extent - Earthquake

Scientists determine an earthquake's magnitude by measuring the amplitude of ground motion as recorded on a seismograph, and then correcting the measurement to account for the effects of

distance from the epicenter. The magnitude scale is a 'power of ten' scale; thus if a magnitude 3.8 caused ground motion of 1/10 inch at a particular location, a 4.8 at the same epicenter would cause ground motion of 1 inch, and a 5.8 would cause ground motion of 10 inches. This means that magnitude 3 and magnitude 7 earthquakes are enormously different with respect to their ground motion and the size of and slip on the faults that produce them.

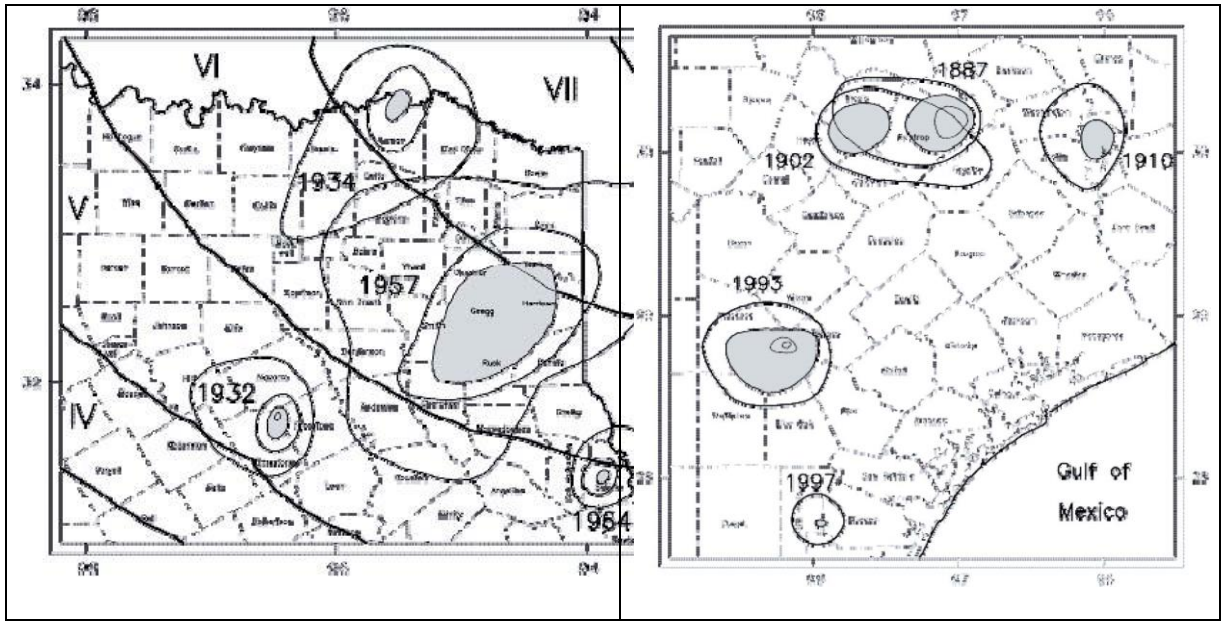
Magnitude	Earthquake Effects	Estimated Number Each Year
2.5 or less	Usually not felt, but can be recorded by seismograph.	900,000
2.5 to 5.4	Often felt, but only causes minor damage.	30,000
5.5 to 6.0	Slight damage to buildings and other structures.	500
6.1 to 6.9	May cause a lot of damage in very populated areas.	100
7.0 to 7.9	Major earthquake. Serious damage.	20
8.0 or greater	Great earthquake. Can totally destroy communities near the epicenter.	One every 5 to 10 years

Scientists also use the Modified Mercalli Intensity (MMI) scale to describe how strong the motion is at a particular location. The MMI is a number between one and twelve, expressed as a Roman numeral such as MMI IV or MMI IX so that the number won't be confused with magnitude. While each earthquake has only one magnitude, it has much different intensities, since earthquake damage becomes less severe as one moves away from the epicenter. Usually, most of the damage done by an earthquake occurs in the regions nearest the epicenter which have the highest intensities. While intensity depends strongly on factors such as soil properties, in most cases earthquakes with larger magnitudes have higher maximum intensities.

The Modified Mercalli Intensity Scale (MMI)	
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.

Previous Occurrences – Earthquake



Historically Significant Earthquake Occurrences in Texas		
Date	Affected Area	Remarks
October 22, 1882	Sherman, Texas Magnitude: 5.6	Heavy machinery vibrated, chimneys crumbled, and movable objects overturned
January 5, 1887	Bastrop County Magnitude: 4.1	Shocks felt over 4,600 square kilometers
May 3, 1887	West Texas, including El Paso and Fort Davis Magnitude: 7.4	Earthquake originated in Sonora, Mexico
July 30, 1925	Texas Panhandle Magnitude: 5.4	Shocks covered 518,000 square kilometers reaching from Roswell, New Mexico to Leavenworth, Kansas
August 16, 1931	Brewster, Jeff Davis, Culberson,	Severe damage was reported

	and Presidio Counties Magnitude: 6.0	at Valentine, where all buildings except wood-frame houses were damaged severely and all brick chimneys toppled or were damaged
April 9. 1932	Mexia-Wortham, Texas Magnitude: 4.0	The shock was also felt in Coolidge, Currie, Groesbeck, Hillsboro, Teague and Richland
April 11, 1934	Northeastern Texas Magnitude: 4.2	The tremor was most distinctly felt at Arthur City, Chicota and Powderly
June 19, 1936	Texas Panhandle near Borger, Texas Magnitude: 5.0	Effects were noted at Gruver, White Deer, and Whittenberg, Texas, Kenton, Oklahoma, and Elkhart, Kansas
March 11, 1948	Texas Panhandle Magnitude: 5.2	The strongest effects (VI) were reported from Amarillo, Channing, Dalhart, Electric City, Panhandle, Perico, and Perryton
April 9, 1952	Central Oklahoma Magnitude: 5.5	Shocks felt from North Texas to Austin
March 19, 1957	Texas area bordering portions of Arkansas and Louisiana Magnitude: 4.7	Effects were felt in Gladewater, Diana, Elkhart, Marshall, Nacogdoches and Troup
April 23-28, 1964	Texas-Louisiana border region near Hemphill, Texas Magnitude: 4.4	The shock was also felt at Bronson, Geneva, Milam and Pineland
April 9, 1993	Atascosa County Magnitude: 4.3	Campellton home knocked off foundation. Natural-gas processing plant shut down
April 14, 1995	Brewster County Magnitude: 5.7	Broken water and gas mains, cracked walls, and small fires erupted following aftershocks
November 5, 2011	Oklahoma City and Tulsa Magnitude: 5.6	Tremors were felt into North Texas
Sources: Principally, the U.S. Geological Survey and the Institute for Geophysics at the University of Texas at Austin. Also, previous Texas *Almanacs*.		

Previous Occurrences – Earthquakes

Slight earthquakes do occur with frequency. Those of higher magnitude, which could cause damage, have occurred about every 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.

EXPANSIVE SOILS

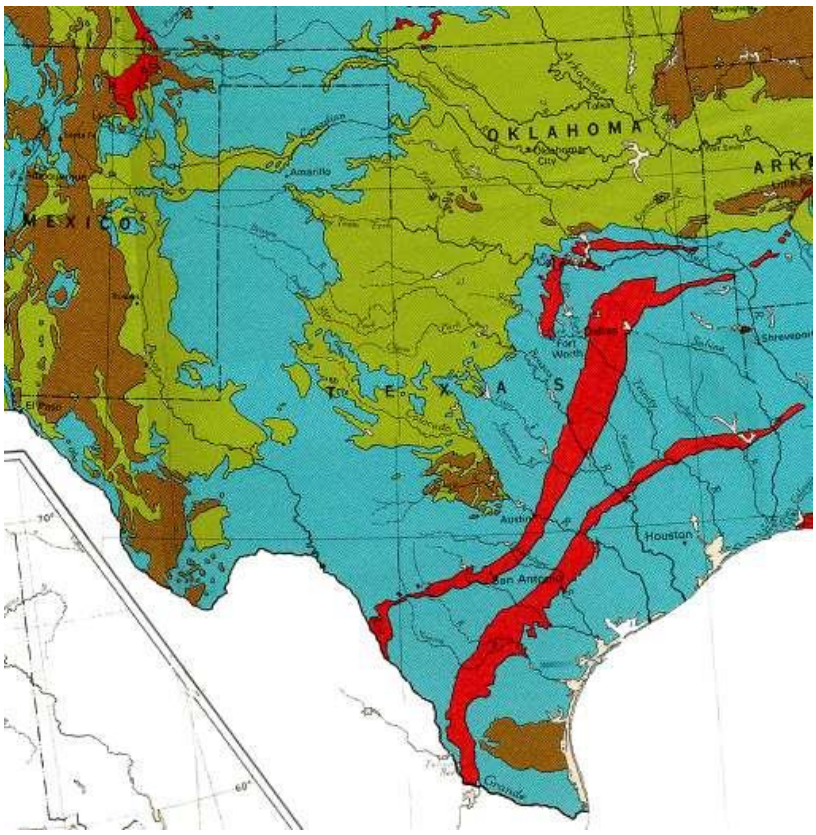
Expansive soils are defined as soils and soft rock that tend to swell or shrink due to changes in moisture content. Changes in soil volume present a hazard primarily to structures built on top of expansive soils.

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

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

Location – Expansive Soils

Expansive soils are problematic for most of the state. Most expansive soils are located in a band 200 miles west from the coastline, stretching approximately from Beaumont south to Brownsville. There is another band of expansive soils stretching from Laredo northeast through San Antonio, Austin and Dallas along an area also known as the I-35 corridor. These areas receive the most moisture and are also vulnerable to droughts, which can cause the soils to expand and contract.



Location of varying types of expansive soils across Texas

- Unit contains abundant clay having high swelling potential
- Part of unit (generally less than 50%) consists of clay having high swelling potential
- Unit contains abundant clay having slight to moderate swelling potential
- Part of unit (generally less than 50%) consists of clay having slight to moderate swelling potential
- Unit contains little or no swelling clay
- Data insufficient to indicate clay content of unit and/or swelling potential of clay.

Extent – Expansive Soils

The soil expansion can be measured in terms of its swelling potential, or volumetric swell. The expansive soil index below requires soil testing. Soil material is disaggregated and passed through the #4 sieve and then brought to approximately the optimum moisture content (as determined by American Society for Testing and Materials [ASTM-D-1557]). The optimum moisture content equates to approximately 80 to 85% of saturation. After setting for 6 to 30 hours, the moisture-conditioned soil is compacted into a 4-in diameter mold. The moisture content is then adjusted, if necessary, to bring the sample to 50% saturation. A 144 psf surcharge is applied and the sample is wetted and monitored for 24 hours, measuring the volumetric swell. The Expansion Index is calculated as follows:

$EI = 100 \times \Delta h \times F$

Where Δh = percent swell and F = fraction passing No. 4 sieve

The following “ratings” can be accepted examples expected for “extent” when a risk is identified as Expansive Soils

ASTM D4729-11 Expansive Soils Index (in %)

0–20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High

Previous Occurrences – Expansive Soils

Expansive soil is a condition that is native to Texas soil characteristics, and cannot be documented as a time-specific event, except when it leads to structural and infrastructure damage.

The great increase in damages in Texas caused by problems with expansive soils can be traced to the rise in residential slab-on-grade construction which began to accelerate in the 1960s. Prior to that time, most residential construction in Texas was pier and beam, with wood siding or other non-masonry covering.

Finally, as the housing boom of 2003-2006 began, communities began to realize that they were losing out on millions in property tax revenue by allowing the situation to continue. A home that has half of its value eliminated by foundation cracking (a common statistic) also generates half the tax and school revenue. This awaking is still in its infancy; thousands of communities across the state that are underlain by expansive soils still have no code requirements for special treatment of foundations.

Probability – Expansive Soils

Percentage of Insurance Claims Made in Texas Involving Foundation

1960	3%
1970	5%
1980	9%
1990	13%
2000	14%
2005	14%
source: Texas Department of Insurance	

Severe damage from expansive soil is not well documented so this hazard, although prevalent, its occurrence as catastrophically damaging is not documented:

Frequency Of Occurrence:

☐ Highly likely: Event probable in next year.

☐ Likely: Event probable in next 3 years.

☐ Occasional: Event possible in next 5 years.

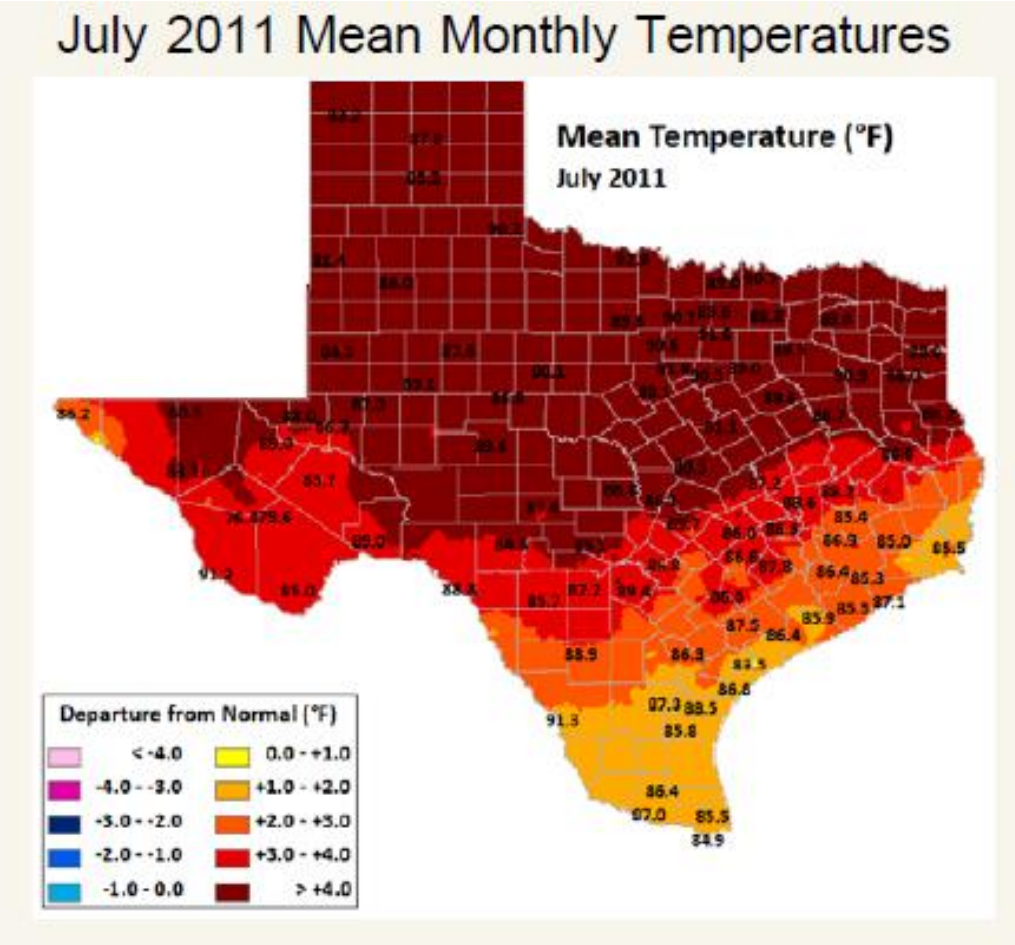
☒ Unlikely: Event possible in next 10 years.

EXTREME HEAT

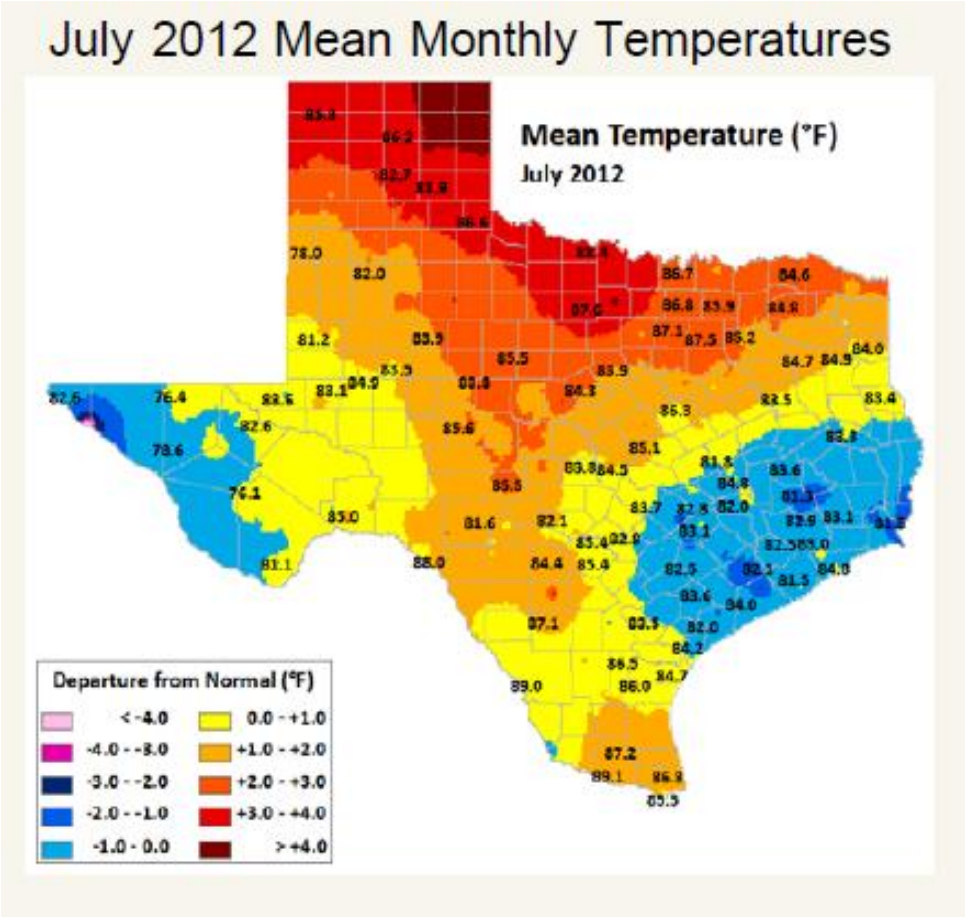
Extreme Heat is defined as a combination of very high temperatures and, usually, exceptionally humid conditions. When persisting over a period of time, it is called a heat wave.

Location – Extreme Heat

All of Texas is vulnerable to extreme heat, but most particular in West Texas. In addition, large metropolitan areas, such as Dallas/Fort Worth and Houston may experience extreme heat since they have an abundance of concrete. This effect is known as urban heat island and can be dangerous to those without air conditioners.



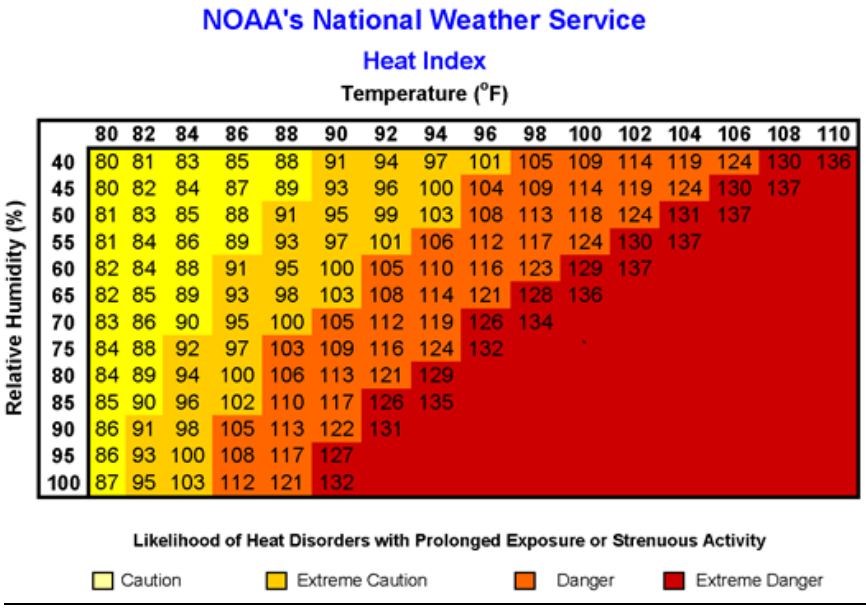
http://climatexas.tamu.edu/index.php/climatic-bulletins/july-2011



http://climatexas.tamu.edu/index.php/climatic-bulletins/july-2012

Extent – Extreme Heat

There is not a standard designation of an extreme heat day. It is a complex number assigned by local National Weather Service (NWS) regions based upon heat index, time of year, and area of the country. Thus a heat index of 105 in Austin, Texas in July is considered routine. The same index in New York City in August would warrant an extreme heat warning.



http://www.nws.noaa.gov/os/heat/index.shtml

Previous Occurrences – Extreme Heat

Extreme Heat Occurrences in Texas

LOCATION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
ANGELINA (ZONE)	8/2/2010	1	0	0.00K	0.00K
ANGELINA (ZONE)	8/24/2010	1	0	0.00K	0.00K
TARRANT (ZONE)	8/1/2011	0	63	0.00K	0.00K
BELL (ZONE)	8/1/2011	1	0	0.00K	0.00K
COLLIN (ZONE)	8/1/2011	1	0	0.00K	0.00K
HOOD (ZONE)	8/1/2011	1	0	0.00K	0.00K
NUECES (ZONE)	8/1/2011	1	0	0.00K	0.00K
FANNIN (ZONE)	8/1/2011	3	0	0.00K	0.00K
KAUFMAN (ZONE)	8/1/2011	3	0	0.00K	0.00K
DALLAS (ZONE)	8/1/2011	4	130	0.00K	0.00K
WOOD (ZONE)	8/4/2011	0	0	200.00K	0.00K
HARRIS (ZONE)	8/4/2011	1	0	0.00K	0.00K
DUVAL (ZONE)	6/10/2012	1	0	0.00K	0.00K
DALLAS (ZONE)	7/20/2012	1	0	0.00K	0.00K

http://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=48%2CTEXAS

Significant Extreme Heat Occurrences in Texas		
Date	Affected Area	Remarks
August 12, 1936	Seymour, Texas	Recorded state record 120°F
July 1-31, 1980	Central and Southwest Texas	Considered one of the worst heat waves in Texas history resulted in nine deaths. Del Rio recorded average daily temperature of 103°F. The month proved to be the hottest on record for Austin and San Antonio. Damage estimates reached $60 million.
July 27, 1994	Statewide	The statewide record (120°F) was tied in Monahans, Tx.
February 21, 1996	Statewide	High temperatures were reported over the entire state, breaking records in nearly every region of the state. Temperatures near 100°F shattered previous records by as many as 10°F as Texans experienced heat more characteristic of mid-summer than winter.
July 1998	Statewide	Summertime drought and heat wave cost over $2B dollars to agriculture.
August 1999	North Texas	Excessive heat throughout the month resulted in 16 fatalities in the Dallas/Fort Worth area. The airport reported 26 consecutive days of 100°F or greater temperatures.
July 2000	North and Southeast Texas	Excessive heat resulted from a high-pressure ridge, particularly from July 12 - 21. Dallas/Fort Worth Airport reported a 10-day average of 103.3°F. College Station had 12 consecutive days of 100°F or greater temperatures. The heat caused 34 deaths in North and Southeast Texas, primarily among the elderly.
Sept. 5, 2000	Statewide	Most of the central and eastern parts of the state exceeded 100°F with Possum Kingdom Lake

		reaching 114°F. Eight records were set.
July - August 2001	Statewide	Excessive heat plagued Texas during July and August, which resulted in 17 deaths in the Houston area.
Sources: Office of State Climatologist, Texas A&M, December 1981; Texas State Historical Association, Texas Almanac		

Probability - Extreme Heat

Predicting extreme heat occurrences is dependent upon the definition of an extreme heat event. As noted in the extreme heat extent section above, there is no standard definition or measurement of an extreme heat occurrence. Texas experiences hot weather in the summer, under both dry and humid conditions. The issue at hand is to identify the benchmark at which one can say the temperatures are abnormally high for an extended, but are not expected to persist.

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.

HAILSTORM

Hail is defined as a frozen precipitation in the form of small balls or lumps usually consisting of concentric layers of clear ice and compact snow.

Texas officials estimate that up to 40 percent of all homeowners' insurance claims in the state result from hail damage.

Location – Hailstorm

The northern half of the state, which is subject to more severe thunderstorms, also experiences more frequent severe hailstorms.

LOCATION OF HAIL OCCURRENCES JAN-DEC 2011

Source: NOAA

Extent - Hailstorm

The National Weather Service (NWS) issues Severe Thunderstorm Warnings for storms when hail of one inch in diameter or larger is expected. (Nationally the hail criteria changed from 3/4" to 1" on January 5, 2010.

TORRO HAILSTORM INTENSITY SCALE				
	Intensity Category	**Typical Hail Diameter (mm)***	**Probable Kinetic Energy, J-m^2**	**Typical Damage Impacts**
H0	Hard Hail	5	0-20	No damage
H1	Potentially Damaging	5-**15**	>20	Slight general damage to plants, crops
H2	Significant	10-**20**	>100	Significant damage to fruit, crops, vegetation
H3	Severe	20-**30**	>300	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-**40**	>500	Widespread glass damage, vehicle bodywork damage

TORRO HAILSTORM INTENSITY SCALE				
	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, J-m^2	Typical Damage Impacts
H5	Destructive	30-**50**	>800	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-**60**		Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	50-**75**		Severe roof damage, risk of serious injuries
H8	Destructive	60-**90**		(Severest recorded in the British Isles) Severe damage to aircraft bodywork
H9	Super Hailstorms	75-**100**		Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100		Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

* Approximate range (typical maximum size in bold), since other factors (e.g. number and density of hailstones, hail fall speed and surface wind speeds) affect severity. http://www.torro.org.uk/site/hscale.php

Hail size and diameter in relation to TORRO Hailstorm Intensity Scale.		
Size code	Maximum Diameter mm	Description
0	5-9	Pea
1	10-15	Mothball
2	16-20	Marble, grape
3	21-30	Walnut
4	31-40	Pigeon's egg > squash ball
5	41-50	Golf ball > Pullet's egg
6	51-60	Hen's egg
7	61-7	Tennis ball > cricket ball
8	76-90	Large orange > Soft ball

9	91-100	Grapefruit
10	>100	Melon

The size code is the maximum reported size code accepted as consistent with other reports and evidence.

Previous Occurrences - Hailstorm

The highest homeowners insurance payouts involve hail. Among one insurance agency's 25 highest claim payouts in history, eight involved significant damage caused by hail. The company's fifth-largest payout for a single catastrophic event occurred in 1992—about 68,000 claims totaling nearly $245 million resulting from a hailstorm in Fort Worth. In June 2012, a Dallas hailstorm resulted in $1.5 billion in insurance claims.

Hail Occurrences in Texas 2011-2012

LOCATION	COUNTY	DATE	MAGNITUDE	PROPERTY DAMAGE	CROP DAMAGE
FORNEY	KAUFMAN CO.	1/20/2010	1.75 in.	10.00K	0.00K
TIGERTOWN	LAMAR CO.	1/20/2010	1.75 in.	5.00K	0.00K
ENGLEWOOD	HARRIS CO.	2/8/2010	0.88 in.	1.00K	0.00K
BRENHAM	WASHINGTON CO.	2/8/2010	1.25 in.	2.00K	0.00K
CONCAN	UVALDE CO.	3/24/2010	1.75 in.	5.00K	0.00K
BRENHAM MUNI ARPT	WASHINGTON CO.	4/7/2010	1.00 in.	1.00K	0.00K
WILLIS	MONTGOMERY CO.	4/7/2010	1.00 in.	1.00K	0.00K
KENDALIA	KENDALL CO.	4/7/2010	1.50 in.	5.00K	0.00K
MARATHON	BREWSTER CO.	4/11/2010	2.00 in.	150.00K	0.00K
SOUTH PLAINS	FLOYD CO.	4/21/2010	2.75 in.	1.00K	0.00K
SOUTH PLAINS	FLOYD CO.	4/22/2010	1.00 in.	10.00K	0.00K
ENNIS	ELLIS CO.	4/23/2010	2.00 in.	2.00K	0.00K
CAMERON	MILAM CO.	4/23/2010	4.00 in.	4.00K	0.00K
SPLAWN	MILAM CO.	4/23/2010	2.50 in.	4.00K	0.00K
KEMPNER	LAMPASAS CO.	4/23/2010	1.75 in.	5.00K	0.00K
GERONIMO	GUADALUPE CO.	4/24/2010	1.25 in.	2.00K	0.00K
LONG PT	WASHINGTON CO.	4/26/2010	1.00 in.	2.00K	0.00K
CALDWELL MUNI ARPT	BURLESON CO.	4/26/2010	1.75 in.	5.00K	0.00K
ROCKS SPGS	EDWARDS CO.	4/30/2010	1.50 in.	10.00K	0.00K
DEL RIO	VAL VERDE CO.	5/1/2010	1.75 in.	10.00K	0.00K
LEAKEY LEWIS ARPT	REAL CO.	5/1/2010	2.00 in.	10.00K	0.00K
VANCE	REAL CO.	5/1/2010	1.75 in.	5.00K	0.00K

VANCE	REAL CO.	5/1/2010	1.50 in.	5.00K	0.00K
JACKSBORO MUNI ARPT	JACK CO.	5/13/2010	1.75 in.	5.00K	0.00K
WALNUT SPGS	BOSQUE CO.	5/16/2010	1.75 in.	4.00K	0.00K
ASPERMONT	STONEWALL CO.	5/17/2010	1.75 in.	2.50K	0.00K
SEAGOVILLE	DALLAS CO.	5/17/2010	1.75 in.	20.00K	0.00K
ALPINE	BREWSTER CO.	5/17/2010	4.25 in.	45.00K	0.00K
PRINGLE	HUTCHINSON CO.	5/18/2010	1.75 in.	0.00K	10.00K
DUMAS	MOORE CO.	5/18/2010	1.75 in.	1.00K	0.00K
MALLETT	SHERMAN CO.	5/18/2010	2.00 in.	15.00K	0.00K
PRINGLE	HUTCHINSON CO.	5/18/2010	2.75 in.	8.00K	0.00K
DUMAS	MOORE CO.	5/19/2010	1.75 in.	12.00K	0.00K
CORSICANA ARPT	NAVARRO CO.	5/20/2010	1.75 in.	1.00K	0.00K
ANGUS	NAVARRO CO.	5/20/2010	1.75 in.	1.00K	0.00K
HUBBARD	HILL CO.	5/20/2010	1.75 in.	1.00K	0.00K
LEROY	MCLENNAN CO.	5/20/2010	2.75 in.	1.00K	0.00K
CHINA SPG	MCLENNAN CO.	5/20/2010	1.75 in.	1.00K	0.00K
HEWITT	MCLENNAN CO.	5/20/2010	1.25 in.	1.00K	0.00K
NORTH PRAIRIE	FALLS CO.	5/20/2010	1.75 in.	1.00K	0.00K
COCKRELL HILL	DALLAS CO.	5/20/2010	1.75 in.	10.00K	0.00K
ANGUS	NAVARRO CO.	5/20/2010	2.75 in.	10.00K	0.00K
HILLSIDE	MCLENNAN CO.	5/20/2010	1.75 in.	10.00K	0.00K
WOODWAY	MCLENNAN CO.	5/20/2010	1.75 in.	20.00K	0.00K
CORSICANA	NAVARRO CO.	5/20/2010	2.75 in.	30.00K	0.00K
VALLEY MILLS	BOSQUE CO.	5/20/2010	1.75 in.	4.00K	0.00K
CHILTON	FALLS CO.	5/20/2010	1.75 in.	5.00K	0.00K
GOLDTHWAITE	MILLS CO.	5/20/2010	1.75 in.	5.00K	0.00K

http://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=48%2CTEXAS

Interestingly, a significant event resulting in costly damage occurred in El Paso, Texas, in 2009 was outside the common occurrence boundary.

Historically Significant Hailstorm Occurrences in Texas		
Date	Affected Area	Remarks
May 16, 1917	Ballinger, Texas	Hail covered the ground up to three feet deep taking seven days to clear.
May 31, 1960	Winkler County	Hail fall was recorded to be over eight inches causing extensive damage.
April 14, 1965	Young County	Hailstones recorded to be over 7.5 inches.

Aug. 24, 1979	West Texas	Worst hailstorm in past 100 years destroyed $200 million in crops, mostly cotton.
May 8, 1981	Tarrant County	Considered worst hailstorm in American history. Damage to buildings caused by 100 mph winds followed by softball size hail injured five people. Damage estimates reached $110 million.
March 16, 1987	Val Verde County	Hailstones from three to four inches with some up to seven inches. Over 400 vehicles damaged.
May 10, 1991	Ward County	Stones recorded to be over six inches causing extensive damage.
May 5, 1995	Dallas-Fort Worth, Texas	Baseball-sized hail in downtown Fort Worth during their May festival and causing numerous injuries (and one death) from people caught out in the open being struck by hail.
May 28, 1995	San Angelo	A supercell thunderstorm produced extreme winds and giant hail in San Angelo, injuring at least 80 people and causing about $120 million in damage. Sixty-one homes were destroyed, and more than 9,000 were slightly damaged. In some areas, hail was six inches deep, with drifts to two feet.
Dec. 17, 1995	Burleson County	Hail fall was recorded to be over 7.05 inches causing extensive damage.
May 10, 1996	Howard County	Stones up to five inches injured 48 people and $30 million worth of property damage.
May 6 & 30, 2001	High Plains and Central Texas	Numerous storms causing excessive damage. Four-inch hail caused nearly $150 million in damages in San Antonio on May 6. On the 30th, supercell thunderstorms in the High Plains region produced winds over 100 mph and golf-ball- sized hail caused more than $186 million in damage. All told, storms caused 36 injuries and more than $358 million in damage to property and agriculture.
April 5, 2003	Sixteen north-central Texas counties	A single supercell thunderstorm produced hail up to 4.5 inches in diameter, along with five tornadoes. Preliminary estimates indicate $800 million in damage.
March 25, 2005	Central Texas	In the evening of March 25, the most destructive hailstorm in 10 years struck the greater Austin area. The storm knocked out power to 5,000 homes in northwest Austin. Hail of two inches in diameter was reported near the Travis County Exposition Center. Total damage was estimated at $100 million.
April 18, 2006	Gillespie County	Hailstones as large as 2.5 inches in diameter

		destroyed windows in homes and car windshields between Harper and Doss in Gillespie County. The hail also damaged 70 percent of the area peach crop, an estimated loss of $5 million.
April 20, 2006	Hays County	Hailstones as large at 4.25 inches in diameter (grapefruit-size) reported south of San Marcos. Damage from this storm was estimated at $100 million with up to 10,000 vehicles damaged and another 7,000 vehicles at homes.
May 4, 2006	Scurry County	Lime to baseball-size hail fell across Snyder in Scurry County for at least 15 minutes. The hail was blown sideways at times by 60-to-70-mph winds. Total damage was estimated at $15 million.
April 13, 2007	Tarrant County	Teacup-size hail was reported in Colleyville as strong storms developed in Tarrant County. Hail damage to 5,500 cars and 3,500 homes and businesses was estimated at $10 million.
March 31, 2008	Northeast Texas	Severe thunderstorms developed across the Red River valley of Northeast Texas, many producing large hail that damaged car windows, skylights and roofs in Texarkana and elsewhere in Bowie County. Damage was estimated at $120 million.
May 14, 2008	Central Texas	A severe thunderstorm southwest of Austin moved northeast across downtown Austin causing extensive damage from winds and large hail. Large trees and branches were knocked down, and baseball-size hail and 70–80 mph winds blew out windows in apartments and office buildings, including the State Capitol. Total damage was estimated at $50 million.
March 30, 2009	Northeast Tarrant County	Ping pong to baseball-size hail fell on numerous cities in northeast Tarrant County due to a strong line of severe storms. Much of the damage was to automobiles, and the overall estimated damage was $95 million.
April 11, 2009	Midland, Texas	Up to golf ball-size hail caused tremendous damage to homes and vehicles during a severe storm. There was an estimated $160 million in roof repair. A woman was pelted in the stomach by a hailstone that broke through the window in her dining room.
Sept. 16, 2009	El Paso, Texas	A series of supercell storms produced golf-ball-size and possibly tennis ball-size hail that

		caused extensive damage. The most costly hailstorm in recorded history for the El Paso area, the estimated damage was $150 million.
Sources: Office of State Climatologist, Texas A & M, December 1981; Texas State Historical Association, Texas Almanac		

Probability - Hailstorm

While a hailstorm usually strikes a relatively limited geographical area, there are parts of Texas where hailstorms average six strikes a year 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.

LAND SUBSIDENCE

Land subsidence is defined as the loss of surface elevation due to the removal of subsurface support. It can range from broad, regional lowering of the land surface to localize, full-blown collapses. Land subsidence occurs in different areas for different reasons.

A sinkhole is a category of subsidence.

According to an article in the Texas Parks & Wildlife online:

"A sinkhole is a natural depression that's formed when subsurface limestone, salt or gypsum is slowly eroded away by groundwater. As surface water infiltrates the soil, it percolates downward and moves deeper into the soil. Over time, the water eats away at the rock layer until voids, or caves, form in the rock. As these voids grow, ultimately the spaces between the rocks become too big and the weight of the earth on top of the rock causes the chamber to collapse.

Natural sinkholes most commonly form in the karst regions of Texas. Karst is an area of irregular limestone in which erosion has produced fissures, sinkholes, underground streams and caverns. In Texas, high concentrations of karst rock occur in the soluble limestone areas of the Hill Country and the gypsum-rich Rolling Plains of northwest Texas.

It is possible, however, for unnatural sinkholes to form. In urban areas, water main breaks can erode the subsoil and cause the earth above to cleave."
http://www.tpwmagazine.com/archive/2008/jan/ed_5/

On the coast, subsidence occurs as water levels are lowered (in Texas primarily from groundwater withdrawal and effects of oil and gas production) in the aquifers and clay begins to lose water and compact. The Gulf Coast areas, such as around the Houston area, were at one time highly vulnerable to land subsidence prior to the restriction of ground water being pumped out.

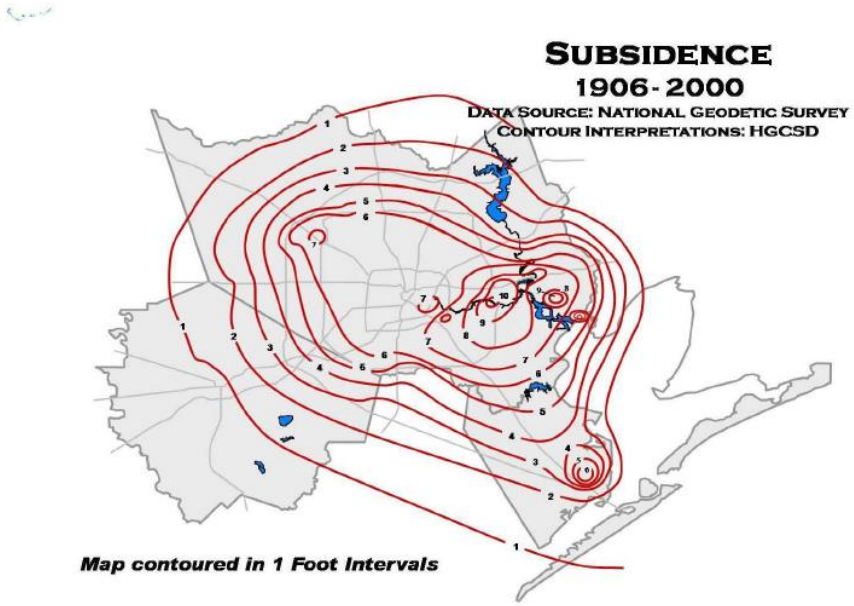
As a result of reduced elevation, loss of wetlands, and the loss of other natural coastal protective features, subsidence increases coastal communities' risk to inundation and saltwater intrusion from storm surge. Subsidence creates and exacerbates erosion and flooding along the shoreline that can threaten structures and critical infrastructure, including hurricane evacuation routes.

Location – Land Subsidence

Location of land subsidence in Texas would most likely be along the Texas Gulf Coast counties where the removal of subsurface support (such as groundwater) could cause the loss of surface elevation. Counties at high risk include Orange, Jefferson, Chambers, Harris, Galveston, Brazoria, Matagorda, Calhoun, Aransas, San Patricio, Nueces, Kleberg, Kenedy, Willacy, and Cameron.

Extent – Land Subsidence

Land subsidence extent is measured by the number of feet of land loss, or sunk. See the contour map of Houston area subsidence below. This area has the potential for the greatest land subsidence in the state.



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Previous Occurrences - Land subsidence

In May of 1975, the Texas Legislature created the Harris-Galveston Subsidence District (HGSD), as a regulatory agency to "end subsidence", and provided HGSD the authority to restrict groundwater withdrawals. Overall, the subsidence rate in the Houston-Galveston area has decreased, as industries and municipalities have converted from using primarily groundwater to using primarily surface water. However, relative sea-level rise and limited amounts of sediments reaching the coast still contribute to coastal wetland loss.

Examples of sinkholes that have affected communities include Wink, in Winkler County which occurred in 1980 and Daisetta, Liberty County, which occurred in 2008.

West and Central Texas have also experienced land subsidence perhaps due to oil exploration or created by the erosion of subsurface limestone, salt or gypsum by groundwater. The latter may have had something to do with the Bering sinkhole in Kerr County and the Devil's Sinkhole near Rocksprings, Texas.

Historically Significant Land Subsidence Occurrences in Texas		
Date	Affected Area	Remarks
1943-1964	Fort Bend County	The eastern one-third of the county has experienced a drop that exceeded one foot while water levels dropped more than 100 feet during this period.
June 3, 1980	Winkler County	The first of two sinkholes that appeared near Wink, Texas measured 120 yards long and 100 yards wide.
June 2000	Houston-Galveston area	Early oil and gas production and a long history of ground-water pumpage in the Houston-Galveston area, Texas, have created severe and costly coastal flooding hazards and affected a critical environmental resource—the Galveston Bay estuary.
May 21, 2002	Winkler County	A second sinkhole appeared approximately one mile from the original Wink sinkhole. It grew much larger covering an area greater than two football fields.
May 7, 2008	Liberty County	In Daisetta, Texas, a huge sinkhole measuring approximately 600 feet long and 525 feet wide caused a section of highway 77 to close after it was determined that parts of the roadway may have subsided by five inches.
Sources: Gabrysch, R. K., 1970, Land-surface subsidence in the Houston-Galveston region, Texas: Internet,symposium on land subsidence, Tokyo, Japan, 1969, Proc. Dec. 2000, United States Geological Survey. *www.co.liberty.tx.us/default.aspx?Liberty_county/sinkhole*. *www.rootsweb.ancestry,.com/txwinkle/midland-paper*		

Probability - Land Subsidence

While groundwater withdrawals have been restricted over the last forty years in the coastal area, subsidence may continue to develop from other types of below ground withdrawals or from natural forces

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.

SEVERE WINTER STORM

Severe winter storm is defined as extreme cold and heavy concentrations of snowfall or ice. Texas is disrupted more severely by severe winter storms than are regions that experience severe weather more frequently.

The type which Texans are most familiar with are snowstorms, blizzards, cold waves and ice storms.

A snowfall with an accumulation of four or more inches in a 12-hour period is considered a heavy snowfall. Snow accumulations of that amount are usually experienced in the northern half of the state and in the higher elevations of West Texas. Snowfall of any amount is rare south of a line from Del Rio to Port Arthur, and it is this rarity of event, coupled with a lack of preparedness for such an event, that creates a severe weather condition.

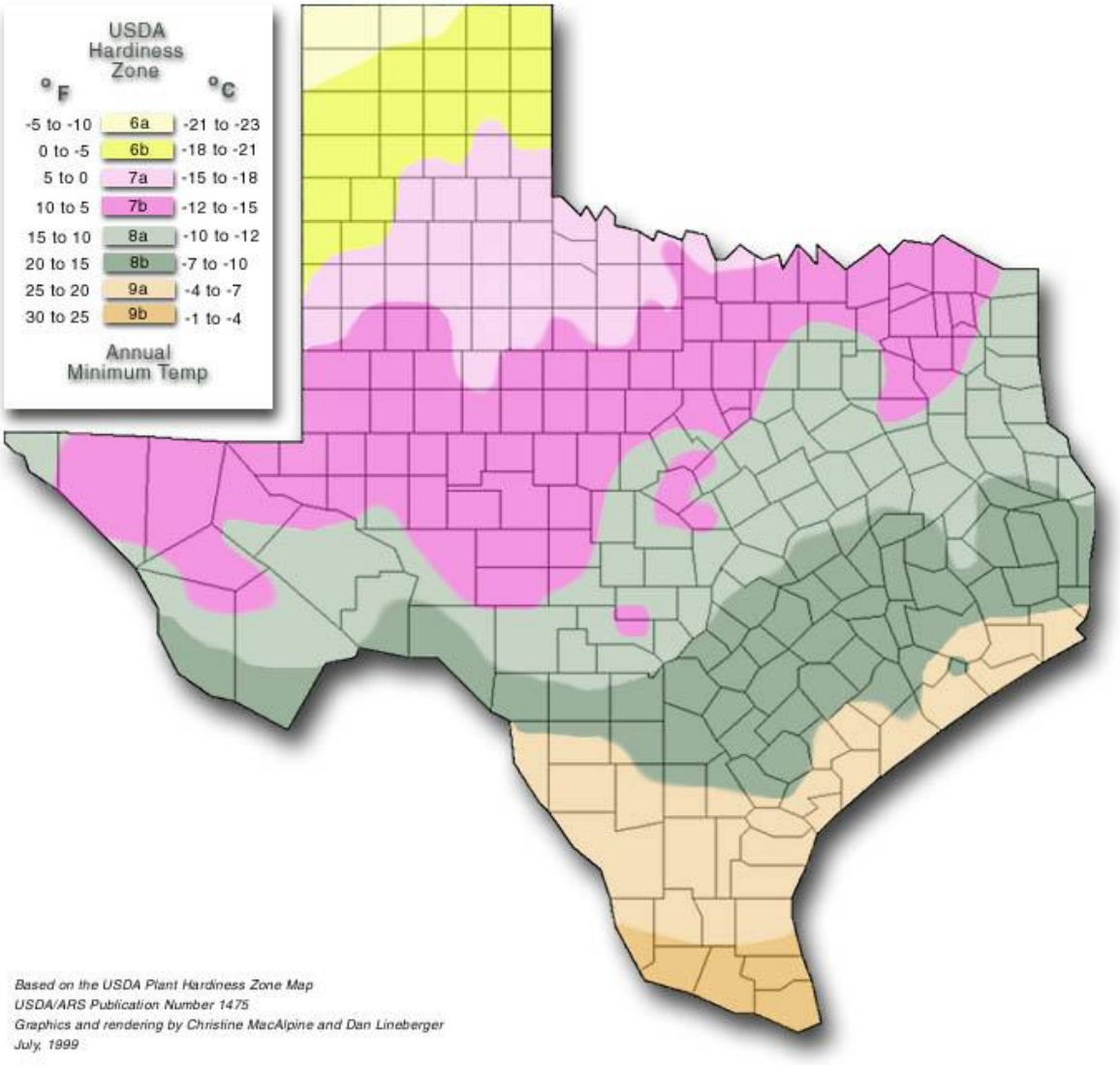
Blizzards are the most perilous of all winter storms, characterized by low temperatures and strong winds in excess of 35 mph, bearing large amounts of blowing or drifting snow. Blizzards take a terrible toll in livestock and people caught in the open. In Texas, blizzards are most likely to occur in the Panhandle and South Plains Regions.

The passage of a winter cold front with a drastic drop in temperature heralds the arrival of a cold wave, usually referred to as a “blue north’er.”

An ice storm occurs when rain falls out of the warm and moist upper layers of the atmosphere into a cold and dry layer near the ground. The rain freezes on contact with the cold ground and accumulates on exposed surfaces. If a half inch of rain freezes on trees and utility wires, damage can occur, especially if accompanied by high winds, thus half an inch is used as the criteria before an icing event is categorized as an “ice storm.”

Location – Severe Winter Storm

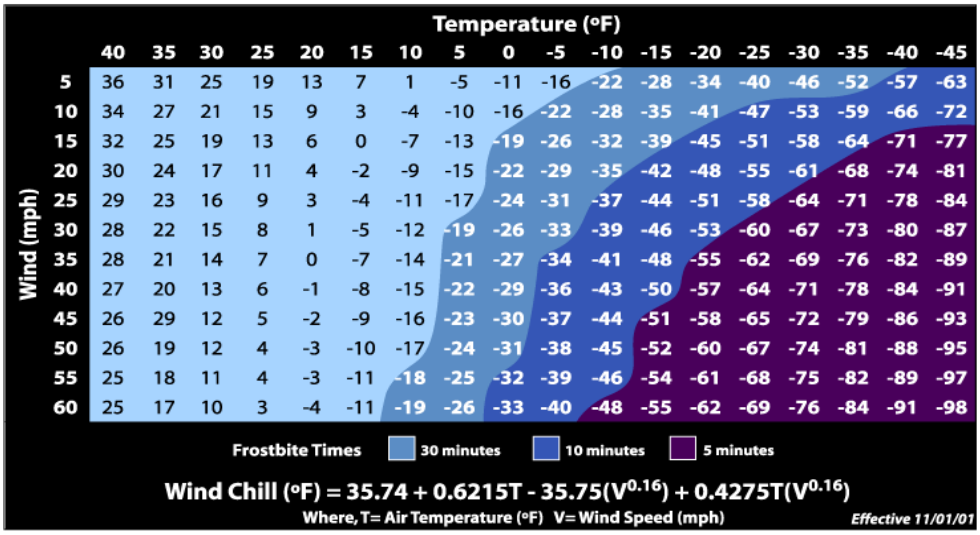
The Texas Panhandle and North Central Texas around Dallas and Texarkana are most vulnerable to severe winter storms. At the same time, these areas are better prepared for severe winter weather. The southern portions of the state are not as likely to incur severe winter weather, but when it does happen, the impact is much stronger because the communities and governments are not as prepared.



Extent – Severe Winter Storm

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. The index was created in 1870, and on November 1, 2001, the NWS released a more scientifically accurate equation which we use today. Following is a

chart for calculating wind chill. (Please note that it is not applicable in calm winds or when the temperature is over 50°).



Wind (mph)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	29	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Previous Occurrences – Severe Winter Storm

Although, the Texas Panhandle and North Central areas around Dallas and Texarkana are most vulnerable to severe winter storms, severe weather can wreak havoc on coastal areas and in the southern tip of Texas.

LOCATION	DATE	PROPERTY DAMAGE
CAMERON (ZONE)	2/3/2011	10.00K
COMANCHE (ZONE)	2/1/2011	100.00K
HAMILTON (ZONE)	2/1/2011	100.00K
FANNIN (ZONE)	2/1/2011	100.00K
SAN PATRICIO (ZONE)	2/3/2011	100.00K
KLEBERG (ZONE)	2/3/2011	100.00K
WEBB (ZONE)	2/3/2011	100.00K
DELTA (ZONE)	2/1/2011	15.00K
LIVE OAK (ZONE)	2/3/2011	15.00K
ERATH (ZONE)	2/1/2011	150.00K
COOKE (ZONE)	2/1/2011	150.00K
DENTON (ZONE)	2/1/2011	150.00K
COLLIN (ZONE)	2/1/2011	150.00K
GRAYSON (ZONE)	2/1/2011	150.00K

HUNT (ZONE)	2/1/2011	150.00K
HOPKINS (ZONE)	2/1/2011	150.00K
HILL (ZONE)	2/1/2011	150.00K
ELLIS (ZONE)	2/1/2011	150.00K
LAMAR (ZONE)	2/1/2011	250.00K
ROCKWALL (ZONE)	2/1/2011	30.00K
SOMERVELL (ZONE)	2/1/2011	40.00K
COASTAL CAMERON (ZONE)	2/3/2011	5.00K
WILLACY (ZONE)	2/3/2011	5.00K
TARRANT (ZONE)	2/1/2011	500.00K
DALLAS (ZONE)	2/1/2011	500.00K
HOOD (ZONE)	2/1/2011	75.00K
JOHNSON (ZONE)	2/1/2011	75.00K
NUECES (ZONE)	2/3/2011	750.00K

http://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=48%2CTEXAS

The charts below list historical record of Severe Winter Storms in Texas.

Historically Significant Cold Wave Occurrences in Texas		
Date	Affected Area	Remarks
Feb. 12 1899	Statewide	Over half the state recorded 0 degree temperatures. Galveston Bay was covered in ice and Tulia set state record at -23°F.
Dec. 1895	Panhandle	Amarillo notched 261 consecutive hours below freezing.
Jan. 1930	Statewide	The temperature got down to 13°F in Galveston.
Jan. 1949	Panhandle , North, East and Central Texas	A cold wave brought below zero temperatures from Dallas to San Antonio. Two ice storms struck the Amarillo – San Antonio – Palestine triangle.
Jan.-Feb. 1951	Statewide	Houston was below freezing for 132 consecutive hours.
Jan. 4, 1959	Panhandle	Spearman, in extreme northern Texas, had a HIGH temperature below 0°F. The low was -22°F.
Jan. 9-12, 1962	Statewide	The temperature dropped to –14°F in the Panhandle and 10°F in the Lower Rio Grande Valley. The Valley saw 65 consecutive hours below freezing.
Jan. 8, 1977	Waco-Longview area	Up to three inches of ice north of a Waco-Longview line caused five deaths.
Sources: Texas and Oklahoma's Greatest Hits, August 5, 2004; Office of the State Climatologist, Texas; Texas State Historical Association, Texas Almanac		

Historically Significant Snowstorm Occurrences in Texas		
Date	Affected Area	Remarks

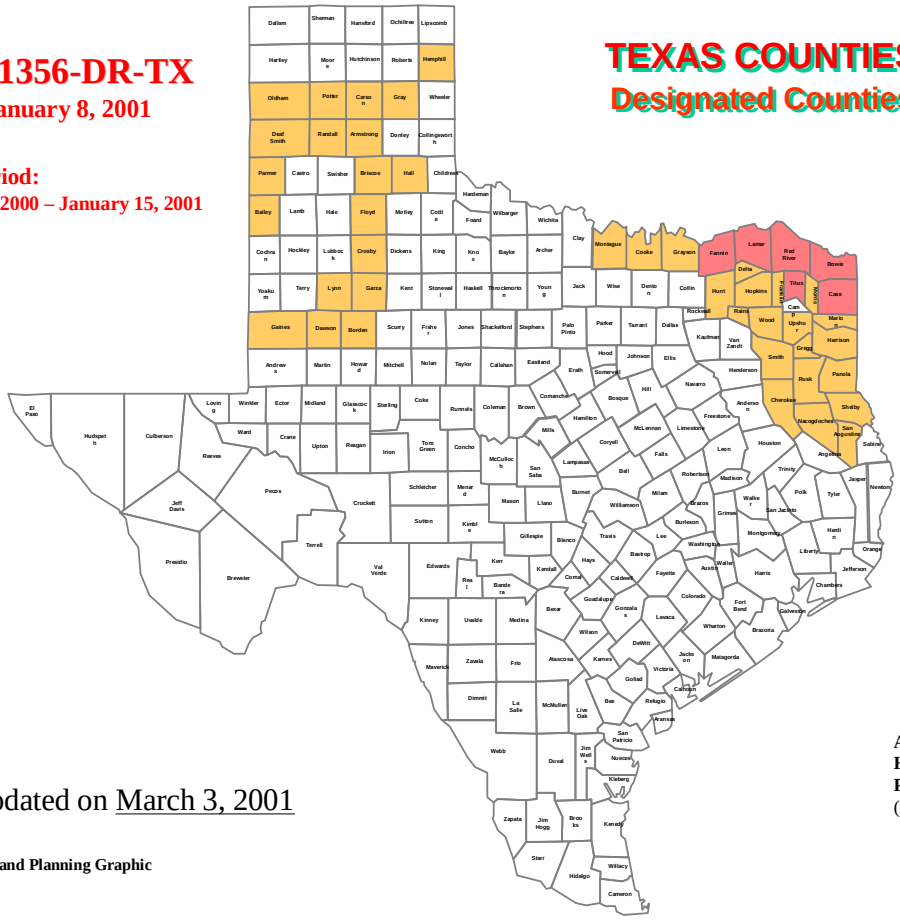
Feb 12-15-1895	Texas Coast	A rare Gulf Coast snowstorm brought up to 20 feet of snow from Houston to Orange.
Feb 2-5, 1956	Panhandle	The all-time single-storm recored was set for Texas when Hale received 33 feet of snow. Twenty people lost their lives.
Feb 20-22, 1971	Panhandle	Drifts of up to 20 feet were reported. Loss of human life was small, but 13,000 head of cattle were lost.
Feb 1-7, 1964	Panhandle	A blizzard produced 25 feet of snow in Borger, with 30 mph winds and drifts of 10 feet.
Dec 1982	El Paso	18.2 inches recorded snowfall, the most in any month.
Jan 20-21, 1983	Panhandle	Estimated 15-18 feet of snow fell from Dalhart to Plainview. Lubbock's monthly total of 25.3 feet breaks previous records.
Jan 12-13, 1985	West and South Central Texas	Accumulations of up to 15 feet fell between San Antonio and the Rio Grande.
Jan 16-18, 1987	Panhandle and South Plains	U to 10-12 inches of snow fell from Swisher to Randall counties. Lubbock recorded up to 117 traffic accidents and four storm-related deaths.
Dec 13-14, 1987	El Paso	16.8 inches of snow fell in El Paso with over 12 inches in the Guadalupe Mountains. The two day total of 22.4 inches shattered single month record of Dec 1982.
Dec 24-26, 2004	Southeast and South Texas	A cold front passed over the state prior to Christmas Eve dropping temperatures below freezing. Another cold front brought snow which accumulated Christmas Eve and into Christmas day. Galveston and Houston recorded 4 inches of snow, while areas even further south, such as Victoria, had 12 inches. Brownsville recorded 1.5 inches of snow.
Sources: Texas and Oklahoma's Greatest Hits, August 5, 2004; Office of the State Climatologist, Texas; Texas State Historical Association, Texas Almanac		

Historically Significant Blizzard Occurrences in Texas		
Date	Affected Area	Remarks
Jan. 10–12, 1918	North Texas	Texas had not suffered such a severe winter onslaught since February 1899. The blizzard brought zero degree temperatures with temperatures from 7°F to 12°F below freezing along the lower coast.
February 1-5, 1956	Panhandle and South Plains	Snowfall was the heaviest on record in Texas. Twenty deaths were attributed to the blizzard.
March 22-25, 1957	Panhandle	Ten dead; heavy livestock losses; transportation halted; 4,000 persons marooned.
Feb. 20-22, 1971	Panhandle	Six to 26 inches of snow were whipped by 40 to 60 mph winds into drifts up to 12 feet. Three persons killed; property and livestock damage at $3.1 million.
October, 1979	Panhandle	9,000 head of cattle lost; thousands of motorists stranded.
December, 1982	El Paso	18.2 inches recorded snowfall, the most in any month.

March 23, 1987	Panhandle	Considered worst spring blizzard in 70 years with snow accumulations of up to two feet. Many schools, businesses and roads were closed with hundreds of motorists stranded and vehicles buried under 12 foot drifts.
February 5, 2008	Moore County	Two dead, five injured; $15.2 thousand in property damage.
Sources: Texas and Oklahoma's Greatest Hits, August 5, 2004; Office of the State Climatologist, Texas State Historical Association, Texas Almanac		
Historically Significant Ice Storm Occurrences in Texas		
Date	Affected Area	Remarks
Jan. 14-15, 1888	South Texas	A rare South Texas ice storm coated the lower valley with one inch of ice.
Jan. 6-12, 1937	Northeast Texas	Worst ice storm in northeast Texas to this date.
Jan, 1956	North Texas	Sleet and freezing rain affected the entire northern half of the state, leaving four dead.
Jan. 8, 1977	Waco-Longview area	Up to three inches of ice north of a Waco-Longview line caused five deaths.
Dec. 30–31, 1978	North Central Texas	Possibly the worst ice storm in 30 years hit Dallas County particularly hard. Damage estimates reached $14 million, and six deaths were storm-related.
Dec. 11-13, 2000	Northeast Texas	Two storms produced up to six inches of ice accumulation, which is an unusually large amount sure to cause widespread devastation. Combined damages in Texas and Oklahoma exceeded $300 million and 27 deaths.
Sources: Texas and Oklahoma's Greatest Hits, August 5, 2004; Office of the State Climatologist, Texas; Texas State Historical Association, Texas Almanac		

FEMA-1356-DR-TX
Declared January 8, 2001

Incident period:
December 12, 2000 – January 15, 2001



Map updated on March 3, 2001

Information and Planning Graphic

Probability – Severe Winter Storm

Texas fluctuates between mild and severe winters on a regular basis:

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.

WINDSTORM

Location - Windstorm

Generally the windstorm risk is greatest in the northern part of the state. The Texas Panhandle is most vulnerable to windstorms as there are not many trees there to provide a natural wind break or barrier. Risk from high winds is greatest on the High Plains of the Panhandle, and just south of there, but the population density in these areas is small. The risk is less but still substantial in the Dallas–

Fort Worth area, but here the population density is also very high. This is the most vulnerable area in the state.

Wind Zones correlate to "design specifications of a shelter or safe room" based on wind speeds with a three-second gust.

Zone 1 = 130 mph
Zone 2 = 160 mph
Zone 3 = 200 mph
Zone 4 = 260 mph

Source: www.fema.gov/safe-rooms/wind-zones-united-states

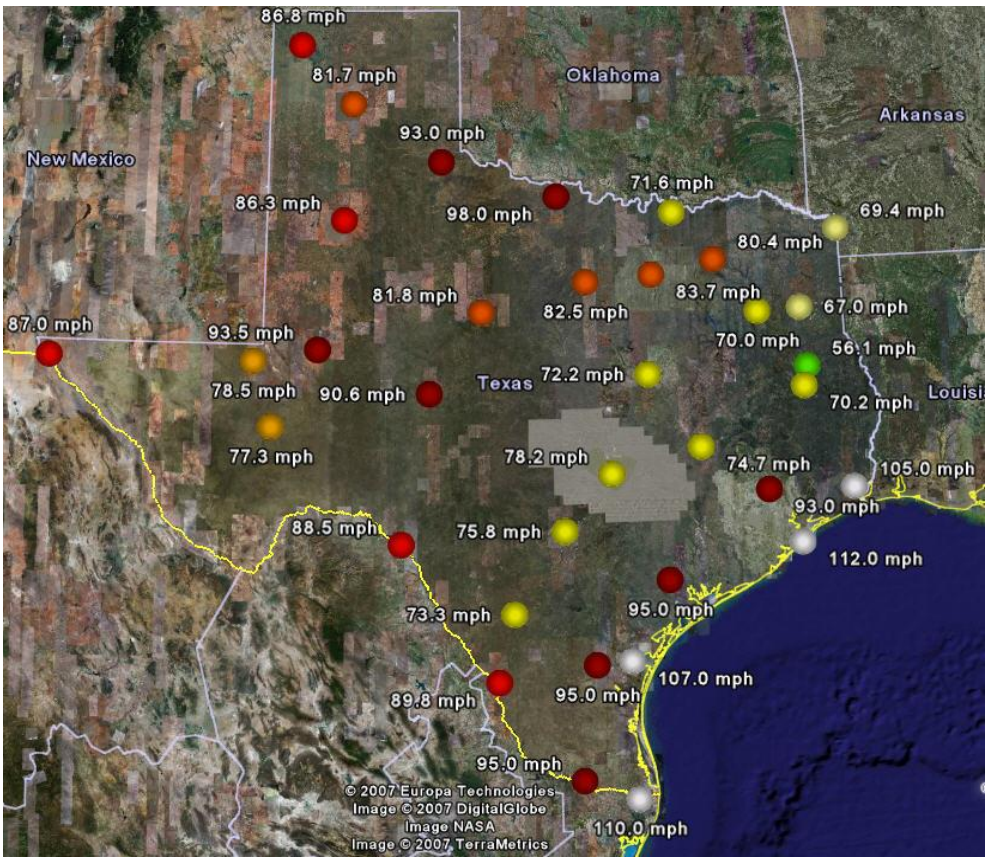
Extent – Windstorm

The generally accepted extent scale for wind events is the Beaufort Wind Scale. The following table lists categories, measurement, classification and appearance descriptions.

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 feet becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 feet taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 feet, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps up, waves 13-20 feet, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (13-20 feet) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Whole trees in motion, resistance felt walking against wind
9	41-47	Strong Gale	High waves (20 feet), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (20-30 feet) 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 (30-45 feet) waves, foam patches cover sea, visibility more reduced	
12	64+	Hurricane	Air filled with foam, waves over 45 feet, sea completely white with driving spray, visibility greatly reduced	

source: www.spc.noaa.gov/faq/tornado/beaufort.html



Wind Speeds (Return Period = 50 yr, Averaging Time = 3 s) estimated from weather stations throughout Texas. (Background courtesy of Google Earth)

Previous Occurrences – Windstorm

Although wind speed of over 72 miles per hour have been documented at weather stations throughout the state as noted in the graphic above, the historical events below demonstrate windstorm occurrences, as opposed to windy winter frontal systems, appear to more recurrently affect certain areas of the state.

Recent occurrences in the Lubbock area made the news. In June 2013, high winds accompanying a thunderstorm left severe damage in its wake, including reportedly derailing a train, downing power lines and tearing up a hospital roof. The Lubbock dust storm of 2011 was reported as one of the worst in decades. Another dust storm in 2012 resulting from 55 mph winds triggered a series of accidents on IH 27.

Historical Significant Extreme Windstorms in Texas		
Date	Affected Area	Remarks
April 29, 1933	Panhandle, South Plains	The dust storm extended from Sweetwater north to Central Kansas and from Albuquerque, New Mexico, to Oklahoma. Newspaper accounts described it as the

		worst sandstorm in years; “as dark as any night” in Perryton. Thousands of acres of small grain crops were blown from the soil.
Jan.–March 1935	Panhandle	Seven times, the visibility in Amarillo declined to zero from dust storms. One of these complete blackouts lasted 11 hours. One of the storms raged for 3.5 days.
Jan. 25, 1965	West Texas	The worst dust storm since February 1956 developed on the southern High Plains. Winds, gusting up to 75 mph at Lubbock, sent dust billowing to 31,000 feet in the area from the Texas-New Mexico border eastward to a line from Tulia to Abilene. Ground visibility was reduced to about 100 yards in many sections. The worst hit was the Muleshoe, Seminole, Plains, Morton area on the South Plains. The rain gauge at Reese Air Force Base, Lubbock, contained three inches of fine sand.
May 17, 1986	Central and Southeast Texas	Strong winds estimated at over 75 mph overturned boats at Lake Livingston, Texas. Six died from drowning and over 100 rescued from Galveston Bay.
May 4-5, 1989	Panhandle and North Texas	Measured wind gusts reached 100 mph at the U.S. Department of Energy's Pantex Plant northeast of Amarillo, 75 mph at Brice, and 86 mph at the Childress airport (Fig 2). Over 100 mobile homes were damaged, overturned, or destroyed. Four tractor trailers were blown over, and a commercial radio transmitting tower was blown down. In addition, many power lines and utility poles were toppled, buildings were damaged, and barns were destroyed. Two people were killed and several dozen injured. Some of the worst damage occurred in Young, Palo Pinto, Hood, Tarrant, Johnson, and McLennon Counties. Over 250,000 customers lost electrical power in Tarrant County (the Ft. Worth metropolitan area) alone.
Jan. 17, 1996	West Texas	A wind event for the history books occurred with a peak wind gust of 128 mph at Guadalupe Pass. The sustained wind was hurricane force from about 10:00 a.m. until about 3:00 p.m. with a maximum sustained wind of 105 mph. Farther south, in southwestern Culberson County, a fatal

		vehicle accident occurred in the eastbound lane of I-10, 14 miles east of Van Horn at 1550 CST. A 56-year-old South Carolina man was killed when he drove his car into a parked trailer truck which had just been involved in an accident.
June 1-2, 2004	North Texas	Dallas-Fort Worth Metroplex area. This event left over 500,000 customers without electric power, injured two people in a mobile home, and caused extensive damage to buildings and trees.
May 2, 2009	North Texas	The National Weather Service determined that a microburst caused the Dallas Cowboys' bubble practice facility to collapse from winds estimated at 70 mph. Twelve people were injured, including one coach who was paralyzed from the waist down. The damage was estimated at $5 million.
June 11, 2009	Central Texas	A peak wind of 67 mph was measured at the Burnet Airport and numerous planes were flipped or blown across the tarmac. Damage in the entire city was estimated at $5 million.
Dec. 19, 2012	Panhandle	A dust storm in West Texas triggered a series of accidents that killed one person, injured at least 17 others and led authorities to close part of Interstate 27 north of Lubbock.
Feb, 25, 2013	South Central Texas	Very strong north winds behind the cold front spread across the region during the late morning through early evening hours. Wind gusts from near 50 to near 60 mph were reported across much of south central Texas. There were reports of widespread damage along the Interstate 35 corridor along with several wildfires.

Search Results for ALL (Zone), More than 500 events were reported between 01/01/2011 and 01/31/2013 (762 days)

Summary Info Windstorm (of first 500 records):

Number of County Zone areas affected:	70
Number of Days with Event:	114
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	2
Number of Days with Event and Property Damage:	16

Number of Days with Event and Crop Damage:	1
Number Event Types Reported:	1

Probability - Windstorm

The table below results from a regression analysis of the measured wind at the Lubbock, Texas airport over the last 40 years. From it we can learn that a manufactured home or barn in the area in the next 10 years should expect to experience sustained winds of 65.3 mph at least once, and will experience winds from a passing thunderstorm of at least 72.8.

Example of High Wind Frequency of Occurrence for Lubbock, Texas

Return Period (years)	Wind Speed (NTS/TS/Mixed)
2	56.4/58.2/60.6
5	61.8/67.0/69.5
10	65.3/72.8/73.8
25	69.8/80.2/80.9
50	73.1/85.6/86.3
100	76.4/91.0/91.5
500	84.6/104.0/104.0

Data in miles per hour.
NTS = non-thunderstorm
TS = thunderstorm
Mixed = recommended design wind

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.

LIGHTNING

Lightning is a massive electrostatic discharge between electrically charged regions within clouds, or between a cloud and the Earth's surface.

A according to The National Lightning Safety Institute http://www.lightningsafety.com the following forms of lightning are defined:

Direct Strike - This is the most dangerous hazard, wherein the person or structure is in a direct path for lightning currents to seek ground. The magnitude of the current determines its effects. A typical amperage of 2OkA acting on a ground of 10 ohms creates 200,000V. A large strike can attain l5OkA levels.

Side Strike - This hazard results from the breakup of the direct strike when alternate parallel paths of current flow into the ground via a person or structure. When the initial current path offers some resistance to current flow, a potential above ground develops and the person or structure's resistance to ground becomes the alternate path of conduction.

Conducted Strike - This hazard occurs when lightning strikes a conductor which in turn introduces the current into an area some distance from the ground strike point. Unprotected connected equipment can be damaged and personnel injured if they become an indirect path in the completion of the ground circuit.

Structure Voltage Gradient - When current passes through two or more structures momentary voltage differentials are created. Poor interconnect bonding may cause a completed circuit potential difference. The same hazard is created, for example, by a person touching an ungrounded object while he himself is grounded. The electrical circuit is completed through him, sometimes with fatal consequences.

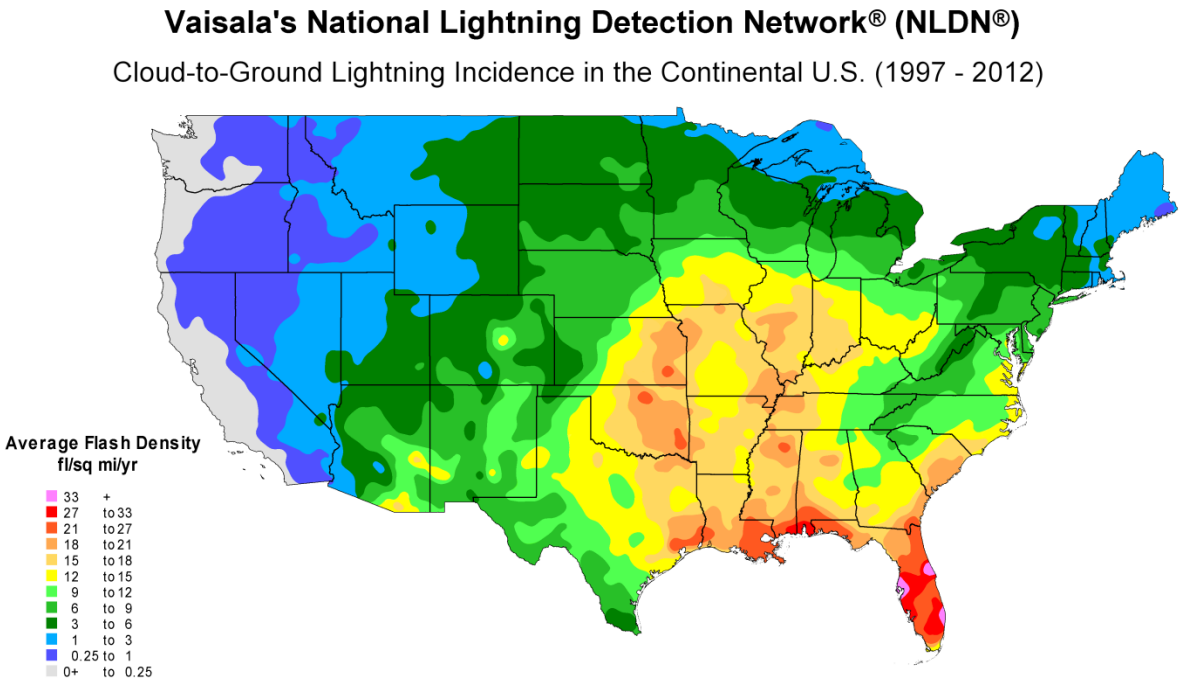
Induced Effects - Lightning can induce electric field and magnetic field coupling into structures and into wiring. Magnetic coupling is transformer action, and the common laws for transformers prevail.

Streamer Conductor - The streamer hazard occurs when a lightning leader influences electric behavior of objects on the earth. Even streamers which do not become a part of the main channel can contain significant amounts of current. Streamer current exposure can affect people and sensitive electronics.

Sequelae - These secondary effects are many. Forest and grass fires, explosive steam conditions in masonry, trees and other water-bearing objects, and consequences of the thunder clap startling a person so as to drop a wrench or inadvertently throw a switch are examples.

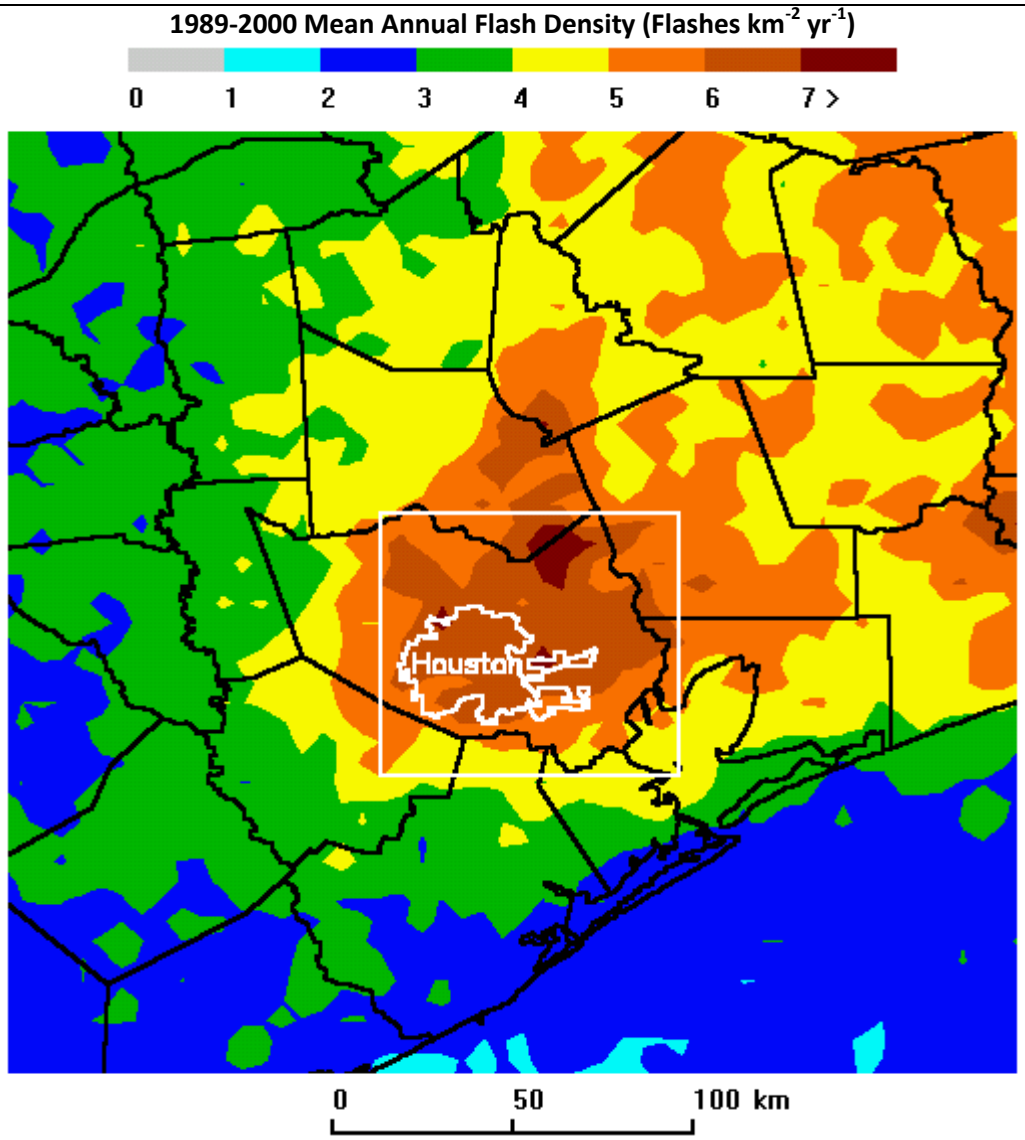
Step Voltage/Touch Voltage - This hazard occurs as a result of a lightning strike hitting the ground and dissipating its energy through the ground. The ground current creates a voltage drop across the surface of the earth, emanating from the earth entry point radially. A person standing on the earth within several hundred feet from the lightning strike point can have several hundred volts generated between his feet. This hazard is identical to a person being grounded while touching two live wires, one with each hand.

Location - Lightning



http://www.lightningsafety.noaa.gov/stats/NLDN_CG_Flash_Density_Miles_1997-2012.png
reprinted with permission from Vaisala

For over twelve years the National Lightning Detection Network (NLDN) has been in operation collecting cloud-to-ground (CG) lightning data for the continental United States. From this data set, areas of enhanced lightning flashes or 'hot spots' have been observed. One such observed hot spot is near the city of Houston, Texas. The phenomenon has been studied with the available data and hypotheses made as to the reason for the lightning hot spot. However, more comprehensive data sets are needed in order to further examine this occurrence. http://www.met.tamu.edu/ciams/heat/intro.html



The map above depicts the mean annual flash density (flashes/km^2/year) for the years of 1989-2000. The Houston metro area is outlined in white, while the white box represents the urban enhancement region (coordinates of its lower left and upper right corners: 29.5° N, 95.7° W; 30.2° N, 94.85° W).

www.met.tamu.edu/ciams/heat/intro.html

Extent - Lightning

Extent for lightning can be expressed in terms of the number of strikes within an interval:

Lightning Activity Level (LAL)	
Activity Levels are valuable guidance tools to aid in the preparation for possible fire initiation from cloud-to-ground lightning.	
LAL 1	No thunderstorms
LAL 2	Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground strikes in a five minute period.
LAL 3	Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a 5 minute period.
LAL 4	Scattered thunderstorms. Moderate rain is commonly produced Lightning is frequent, 11 to 15 cloud to ground strikes in a 5 minute period.
LAL 5	Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a 5 minute period.
LAL 6	Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag Warning.
Source: http://www.erh.noaa.gov/rnk/LAL.htm	

Previous Occurrences - Lightning

The National Oceanic and Atmospheric Administration (NOAA) reports that each year over 400 people are struck by lighting and on average 55-60 result in death while hundreds suffer from permanent neurological disability. In Texas from 1995-2004, 34 people died while another 184 suffered injuries from lightning strikes. The spring and summer months seem to attract the most lightning activity.

Lightning Occurrences in Texas 10/2010 – 6/2013
http://www.ncdc.noaa.gov

Location	County	Date	Deaths	Injuries	Property Damage	Crop Damage
Totals:			3	12	9.020M	0.00K
SULPHUR SPGS	HOPKINS CO.	10/11/2010	0	0	250.00K	0.00K
LINDALE	SMITH CO.	10/23/2010	0	0	20.00K	0.00K

SIMMONSVILLE	BELL CO.	11/1/2010	0	0	100.00K	0.00K
KELLER GOODE ARPT	TARRANT CO.	11/2/2010	0	0	1.000M	0.00K
NINEVEH	LEON CO.	3/14/2011	0	0	50.00K	0.00K
EMORY	RAINS CO.	4/4/2011	0	0	4.00K	0.00K
LIBERTY CITY	GREGG CO.	4/4/2011	0	0	20.00K	0.00K
WILKES SPUR	HUNT CO.	4/25/2011	0	0	0.50K	0.00K
MALAKOFF	HENDERSON CO.	4/25/2011	0	1	0.00K	0.00K
BRIDGEPORT	WISE CO.	5/1/2011	0	0	100.00K	0.00K
LITTLE ELM	DENTON CO.	5/2/2011	0	0	20.00K	0.00K
SLIDE	LUBBOCK CO.	5/11/2011	0	0	124.00K	0.00K
GRAPEVINE	TARRANT CO.	5/11/2011	0	0	7.00K	0.00K
HEWITT	MCLENNAN CO.	5/11/2011	0	0	50.00K	0.00K
KINGSTON	HUNT CO.	5/11/2011	0	0	100.00K	0.00K
FT HOOD AAF	CORYELL CO.	5/11/2011	0	0	50.00K	0.00K
COLLEGE STATION	BRAZOS CO.	5/12/2011	0	0	5.00K	0.00K
WELLBORN	BRAZOS CO.	5/12/2011	0	0	5.00K	0.00K
CARNEY	DENTON CO.	5/22/2011	0	0	5.00K	0.00K
IRVING	DALLAS CO.	5/24/2011	0	1	0.00K	0.00K
EAST DALLAS	DALLAS CO.	5/24/2011	0	0	45.00K	0.00K
DENTON CO.	DENTON CO.	6/21/2011	0	0	100.00K	0.00K
DENTON CO.	DENTON CO.	6/21/2011	0	0	50.00K	0.00K
KAUFMAN CO.	KAUFMAN CO.	6/21/2011	0	0	25.00K	0.00K
PANOLA CO.	PANOLA CO.	6/21/2011	0	0	30.00K	0.00K
COLLIN CO.	COLLIN CO.	6/21/2011	0	0	30.00K	0.00K
WILLACY CO.	WILLACY CO.	6/22/2011	0	0	5.00K	0.00K
WOOD CO.	WOOD CO.	6/28/2011	0	0	150.00K	0.00K
GREGG CO.	GREGG CO.	6/30/2011	0	0	5.00K	0.00K
GREGG CO.	GREGG CO.	6/30/2011	0	0	5.00K	0.00K
TYLER	SMITH CO.	7/4/2011	0	0	30.00K	0.00K
BEAUMONT ARPT	JEFFERSON CO.	7/5/2011	0	0	30.00K	0.00K
AMELIA	JEFFERSON CO.	7/6/2011	0	0	100.00K	0.00K
PINE CREST	JEFFERSON CO.	7/6/2011	0	0	250.00K	0.00K
MEADOW	TERRY CO.	7/12/2011	0	0	15.00K	0.00K
GROVES	JEFFERSON CO.	7/19/2011	0	0	70.00K	0.00K
EDITH	COKE CO.	7/22/2011	0	0	5.00K	0.00K
LUBBOCK	LUBBOCK CO.	8/11/2011	0	0	250.00K	0.00K
VICTORIA	VICTORIA CO.	8/25/2011	0	0	20.00K	0.00K
UNIVERSITY PARK	DALLAS CO.	8/29/2011	0	0	200.00K	0.00K
FT WORTH	TARRANT CO.	9/16/2011	0	0	8.00K	0.00K
PORTWAY ACRES	CAMERON CO.	9/29/2011	0	0	1.50K	0.00K
BOYD	WISE CO.	11/8/2011	0	0	10.00K	0.00K
SAND FLAT	VAN ZANDT CO.	12/5/2011	0	0	7.00K	0.00K
NAVO	DENTON CO.	1/25/2012	0	0	15.00K	0.00K

WEBB	TARRANT CO.	1/25/2012	0	0	10.00K	0.00K
GAINESVILLE	COOKE CO.	1/25/2012	0	0	2.00K	0.00K
HOPEWELL	FRANKLIN CO.	2/4/2012	0	0	20.00K	0.00K
SHERMAN	GRAYSON CO.	3/19/2012	0	0	15.00K	0.00K
LEAGUE CTY SPCLND AR	GALVESTON CO.	3/20/2012	0	0	15.00K	0.00K
KELLER GOODE ARPT	TARRANT CO.	4/8/2012	0	0	12.00K	0.00K
POLTECHNIEC	TARRANT CO.	4/8/2012	0	0	2.00K	0.00K
LAKE TRAMMELL	NOLAN CO.	5/7/2012	0	1	0.00K	0.00K
ANSON	JONES CO.	5/7/2012	0	0	20.00K	0.00K
ZAPATA ARPT	ZAPATA CO.	5/10/2012	0	0	5.00K	0.00K
MC ALLEN	HIDALGO CO.	5/11/2012	0	0	15.00K	0.00K
STUART PLACE	CAMERON CO.	5/12/2012	0	0	5.00K	0.00K
BOONSVILLE	WISE CO.	5/30/2012	0	0	50.00K	0.00K
FAIRFIELD	FREESTONE CO.	5/30/2012	0	0	15.00K	0.00K
FOOT	COLLIN CO.	5/30/2012	0	0	275.00K	0.00K
LEBANON	COLLIN CO.	5/30/2012	0	0	450.00K	0.00K
FOOT	COLLIN CO.	5/30/2012	0	0	275.00K	0.00K
FOOT	COLLIN CO.	5/30/2012	0	0	250.00K	0.00K
BALLINGER	RUNNELS CO.	5/30/2012	0	0	45.00K	0.00K
GRAPEVINE RES	DENTON CO.	5/30/2012	0	0	900.00K	0.00K
ROANOKE	DENTON CO.	5/30/2012	0	0	500.00K	0.00K
NECHES	ANDERSON CO.	5/31/2012	0	0	250.00K	0.00K
PALESTINE	ANDERSON CO.	5/31/2012	0	0	175.00K	0.00K
HEBRON	DENTON CO.	6/6/2012	0	0	60.00K	0.00K
CARNEY	DENTON CO.	6/6/2012	0	0	70.00K	0.00K
PANTEGO	TARRANT CO.	6/6/2012	0	0	30.00K	0.00K
GRAND PRAIRIE	DALLAS CO.	6/6/2012	0	0	30.00K	0.00K
HILLSBORO	HILL CO.	6/7/2012	0	0	68.61K	0.00K
PALESTINE	ANDERSON CO.	6/12/2012	0	0	25.00K	0.00K
JUDSON	GREGG CO.	6/14/2012	0	0	10.00K	0.00K
SHELDON	HARRIS CO.	6/30/2012	1	0	0.00K	0.00K
ORANGE	ORANGE CO.	7/6/2012	0	0	1.00K	0.00K
WAXAHACHIE	ELLIS CO.	7/9/2012	0	0	271.00K	0.00K
SLOCUM	ANDERSON CO.	7/11/2012	0	0	60.00K	0.00K
LITTLE YORK	HARRIS CO.	7/15/2012	2	1	0.00K	0.00K
SHENANDOAH	MONTGOMERY CO.	7/17/2012	0	0	1.00K	0.00K
THE WOODLANDS	MONTGOMERY CO.	7/17/2012	0	0	1.00K	0.00K
EGYPT	MONTGOMERY CO.	7/17/2012	0	0	1.00K	0.00K
SHENANDOAH	MONTGOMERY CO.	7/17/2012	0	0	4.00K	0.00K
THE WOODLANDS	MONTGOMERY CO.	7/17/2012	0	0	1.00K	0.00K
ROCKPORT ARK CO ARPT	ARANSAS CO.	7/18/2012	0	0	10.00K	0.00K
GOLDEN ACRES	HARRIS CO.	7/19/2012	0	0	1.00K	0.00K
MANCHESTER	HARRIS CO.	7/19/2012	0	1	0.00K	0.00K

The list below provides a glimpse of notable lightning strikes in Texas.

NEWARK	WISE CO.	8/6/2012	0	0	200.00K	0.00K
BENBROOK LAKE	TARRANT CO.	8/18/2012	0	0	15.00K	0.00K
SAN ANTONIO	BEXAR CO.	8/18/2012	0	0	50.00K	0.00K
LUBBOCK AIRPARK	LUBBOCK CO.	8/24/2012	0	0	30.00K	0.00K
TELFERNER	VICTORIA CO.	9/13/2012	0	0	5.00K	0.00K
JACKSONVILLE	CHEROKEE CO.	9/13/2012	0	4	0.00K	0.00K
SACHSE	DALLAS CO.	2/10/2013	0	0	250.00K	0.00K
HONEY GROVE	FANNIN CO.	2/10/2013	0	0	100.00K	0.00K
SPRING SKYLINE ARPT	HARRIS CO.	4/2/2013	0	0	35.00K	0.00K
CAMP STANLEY	BEXAR CO.	4/2/2013	0	0	1.000M	0.00K
BURLESON	JOHNSON CO.	4/18/2013	0	0	7.00K	0.00K
ROCKPORT ARK CO ARPT	ARANSAS CO.	4/25/2013	0	0	10.00K	0.00K
BEECAVES	TRAVIS CO.	4/29/2013	0	3	0.00K	0.00K

Historically Significant Lightning Occurrences in Texas		
Date	Affected Area	Remarks
May 12-14, 2000	*Central Texas*	In Bastrop, several people were injured and houses damaged by lightning strikes.
Sept. 14, 2004	*Houston County*	A lightning strike during football practice at Grapeland High School, Houston County, caused one death and injuries to 40 players and coaches.
Aug. 21, 2009	North Texas	Lightning across the Dallas-Fort Worth metropolitan area caused numerous strikes, which unfortunately included a Dallas home going up in flames on the very day a new family was moving in. A family in Fort Worth suffered mostly roof damage and quite a scare when lightning struck their home with family members inside.
Aug. 28, 2009	North Texas	A pregnant woman in Bedford was struck by lightning and had to be revived with CPR before being taken to Parkland Memorial Hospital in Dallas. The woman was struck as she got out of her car, and unfortunately the unborn child

		did not survive and the woman died three days later.
Dec. 25, 2009	Nacogdoches County	A possible lightning strike caused an oil well fire, and isolated flooding and washouts of roadways accompanied the storm.
May 15, 2010	Central Texas	Lightning sparked a fire that completely destroyed a family's home in the Central Texas town of Kyle. The family and their puppies escaped the blaze, which started while they were asleep in their home.
May 17, 2010	Central Texas	A house in Dripping Springs was completely destroyed by a fire resulting from a lightning strike. The house was believed to be empty at the time of the fire.
May 28, 2010	Houston, Texas	A three-game high school baseball playoff series between Brenham and Texas City being played at Reckling Park on the campus of Rice University was postponed due to lightning and excessive rainfall.
Nov. 3, 2010	North Texas	Lightning has caused 12 house fires in the North Texas city of Southlake this past year and city officials are wondering if the city might see a higher frequency of lightning strikes than surrounding areas.
July 8, 2012	North Texas	Lightning reportedly struck the Rangers Ballpark in Arlington, halting a baseball game between the Texas Rangers and the Minnesota Twins. No injuries reported.
May 21, 2013	Northeast Texas	A Texas woman standing outside an IHOP restaurant holding an umbrella was killed when lightning suddenly struck her around 10:30 p.m. Tuesday night in the city of Lufkin.

Sources: Societal Impacts of Climate on Texas: Aug. 2009, Dec. 2009, May 2010, Nov. 2010 Report, Office of The State Climatologist, Texas A & M University; 2013 AccuWeather; May 22, 2013, Lufkin News; Significant Weather, 2000s, Texas State Historical Association, Texas Almanac

Probability - Lightning

According to geology.com, states along the Gulf of Mexico have frequent lightning. Lightning is a frequent occurrence across the state during thunderstorm activity.

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.

HAZARD IMPACTS ON STATE FACILITIES

The State Facility Database was created by TDEM in partnership with the Texas Department of Information Resources and the Texas Natural Resource Information Systems (TNRIS). It provides a GIS database for the state to assess the vulnerability to hazards of state owned or operated buildings, infrastructure and critical facilities.

TDEM updated the State Facility Database of vulnerability and estimated losses in 2009 by funding a grant to TNRIS to create the Geospatial Emergency Management Support System (GEMSS). State agencies and state-owned institutions of higher education can access the GEMSS database to edit and update their building information directly rather than submit that information to TDEM for input. This process improvement gives control to the individual agencies and institutions to maintain their own records and provides the ability for them to determine their own vulnerabilities of existing or new buildings when appropriate.

The analysis for this Update mirrors the 2010 figures. Minimal updates were entered into the State Facility Database during the 2008-2013 planning period, and these did not change the 2010 data in significance. Significant change to state facilities evolves slowly. TDEM will continue to support the updating of the database during the 2013-2016 period but will also consider moving to another state-supported reporting system which does not require voluntary updating.

The typical Texas state building contains a gross area of approximately 56,000 square feet, two to three stories high, and a building structural type of steel frame, enclosed with masonry and glass. The occupancy class is government - general service with an approximate value of $6,800,000. Approximately 30 percent are owned by agencies. The remaining are leased or leased with an option to purchase by the Texas Facilities Commission.

While the typical state building is as described above, state-owned buildings vary tremendously in square footage, cost, building structural type, occupancy class, and number of stories. State structures run the gamut from simple, small, ruggedly engineered structures housing critical equipment such as water pumps and emergency generators, multi-million dollar university nuclear energy research facilities, state schools and hospitals, state correctional facilities, to aircraft hangers and repair facilities.

Flood

1,336 State-owned structures with a structure plus contents value of 857,092,910 (Structure: $711,967,855, Contents: $145,125,055)

Flood Loss Estimates to Texas-Owned Facilities

Depth of Flooding	% Damage to structure	$ Amount	% Damage to contents	$ Amount	Sub-Total (column 3 + column 5)	Grand Total
1’	9	47,961	13.5	14,664	$62,625	$83,667,000
2’	13	69,278	19.5	21,182	$90,460	$120,854,560
3’	18	95,923	27	29,329	$125,252	$167,336,672
4’	20	106,582	30	32,358	$138,940	$185,623,840

For the average annualized loss, we did an average of the figures in column 6 and multiplied by one percent.

The average annualized estimated losses due to floods in the 100-year floodplain are $5,574,820.

Hurricane

In an attempt to manage hurricane evacuation, the state has delineated five hurricane risk areas, and 6 hurricane study sectors; the risk areas correspond to the five categories of hurricane intensity, and the study sectors are simply the length of the Texas coastline divided by the average width of storm-force winds in an average hurricane. This same delineation was used to estimate hurricane losses.

Hurricane losses were estimated due to high winds and storm surge. (Losses in a hurricane due to riverine flooding are counted under losses to flooding.) The following logic was used to estimate losses. As with tornadoes, we assume a 65 mph roof design on state facilities.

Hurricane Loss Estimates to Texas-Owned Facilities
A Category 1 hurricane does 10 percent damage to state facilities in risk area 1, and 0 percent to other facilities.

A Category 2 hurricane does 10 percent damage to state facilities in risk area 2, and 20 percent to facilities in risk area 1.
A Category 3 hurricane does 10 percent damage to state facilities in risk area 3, and 20 percent to facilities in risk area 2, and 30 percent to facilities in risk area 1.
A Category 4-5 hurricane does 10 percent damage to state facilities in risk area 4-5, 20 percent damage to facilities in risk area 3, 30 percent damage to facilities in risk area 2, and 100 percent damage (due to surge) to facilities in risk area 1.

Further, a hurricane only affects one fifth (due to the five study sectors) of the state facilities in a risk area, and the probability of a hurricane strike was derived from NWS statistics. Category 4-5 storms were consolidated due to the inability to quantify the probability of strike based upon only one Category 5 event in recorded Texas history.

Average annualized losses due to hurricanes are approximately $1,488,691.

Wildfire

State-owned structures: 24 structures with a structure plus contents value of $286,050.

According to the Texas A&M Forest Service, there have been no losses to state facilities from wildfires. So we have no historical data on which to base our loss estimates. Only 24 of the 12,340 State structures that have been identified so far are in the Wildland-Urban Interface (WUI) area. The best we can do is to take two percent of the value of the structures to come up with our average annualized loss.

Tornado

10,764 state-owned structures with a total structure plus contents value of $13,778,192,400.

Texas estimated its risk to tornadoes by determining what percentage of its land is covered by a tornado track each year, within each tornado frequency zone, and then assuming an equal percentage of the state's facilities, in that frequency zone, would be struck. National Weather Service data was used to determine the area covered and strength of and average Texas twister. We further assumed all of the state-owned and leased structures are built to code (65 mph) rather than engineered and used 50 percent of the building and contents to estimate losses when a tornado struck a building.

Average annualized losses due to tornadoes are approximately $2,878,766.

Drought

Does not cause damages to state-owned or operated facilities.

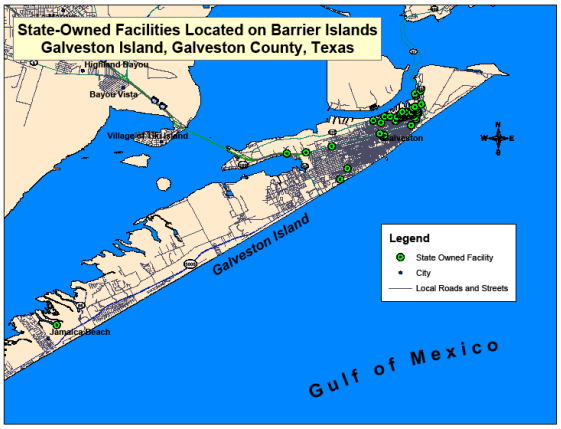
Coastal Erosion

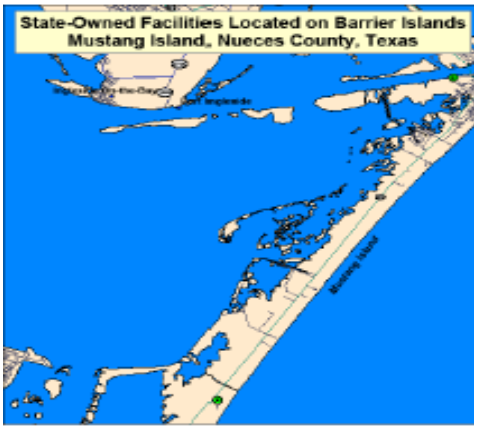
Although TDEM has no captured costs from loss, the now defunct Highway 87 that runs on Bolivar Peninsula from Sea Rim State Park to High Island, was washed out repeatedly from storms resulting in 20 miles of eroded highway. As the coastline retreated from numerous storms, the road became as close as 100 feet from high tide in places.

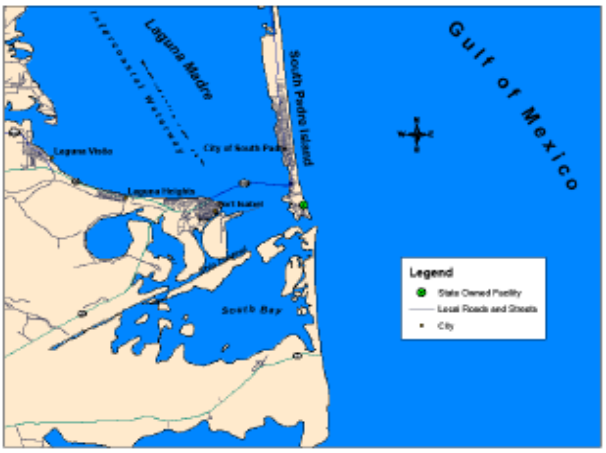
The vast bulk of state facilities are behind the seawall on Galveston Island and at no risk from coastal erosion. One facility, in the vicinity of Jamaica Beach, is a Texas Parks and Wildlife facility valued at $83k. The beach is retreating in this location, but at the current rate it will still be there in 50 years, we therefore assess no annual damages against it.

The beach near Port Aransas is accreting, while the beach on Mustang Island is stable. We therefore assess no damages against the two state facilities shown. The beach at South Padre Island is accreting in the vicinity of a state facility; but erosion will not threaten this facility in the near future.

The state has no record of damages from coastal erosion, and none appear to be threatened in the near future.







Dam/Levee Failure

Does not cause damages to state-owned or operated facilities, as none are located in this risk area.

Earthquake

While the most severe earthquake in the state's history is the magnitude 6.0 Valentine, Texas, earthquake of 16 August, 1931, there are very few state facilities in that area. A better indicator of earthquake risk to state facilities is one near a populated area. The 4.2 magnitude earthquake near Fashing in Atascosa County on 9 April 1993 (near San Antonio) fits this description.

The State Facilities Database is not configured yet to run under HAZUS-MH Earthquake. Using the 1993 Fashing earthquake data with today's background census data results in $145,540 in damages to all government facilities. Assuming government facilities are equally distributed with one third each local, state and federal, this results in damages to state facilities of $48,513 from a similar event.

Converting this to an annual figure results in earthquake damages with annualized losses of $3,465.

Expansive Soils

This loss data is difficult to ascertain. First, a large percentage of the state's business is conducted in leased buildings, so foundation repairs are passed on to the owner, not absorbed by the state. State buildings tend to be more like commercial construction and thus have a much lower loss rate than residential construction. Losses due to pipe breaks from differential soil expansion are buried in routine maintenance figures. State buildings never change hands so a reduction in value due to wall/foundation cracks is never detected. Finally, even when foundation repair bills are reported, it is not apparent if the repair was from soil expansion or from some other source, such as erosion.

A loss to Texas highways from expansive soils is an issue that should be considered by the next Update. According to a TxDOT/FHA report, "pavement structures deteriorate under the combined effects of traffic loading and environmental conditions such as moisture changes. The effect of moisture changes can be particularly detrimental in many locations of Texas, which are characterized by the presence of expansive clays."[1]

Extreme Heat

Extreme heat does not cause damages to state-owned or operated facilities.

Hailstorm

[1] Zornberg, J.G. [and others] " Validating Mechanisms in Geosynthetic Reinforced Pavements". CRT Technical Report 0-4829-1. February 2008.

Using insurance industry figures for commercial structures, a H3 storm would inflict $2,764 in damages, mostly for window damages to state-owned facilities. Reducing this figure per storm to an annual amount will result in damages of $1,316.

Damages from hailstorm are estimated to have an annualized loss of $1,316.

Land Subsidence

There are no known estimates of damages to state-owned or operated facilities from land subsidence.

Severe Winter Storms

Claims against the FEMA Public Assistance program for repairs to state facilities totaled $13,050,000 in DR-1356 a major disaster declaration January 8, 2001 that covered 46 declared counties.

Damages from winter storm are estimated to have an annualized loss of $2,175.

Windstorm

Developing losses to state facilities from high winds is fairly straightforward. Assuming state facilities in interior counties are built to the state-mandated 90 mph code and applying the FEMA developed estimate of 2.5 percent damage per mph over design winds yields no losses in the 2, 5, 10, 25, and 50 year events. 2.5 percent damage is accrued in the 100-year event ($130,459,306) and 35 percent in the 500-year event ($1,826,430,282).

These figures initially appear substantial, but when converted to annual damages total a more reasonable $495,745.

Lightning

There are no known estimates of damages to state-owned or operated facilities lightning; therefore, the annualized losses are zero.

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Section 3 – HAZARD MITIGATION STRATEGY

The team must identify desired outcomes, and then identify and implement actions to achieve those outcomes. These measurable outcomes are the objectives of mitigation. Examples include protecting residents against bodily injury due to tornadoes or removing homes in the floodplain to eliminate deaths and property damage during flood events. These objectives provide structure to broader, un-measureable goals, the overarching "*purpose*" of our objectives and the subsequent actions taken.

IDENTIFIED GOALS

The update assessment began with reviewing the 2010 mitigation goals and expanding on them.

Mitigation is a complementary part of an effective comprehensive emergency management program. TDEM's mitigation goals share much in common with emergency management's preparedness, response, and recovery missions. These are:

Goal 1 ***Reduce or eliminate hazardous conditions that may cause loss of life***

Goal 2 ***Reduce or eliminate hazardous conditions that may inflict injuries***

Goal 3 ***Reduce or eliminate hazardous conditions that can cause property damages***

TDEM and other state agencies continue to cultivate cooperation among partner agencies whose mitigation goals are similar. This helps all agencies achieve their goals. For example, degradation of important natural resources, such as erosion of public beaches, is a growing concern which led TDEM to work more closely with the General Land Office.

Goal 4 ***Reduce or eliminate hazardous conditions that degrade important natural resources***

Repetitive losses due to flood events continue to plague areas of the state. Even with aggressive policies to support acquisitions through HMA funding, new vulnerable developments appear to be built at the same rate that flood-prone structures are removed. It has been the practice of the TWDB to include as a goal the reduction in repetitive flood losses to meet SRL cost share requirements. This goal has been added to the plan's goals to include all types of repetitive losses due to frequent probability of events.

Goal 5 ***Reduce or eliminate repetitive losses due to frequent probability of occurrence***

In addition, the team has agreed that the lessening of economic losses within a community should be addressed as a mitigation goal. Economic loss due to structural damage will ultimately hinder the

long-term recovery of a community; lessening economic loss results in communities that are more resilient and sustainable:

Goal 6 Lessen economic impact within communities when hazards occur

All the above goals guide the selection of mitigation projects. The overall goal of the plan is to motivate state and local agencies, as well as the private sector, to prevent or lessen the effects of hazards by establishing priorities for hazard mitigation programs and implementing pre-identified actions.

TDEM achieves its goals through successful implementation of actions at the local level. However, the team recognizes that no matter how good mitigation may be in theory, it is of little value unless the local jurisdictions are able plan out a strategy and implement actions. Our challenge at the state is to encourage and assist the local communities to embrace mitigation as a valuable tool. This is achieved through offering funding opportunities and technical assistance for mitigation planning and project implementation.

FEMA's hazard mitigation assistance (HMA) grant programs provide funding opportunities for pre- and post-disaster mitigation. While the statutory origins of the programs differ, all share the common goal of reducing the risk of loss of life and property due to natural hazards. The grants are provided to the state if it has an approved State Hazard Mitigation Plan. The state, in turn, provides sub-grants to local governments and communities with approved mitigation plans.

FUNDING PRIORITIES

The plan ranks several natural hazards based on annualized losses to property, captured from local mitigation plans, and uses this ranking as a decision tool to channel grant funds to the greatest need. These top hazards are determined to most likely impact the state, incur the greatest losses, and impact the most people. The hazards that were projected to have the highest overall losses are ranked as follows -- flood, hurricane, wildfire, tornado, and drought. These top hazards also correspond closely to the top natural hazards identified regionally in a questionnaire sent to local jurisdictions, as discussed in Section 2.

Any mitigation project proposed for funding though the federal hazard mitigation assistance grant programs administered by TDEM including state agency projects, must:

- Support the goals and objectives of the State Hazard Mitigation Plan
- Be cost effective, technically feasible, environmentally sound and target the greatest need

It is important to remember that it may take years to accomplish objectives and possibly more years before a similar hazard event occurs again to determine if specific mitigation projects are successful. With this in mind, the team will continue to monitor the effectiveness of Texas' mitigation goals and strategies and may amend them at any time to enhance the state's capabilities.

CAPABILITY

The TDEM Mitigation Section works on an active and ongoing basis with local governments to identify those actions most cost beneficial and feasible for mitigation grants and planning. The ability to implement actions depends on the locals' capabilities.

Cities and counties look to the Texas constitution and statutes to determine what they may or may not do. Authoritative capability in Texas is generally determined through home rule law. Texas has a long history of home rule whereby cities of 5,000 or more populations may elect a home rule charter. With this charter, jurisdictions have the authority to enforce building codes and many other regulations that affect hazard mitigation.

In contrast, the powers of small cities (<5000), those cities that do not adopt a home rule charter, and all counties are limited as general law municipalities. These cities and the counties are restricted to doing only what the state directs or permits them to do. If a general law city or county has not been granted the express or implied power by the state to initiate a particular action, none may be taken. Texas does not give authority to counties for certain actions or enforcement activities such as zoning or building codes because there is no enabling legislation. Floodplain regulation is granted, as are certain fire measures. Until authority and enabling legislation is granted to these governments through the Texas Legislature, counties cannot enact building and land management standards or use of zoning as a means to regulate development. A consequence of this is that minimal building standards are observed in rural areas while municipalities exercise complete authority to set higher standards for the protection of life and property. Incorporated cities in Texas have limited authority for various purposes in areas beyond their city limits. Extraterritorial jurisdiction (ETJ) extends for different distances depending upon the number of inhabitants in a city. An ETJ enables a city to extend regulations related to certain aspects of development to outside their city limits.

Our Texas Constitution prohibits the state from establishing state level zoning ordinances, and there has been no push to change this. Frequent legislative attempts to modify enabling legislation to give county governments the authority to regulate zoning and to adopt building codes have never been successful.

LOCAL CAPABILITY PER INTERNAL FACTORS

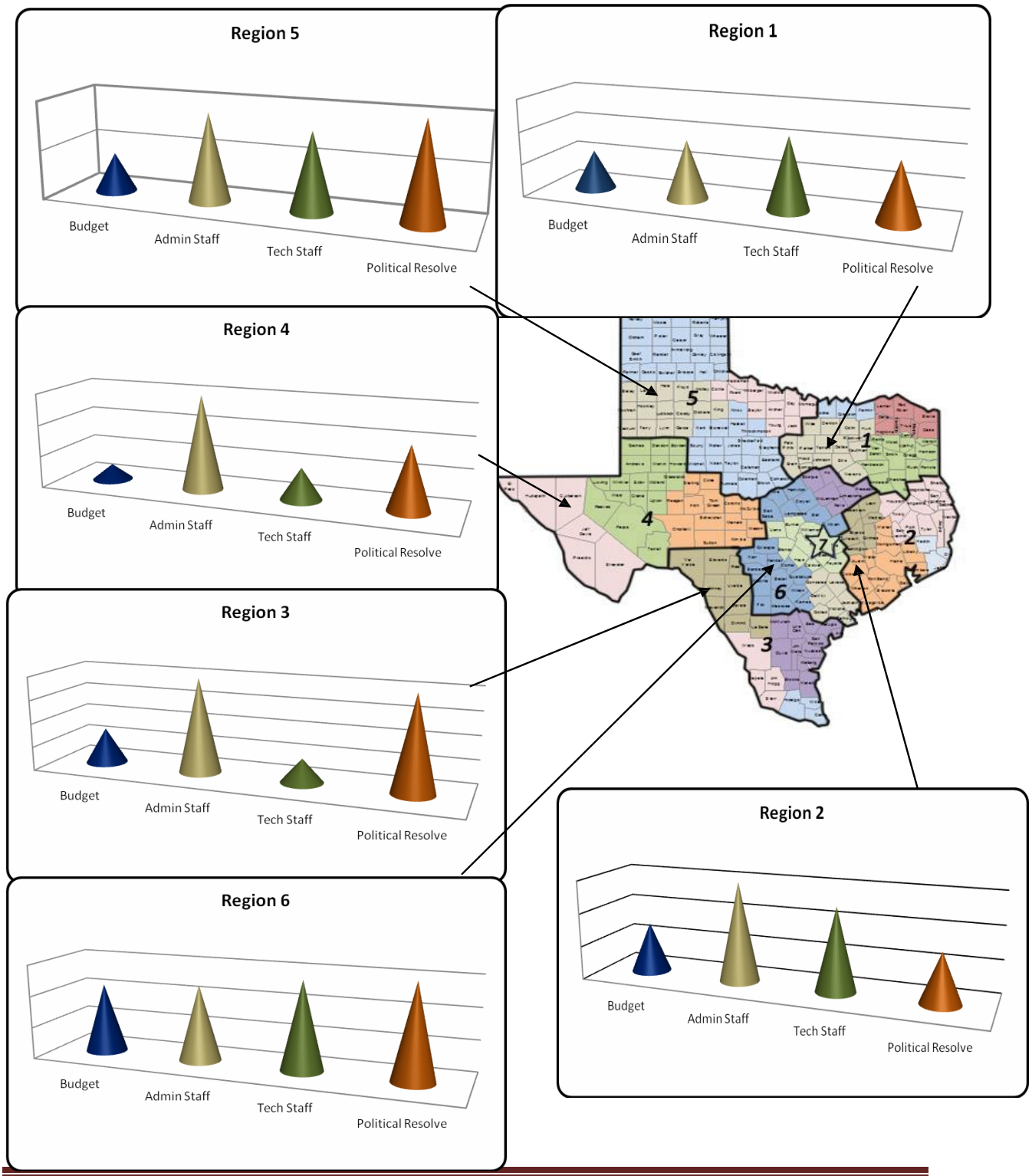
Internal administrative and financial factors also contribute to local capability. Does the community have the resources to implement actions – does it have the staff, the expertise, the money, the political will it takes to move mitigation forward?

To capture the current local capability at this level, staff distributed a detailed questionnaire to the emergency management coordinators located in all 254 county seats and six to TDEM Regional Coordinator representing the eyes and ears on local conditions. Responses provided data regarding relative effectiveness of both local authority (International Residential Code, National Flood Insurance Program, fire protection codes and zoning), and internal factors (local budgets, administrative staff, technical staff and political resolve).

Although the sample was small, and not intended to be statistically accurate at the regional level, the findings support what the staff perceives as reasonably representative conditions.

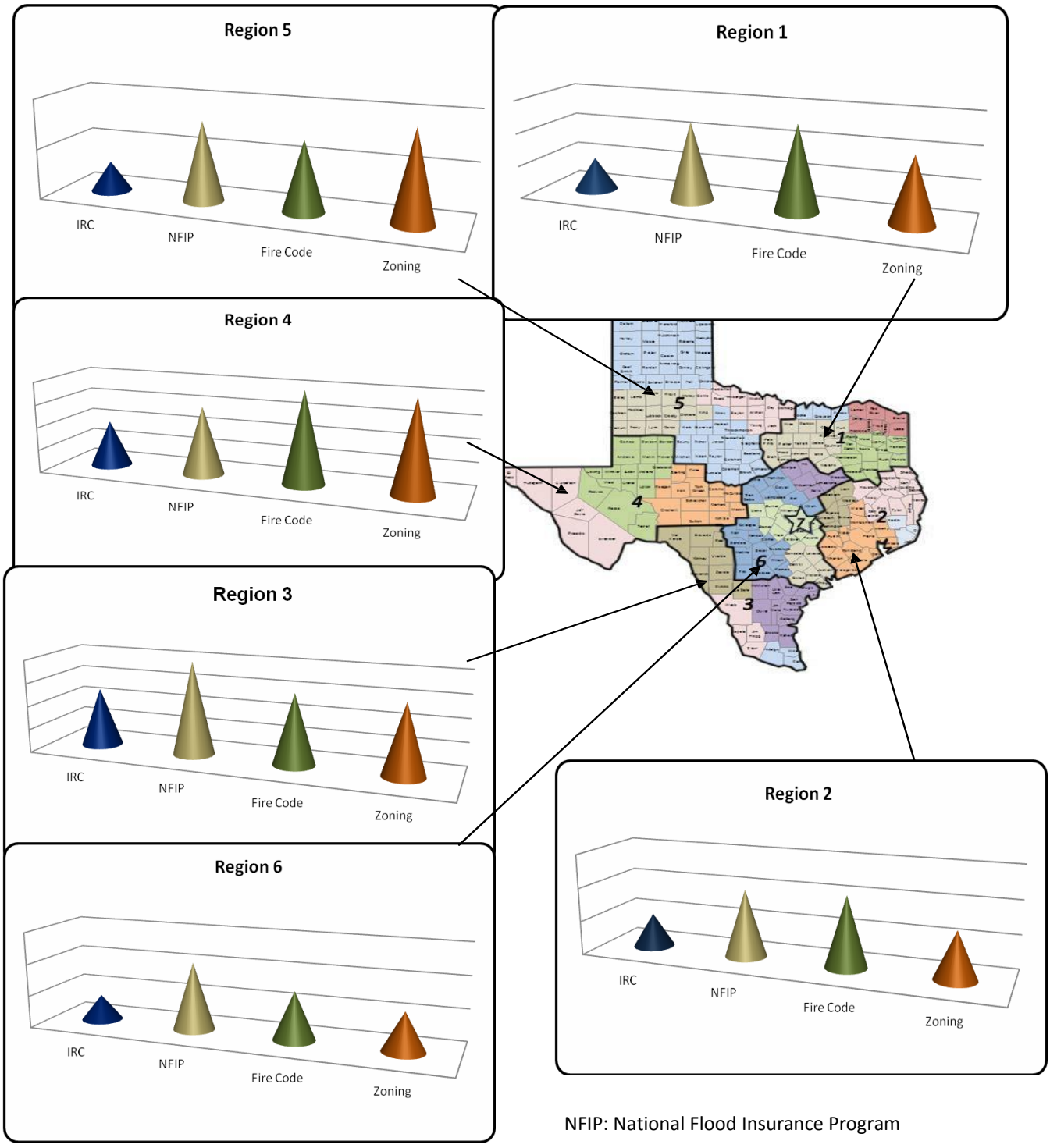
Summary of Questionnaire

Ranking Effectiveness of Internal Capacity in Mitigating Damages



Summary of Questionnaire

Ranking Effectiveness of Authorities in Mitigating Damages



NFIP: National Flood Insurance Program

STATE CAPABILITIES

Texas lacks the ability to conduct any statewide enforcement of policies, programs or other measures due to restrictions in the state constitution. Because the constitution establishes Texas as a home rule state – any power that is not specifically stipulated in the constitution as a state power goes to the local jurisdictions. In other words, Texas is constitutionally prohibited from statewide enforcement of any statewide measures. The state's pre- and post-disaster hazard management measures are thus limited to grant allocation and management of funds, public outreach and education programs, and non-enforceable statewide or regional incentives and disincentives.

Pre- and Post-Disaster Hazard Management:

Incentives: The state currently does not have measures to incent or dis-incent adoption and enforcement of local building codes or of land use restrictions. There are small incentives in the form of reduced homeowner insurance rates through the Institute for Building and Home Safety and NFIP/CRS programs. These incentives have thus far proved to be too small to drive homeowners and communities to adopt them widespread. In recent years TDEM, through the HMA grants of HMGP and PDM, began offering a rebate incentive for builders and homeowners to build or install individual safe rooms. This program has raised the viability and the visibility of individual safe rooms in high tornado/windstorm regions of Texas.

Education and Outreach: The state does conduct extensive outreach and education programs to get the message out to communities on why they should adopt and enforce more stringent building codes and land use restriction, and other pre-hazard management messages, including the successful "Turn Around Don't Drown" (TADD) campaign to remind drivers not to drive into flooded roadways. Pre-disaster training measures to reduce wildfire risk and education on reducing water consumption are other hazard specific education and outreach directives.

Better Floodplain Management: The number of well-trained floodplain managers has grown dramatically over the past decade, and they are better trained, resulting in better floodplain management practices. A significant amount of mitigation grant funding goes toward the purchase of repetitive flood properties. The result is the rate of increase in the number of repetitive flood is now less than the state's population growth, even though there are more repetitive flood properties now than there were ten years ago. However, the total number of individuals at risk is lower. The situation is trending toward improvement. State post-disaster management is largely via grant funded mitigation.

Construction of Community Safe Rooms: TDEM has directed mitigation grant funding toward community safe rooms in areas that are densely populated. Multi-hazard safe rooms mitigate injury during hurricane and tornado events.

Limited Development in Coastal Areas: Although Texas does not have authority to develop or enforce land use restrictions, the combination of the Coastal Barrier Resources Act (COBRA), expansion of state and federal parks and reserves, and expansion of conservation land trusts has vastly reduced coastal land that is viable and available for development. The effect is Texas is not seeing an increase in storm surge areas.

The SHMT reviews, evaluates and discusses both pre and post-disaster measures on an annual basis to determine if the measures in place need revision. In 2013, the team members deemed the state's pre-disaster hazard management to have some strong aspects and some limited aspects. The team's assessment of the state's post-disaster hazard management that it is of value via judicious use of grant funding, mitigating damages and injury from the state's most threatening hazards. The team also determined the measures in place were acceptable and will continue to recommend ongoing improvement in pre- and post-disaster mitigation projects, actions and programs.

The most effective mitigation measures are**:**

- Building Codes
- Land Use Restrictions

As indicated in the previous discussion regarding home rule limitations on state powers, Texas can neither designate nor enforce either of these measures, all team members and stakeholders can encourage implementation and enforcement through outreach and education.

An evaluation of Texas statutes, regulations, policies, programs and state funding capabilities related to hazard mitigation is discussed below.

Texas Government Code Title 4 Subtitle B Chapter 418 Subchapter A Also known as the Texas Disaster Act of 1975	These sections discuss county, municipal, and inter-jurisdictional emergency management programs. It is by this code that counties retain EMCs and collect and provide information to support emergency management programs. Section 418.102 articulates that a county "shall maintain an emergency management program or participate in a local or inter-jurisdictional emergency management program that, except as otherwise provided by this chapter, has jurisdiction over and serves the entire county or inter-jurisdictional area." In addition, Section 106 states: "Each county shall prepare and keep current an emergency management plan for its area providing for disaster mitigation, preparedness, response, and recovery." Annex P Hazard Mitigation Plan describes how they handle hazard mitigation in their community. It requires the EMPG jurisdictions to address mitigation issues.
Texas Administrative Code, Title 28, Part 1, Chapter 5, Sub-Chapter E	To be eligible for catastrophe property insurance construction, repairs or additions made shall comply with the 2000 IRC Section 5.4007-5.4011 Applicable Building Code Standards in Designated Catastrophe Areas for Structures Constructed, Repaired or to Which Additions Are Made.
Texas Water Code Title 2, Chapter 16,	Adopt more comprehensive floodplain management regulations that the political subdivision determines are necessary for planning and appropriate

Sec. 16.315	to protect public health. Participate in floodplain management initiatives such as the National Flood Insurance Program's (NFIP) Community Rating system (CRS).
Texas Water Code, Title 2, Chapter 16, Sec. 16.3145	The governing body of each city and county shall adopt ordinances or orders, as appropriate, necessary for the city or county to be eligible to participate in the NFIP program.
Local Government Code, Chapter 240, Subchapter Z Section 240.906 and Chapter 352, Subchapter D	Authorizes counties to prohibit or restrict outdoor burning and provided for a criminal penalty. Allows counties to issue burn bans if drought conditions exist in a county (determination by the Texas Forest Service). Jurisdictions (cities and counties) have used this tool (burn bans) to prohibit outdoor burning thereby decreasing the probability of grass and wildfires.
Local Government Code, Chapter 240, Subchapter Z Sec. 240.901	Authorizes land use regulation for flood control in coastal counties.
Texas Insurance Code Title 10 Chapter 2210 Sec. 2210.251	Provides certain inspection requirements for structures to be considered insurable property for windstorm and hail insurance through the Texas Windstorm Insurance Association (TWIA). All new construction, repairs or additions after January 1, 1988, shall be inspected or approved by the Texas Department of Insurance for compliance with the building specifications adopted by the Commissioner of Insurance. Insurers may offer insurance premium discounts to insureds statewide for eligible impact-resistant roof coverings.
Coastal Coordination Act of 1991 Texas Natural Resources Code Chapter 33 sec. 201 et. seq.	The Texas Coastal Management Program (CMP) calls for the development of a comprehensive long-range plan for the coast in cooperation with state agencies, local governments, and coastal citizens. It established the Coastal Coordination Council to oversee the development of the state's coastal management plan, to adopt coast-wide management policies, and to implement the plan and designate the physical boundary for the coastal area.
Coastal Erosion Planning and Response Act (CEPRA) Texas Natural Resources Code Chapter 33 Subchapter H	To address the erosion problem along the Texas coast, in 1999, the 76th Texas Legislature authorized the GLO to administer coastal erosion control grants in partnership with local governments, state and federal agencies, non-profits, and homeowner associations. Funding for CEPRA comes from state funds appropriated each biennium. The 81st Texas Legislature provided approximately $25 million in state appropriated funding for Cycle 6 projects in the FY2010 – FY2011 biennium.
Beach and Dune Rules	Provides regulatory guidance to local governments for the administration of the Open Beaches Act (OBA) and the Dune Protection Act (DPA) generally

31 Texas Administrative Code Section15.1 et. seq.	within 1000 feet landward of mean high tide. The Texas Legislature adopted the OBA in 1959 to authorize the GLO to enforce a public beach easement from mean low tide to the natural line of vegetation, guaranteeing the public free and unrestricted access. The Texas Legislature enacted the DPA in 1973 in recognition of the importance of sand dunes as a state natural resource for the health of the beach and for the protection they provide during storms.
The Coastal Impact Assistance Program (CIAP) was authorized by Congress with the enactment of Sec 384 of the Energy Policy Act of 2005 (Act), amending Sec 31 of the Outer Continental Shelf Lands Act	The Coastal Impact Assistance Program (CIAP) was authorized by Congress with the enactment of Section 384 of the Energy Policy Act of 2005 (Act), amending Section 31 of the Outer Continental Shelf Lands Act. The purpose of CIAP is to assist coastal states in mitigating the impacts associated with Outer Continental Shelf (OCS) oil and gas production through the disbursement of funds. Under the provisions of the Act, the authority and responsibility for the management of CIAP is vested in the Secretary of the Department of the Interior, who delegated this authority and responsibility to the Minerals Management Service (MMS), which in 2010 became the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE). The purpose of CIAP is to assist coastal states in mitigating the impacts associated with Outer Continental Shelf (OCS) oil and gas production through the disbursement of funds. Under the provisions of the Act, the authority and responsibility for the management of CIAP is vested in the Secretary of the Department of the Interior, who delegated this authority and responsibility to the Minerals Management Service (MMS), which in 2010 became the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE). The Act requires the designation of the state agency that will have the authority to represent and act for the State in dealing with BOEMRE for CIAP purposes. Governor Rick Perry named the Office of the Governor as the designated state agency for the Texas CIAP and appointed the GLO as the administrative agency for CIAP. To oversee the state portion of the CIAP program, on January 26, 2006, Governor Perry established a three-member Coastal Land Advisory Board (CLAB). The CLAB is comprised of commissioners from the Texas General Land Office, Texas Railroad Commission, and the Texas Department of Transportation.
Texas Water Code Title 2 Subtitle C Chapter 16	The Texas Legislature enacted enabling legislation in 1999 to have a proactive approach to drought planning by mandating a formal organization comprised of State and Federal agencies within the State to manage drought, emphasize drought monitoring, assessment, preparedness, mitigation and assistance.
Texas Administrative Code Title 30 Chapter 299 sec 299.61	TCEQ rules require the owners of high and significant classified dams to submit Emergency Action Plans (EAPs) to the TCEQ by Jan. 1, 2011, unless they have requested and received an extension of this deadline.

STRATEGY

In the plan's Introduction, the concept of mitigation was introduced and defined. This plan speaks to the need to "doing something today to reduce tomorrow's risk," and to "break the repetitive cycle of response to and recovery from natural hazards by implementing mitigation actions that produce long-term solutions."

Again, as the planning process moves forward over the next three years, the State will "team" together to mitigate losses from natural hazards by working together on strategy to achieve our common goals. With each update, the plan presents a status report on the previous mitigation actions identified.

Previous Actions

Below is a status report on the 2010 plan's actions.

2010 Tornado Mitigation Strategies Status Report	
Promote and provide for the protection and safety of the population in the state. This includes the adoption and enforcement of appropriate building codes and/or design criteria, construction of area mass shelters in public facilities, schools, mobile home parks, etc., the construction of safe rooms in homes, and other public or personnel protective shelter initiatives. In 2006, TDEM added the individual safe room grant program under HMPG and PDM to better provide for the protection and safety of the people.	Ongoing
Promote and provide for expanded coverage options for standard peril and windstorm insurance coverage for public and private property. This strategy is ongoing.	Ongoing
Promote and provide enhanced, statewide awareness, along with information, instructions, and guidelines concerning risks, consequences, public safety, and mitigation of the tornado hazard.	Ongoing
Promote and provide enhanced warning capabilities that ensure 90 percent or more of the state's population receives accurate and timely warnings and adequate reaction time prior to the occurrence of weather related disaster events. This includes actions to enhance and expand hazard occurrence indicators such as volunteer storm-spotters networks; river, tide, seismic, wind and rainfall gauge systems; and data collection projects such as post-storm analysis that collect and record damage area footprints and high water markers, etc. This also includes actions that proactively pursue installation of additional NOAA weather radio transmitters by local governments, schools districts, state	Ongoing

agencies, river authorities and civic-minded groups in all parts of the state not yet under the umbrella of NOAA. This strategy is ongoing.	
Require all new state construction to meet IRC wind speed. This strategy is ongoing.	Ongoing

2010 Wildfire Mitigation Strategies Status Report	
TFS maintains an Wildland Urban Interface traveling exhibit that illustrates and demonstrates what can be done to protect a home and property with just a few steps for making a home fire-wise. The exhibit van is wrapped in illustrations depicting the seven regions of Texas complete with wildland, vegetation, and construction similar to those found in rural areas. The trailer wrap depicts homes, wild lands, and firefighters fighting rural fires.	Ongoing
TFS maintains a web site that contains a number of fire safe mitigation initiatives such as how to protect homes from wildland fires; explaining wildland urban interface and risk reduction measures to take by property owners; and a number of other risk reduction topics. The website may be found at http://texasforestservice.tamu.edu.	Ongoing
The Texas Education Agency requires fire prevention and safety to be taught in public schools. Adherence to this requirement varies from district to district.	TFS offers school fire prevention programs primarily through school districts in East Texas
TFS Predictive Services staff calculates and predicts the statistical probability of fire occurrence and behavior; disseminate wildfire assessment information to elected officials, including KBDI drought information for burn ban determinations; and works with the National Weather Service to determine areas of extreme fire danger to pre-position personnel.	Ongoing
TFS Prevention staff work with local governments and the public to develop targeted prevention campaigns based on local fire activity.	Ongoing
TFS Wildland Urban Interface staffs help communities determine wildfire risk levels, identify hazards, and determine mitigation treatment options through the Community Wildfire Protection Plan (CWPP) process. A user-friendly CWPP “template” is available online to empower communities to determine their own choices for reducing wildfire hazards.	Ongoing CWPPs are prepared by the jurisdiction and the TFS is a participant in the CWPP Process
TFS provides technical support for the development of Firewise	Ongoing

Communities USA.	
TFS sponsors two Wildland Fire Training Academies annually. A spring academy held in Lufkin and a fall academy held in Bastrop. The Rural Volunteer Fire Department Assistance Program (HB 2604) provides training grants for volunteer firemen to receive nationally certified wildfire and emergency management training.	Ongoing
TFS makes available Southern Fire Risk Assessment System (SFRAS) maps available to communities and counties. These maps can be used for wildfire mitigation purposes including maps which depict surface fuels, wildfire occurrence, urban wildland interface areas, wildfire suppression difficulty, etc.	Evolved – SFRAS is available through TxWRAP

2010 Drought Mitigation Strategies Status Report	
TDEM will provide training and educational programs focusing on the preparation of emergency management coordinators to respond to natural hazards and to teach them the best ways to mitigate the effects of those hazards.	Ongoing. Drought mitigation strategies are identified in mitigation planning courses

2010 Dam Failure Mitigation Strategies Status Report	
The state will provide funds that will assist local jurisdictions to pay for the cost of a study that determines the dam failure inundation area. (a) For local jurisdictions that have obtained a mitigation planning grant for the purpose of creating or updating their local mitigation plan, TDEM will provide state technical assistance funds, if requested and when available, for the purpose of determining the inundation area as part of the local risk assessment for dam failure.	Funding source not identified
(b) Local jurisdictions may apply for funds to develop a dam failure inundation map through the Flood Protection Planning (FPP) grant offered by the Texas Water Development Board.	Ongoing

2010 Coastal Erosion Mitigation Strategies Status Report	
GLO has identified the need for the natural beach and dune system to be restored along Galveston Island. This includes numerous residential subdivisions impacted by Hurricane Ike and now subject to coastal flooding associated with severe storms and high tide events. A cost effective approach is to restore the natural beach and dune system complete with dune vegetation along the project area. Beach and dune restoration is estimated to cost $3 to $7 million per mile depending on the volume of sand needed for the project.	Ongoing
GLO has identified the need to restore the natural beach and dune system for this 21-mile area, complete with dune vegetation along the Gulf of Mexico shoreline on Bolivar Peninsula. The estimated construction cost for the beach nourishment and dune restoration is $3 to $7 million per mile depending on the volume of sand needed for the project.	Ongoing
GLO has identified the need for approximately two to four miles of beach and dune restoration, along an approximate nine-mile stretch, of the Gulf shoreline adjacent to CR257 near the western limits of Treasure Island (San Luis Pass) to near the eastern limits of the Village of Surfside Beach (Freeport jetties) and 6.25 miles southwest of the jetties to the mouth of the Brazos River to include Quintana and Bryan beaches. Dune restoration and beach nourishment is estimated at $3 to $7 million per mile to construct depending on the volume of sand needed for the project.	Ongoing
GLO has identified eight miles at Sargent Beach as a recommended project for beach and dune restoration projects to help provide a level of protection for the granite revetment from the effects of wave energy and storm surge. Beach and dune restoration is estimated to cost $3 to $7 million per mile to construct depending on the volume of sand needed for the project.	Ongoing. In 2013, Matagorda County completed a beach nourishment project at Sargent Beach using 80,000 cubic yards of sand with funding provided by the GLO's Coastal Erosion Protection Response Act and GLO's Disaster Recovery Community Development Block Grant programs. Matagorda County and the US Army Corp of Engineers are evaluating the use of groins and breakwaters as erosion response structures along the Gulf shoreline.

GLO has identified the need for the restoration of the beach and dune system from Isla Blanca Park at the Brazos Santiago Pass jetties to five miles north into the city of South Padre Island. Dune restoration and beach nourishment is estimated to cost $3 to $7 million per mile to construct depending on the volume of sand needed for the project and the availability of dredged material from the Brazos Santiago Pass.	Ongoing
GLO has identified the need to protect and restore Texas' coastal wetlands and marshes because these habitats are experiencing degradation from developmental pressure. Other factors contributing to the degradation and loss are relative sea level rise and erosion from wind and wave action. The loss of the protective function these natural systems provide increases the vulnerability to coastal communities and their infrastructure. Restoration and protection of these wetlands and marshes will restore the natural flood control system of the barrier islands.	Ongoing. Currently working with a technical advisory committee comprised of over 40 diverse coastal experts to identify the varying issues of concern along four regions of the Texas coast. ShoringUpTexas.org offers the first overview publication on the importance of the Texas coast. Additional work will start in mid 2013 to examine possible solutions for the issues on a regional and sub-regional scale and the development of a GIS tool for resource management codes and coastal natural resource area mapping along the coast.
GLO continues to utilize education and outreach to increase public and private sector awareness for hazard mitigation planning in coastal communities. Hurricane Ike drove home the importance of preparedness and mitigation.	Ongoing
Development of planning committees consisting of coastal decision makers for long-term planning on a regional scale.	Ongoing. GLO is currently working with a technical advisory committee comprised of over 40 diverse coastal experts to identify the varying issues of concern along four regions of the Texas coast. ShoringUpTexas.org offers the first overview publication on the importance of the Texas coast. Additional work will start in mid 2013 to examine possible solutions for the issues on a regional and sub-regional scale and the development of a GIS tool for resource management codes

	and coastal natural resource area mapping along the coast.
Local and regional workshops, in conjunction with Texas A&M University, to promote two CMP funded projects - Texas Sustainable Coast Initiative's Vulnerability Atlas and the study of local and regional mitigation action plans along the Texas coast as tools for planning.	
Participate in annual training for coastal governments, in conjunction with the Texas Division of Emergency Management and the Texas Water Development Board, for the promotion and processing of all hazard mitigation assistance funding. This includes the Hazard Mitigation Grant Program (HMGP), Pre-disaster Mitigation Program (PDM), Flood Mitigation Assistance Program (FMA), Repetitive Flood Claims (RFC) Program, and Severe Repetitive Loss (SRL) program grants to maximize local governments' efforts for funding mitigation projects.	
Distribution of the Texas Coastal Homeowners Handbook in English and Spanish beginning in May 2013 to help coastal property owners protect their property and prepare for coastal natural hazards.	Ongoing. The English version can be downloaded at: http://www.glo.texas.gov/what-we-do/caring-for-the-coast/_publications/homeowners-handbook-hurricanes.pdf. The Spanish version can be downloaded at: http://www.glo.texas.gov/what-we-do/caring-for-the-coast/_publications/homeowners-handbook-spanish.pdf
Coastal Community Resilience Risk and Resilience Assessment. GLO is working with the Gulf of Mexico Alliance, Texas Sea Grant and the Mission-Aransas National Estuarine Research Reserve to provide tools to coastal communities to better understand the risks and impacts associated with coastal hazards, including climate changes. In addition, the Alliance will assess the risks of coastal hazards to the natural, built, and social environments of the Gulf Coast and increase infrastructure to better quantify these risks in the future. This implementation measure replaces the previous measure, which was the development and distribution the Texas Hazard Mitigation Guidebook to provide a tool for coastal	Ongoing. The GLO is partnering with the Gulf of Mexico Alliance in establishing StormSmart Coasts (http://tx.stormsmart.org/) to provide additional resources for coastal decision makers looking for the latest and best information on how to protect their communities from weather and climate hazards. GLO also sponsored a Community

communities to plan for natural hazards such as erosion, floods, and hurricanes.	Rating System workshop in April 2013: Reducing Insurance Costs through Comprehensive Floodplain Management at the Mission-Aransas National Estuarine Research Reserve.
Acquisition of structures seaward of the line of vegetation and within dune restoration projects will be necessary to have an effective project and provide protection to property and critical infrastructure. When necessary, the GLO will use state appropriated Coastal Erosion Protection Response Act (CEPRA) funds as a source to leverage federal funding for the acquisition or removal of properties affected by a dune restoration project.	Ongoing

Data Deficiency Status Report The following information discusses data shortfalls acknowledged in the 2010 plan and remedies going forward		
2010	**2013**	**2016**
Local Government Data: For those local mitigation plans approved in 2005, their updates were due in 2010 and reported loss data was expected to be incorporated into the 2010 state plan update. However, these local mitigation plans are currently in draft and current data was not available in 2010 thus, 2005 data was retained when necessary. TDEM expected to summarize more recently FEMA approved local plans' loss estimate findings into the 2013 update of this plan.	A review of either single- or multi-jurisdictional plans representing populated areas from each region failed to produce a consistent, cohesive supply of loss estimate documentation. The requirement to address impact (loss) can also be described in qualitative terms or in dollar damages per incident rather than annualized. What was captured in a meaningful way is presented in the plan. Planners implemented a questionnaire to capture current local data from the same sources most likely responsible for mitigation planning oversight, the local emergency coordinators. The intent is to continue to refine and resurvey the respondents on a regular basis so that they can regularly capture this information.	Continue with questionnaire distribution so that local planners have opportunity to consider and capture information. Encourage a loss estimate approach in mitigation planning courses.

State Data: TDEM updated the State Facility Database (vulnerability and estimated losses) in 2009 by funding the creation of the Geospatial Emergency Management Support System (GEMSS). GEMMS was created by the Texas Natural Resource Information Systems (TNRIS). The State will continue to add and edit data by allowing GEMSS to be edited once a year by all of the state agencies that have buildings listed in the state facility database.	GEMSS input by agency representatives continues to be voluntary. With change in management across agencies, the update procedure needs to be re-implemented and new contacts identified. As facilities have not significantly increased or decreased, this plan relies on 2010 entries as current for state facilities. TDEM will consider migrating to other systems such as TxMAP, as auxiliary data services	TDEM will reinitiate the program or consider migrating to other systems such as TxMAP, as auxiliary data services.

2013 ACTIONS

The State Hazard Mitigation Team discussed strategies and actions to address in the 2013 State Hazard Mitigation Plan. Actions were discussed based on merit, identification of authority and responsibility to provide an comprehensive planning document. Each strategy is based upon identified hazards within the State. Actions for each hazard are established with the implication that there is potential for multiple impacts from the same risk. The effect of the hazards may result in damage to the economy, infrastructure, natural resources or loss of life.

Each proposed action emphasizes collaboration between responsible agencies to best serve the general population of Texas. The efforts may challenge agencies to identify new partnerships and opportunities to increase capabilities. These actions should benefit the state and minimize the effects of hazards.

Each proposed state mitigation action has been ranked as a High Priority. Actions were discussed and analyzed in terms of feasibility, cost effectiveness, capacity to execute, and conformance with the plan's goals.

Certain local mitigation actions were given a High Priority based on factors that were complimentary to identified state goals. The SHMT maintains regular coordination with local jurisdictions to identify and maximize available grant funds.

HAZARD	Flood	
ACTION	Encourage local communities to enforce above minimum floodplain compliance. These include zero rise, 18 inch curb, ultimate flood plain, fees for open space conversion, and freeboard ordinances on coastal properties	**Zero Rise refers to requiring mitigation projects, such as detention ponds, be implemented during land development so that a finished development would not result in any increase in flood levels within a community.** **18 inch curb refers a code requirement that first floor elevation be at least 18 inches above the top of the curb at the front of the lot whenever there is not a determined Base Flood Elevation (BFE).** **Freeboard is usually expressed in feet above BFE to provide a margin of safety against future increases in flood level.**
FEASIBILITY	Economic ability exists; payoff contributing to state strategy	
STRATEGY CONTRIBUTION	Decreases to flood losses over time. Decreases need for response and recovery	
RESPONSIBLE AGENCY	Agencies such as TDEM and TWDB to provide encouragement through training and outreach opportunities	
PRIORITY	High priority as state-level action	

HAZARD	Flood	
ACTION	Continue to expand outreach on Turn Around Don't Drown (TADD) campaign	**Almost all deaths from flash flooding happen from vehicles driving into low water crossings.** **The TADD program is highly recognizable successful in reinforcing this message.**
FEASIBILITY	Ability to expand on existing programs; economically feasible	
STRATEGY CONTRIBUTION	Reduces loss of life by changing behavior over time; reduces need for emergency response	
RESPONSIBLE AGENCY	TFMA to continue with ongoing programs; TDEM and TxDOT to implement outreach through identification of new mediums and funding	
PRIORITY	High priority as state-level action	

HAZARD	Hurricane/storm surge	
ACTION	Discourage development in low lying/flood-prone areas along the coast by prioritizing grant funding away from areas that are less than 2 to 2-1/2 ft msl. Add water/wastewater to Coastal Barrier Resources Act (COBRA) restrictions	**Federal disaster assistance is limited to emergency relief – there are no loans or grants to repair or rebuild structures in COBRA areas. By restricting federal expenditures and financial assistance which have the effect of encouraging development of coastal barriers, Congress aimed to minimize the loss of human life and damage to fish, wildlife, and other natural resources associated with coastal barriers.**
FEASIBILITY	Fewer environmental issues involved than in developing projects to block the hazard, such as building levees, or dikes. Infrastructure is difficult to maintain at low lying/flood-prone areas. Infrastructure spending should be prioritized to areas where it is easier to maintain over its useful life.	
STRATEGY CONTRIBUTION	Decreases vulnerabilities over time by limiting new development and not replacing existing development. Decreases need for Response and Recovery	
RESPONSIBLE AGENCY	Agencies such as TDEM, TCEQ, and TWDB, acting as agencies that provide grant support	
PRIORITY	High priority as state-level action	

HAZARD	Hurricane/Storm Surge	
ACTION	Recruit conservancy agencies to purchase and maintain key undeveloped land in coastal areas	**The National Fish and Wildlife Foundation (NFWF) announced the public launch of the Gulf Environ-mental Benefit Fund through which NFWF will administer and monitor $2.544 billion from plea agreements resolving certain criminal cases arising from the 2010 Deepwater Horizon explosion and oil spill in the Gulf of Mexico. The Fund will receive $203 million for natural resource projects in Texas. The National Fish and Wildlife Foundation, a Congressionally chartered non-profit corporation, is one of the largest private funders of conservation projects in the United States.** **-http://www.nfwf.org**
FEASIBILITY	Funding availability may be limited to private donations (for example Deepwater; involves private property purchases; eliminates future development)	
STRATEGY CONTRIBUTION	Reduces hazardous conditions that cause loss and prevents further degradation of important natural resources; reduces intense development pressures	
RESPONSIBLE AGENCY	Possibly GLO to identify available funding; TDEM to provide encouragement through training and outreach opportunities	
PRIORITY	High priority as state-level action	

HAZARD	Hurricane/Storm Surge	
ACTION	Encourage local communities to enforce above minimum floodplain compliance through freeboard ordinances on coastal properties	**Freeboard is usually expressed in feet above BFE to provide a margin of safety against future increases in flood level.** **Recommendation is that coastal communities have at least a 2 foot freeboard to take into account expected increases in base flood elevations over the life of the commercial or residential structure.**
FEASIBILITY	Economic ability exists; high payoff to contributing to state strategy	
STRATEGY CONTRIBUTION	Decreases to flood losses over time. Decreases need for response and recovery	
RESPONSIBLE AGENCY	Agencies such as TDEM, TWDB, and TFMA to provide encouragement through training/outreach opportunities	
PRIORITY	High priority as state-level action	

HAZARD	Hurricane / Wind	**"Stick-Net" Project NSF/IGERT and Atmospheric Science Group Field Research Initiative** **Texas Tech developed a cost effective process to improve wind speed measurement, via installation of numerous "stick" wind speed measurement devices.** **Peak wind speeds are recorded on SD cards in the devices. Post event the cards are collected and wind speed measurements, at specific locations, are captured.** 
ACTION	Implement a program that can determine whether hurricane loss is due to flood or wind through a measurement of wind speed, flood depth, and building code standard (year built and providing the means to do so by developing algorithm and providing additional measurement sensors)	
FEASIBILITY	Must provide better wind speed measurement coverage than currently exists; would need to convince industry of reliability	
STRATEGY CONTRIBUTION	Reduces long-term recovery	
RESPONSIBLE AGENCY	TDI, TDEM, Texas Tech University	
PRIORITY	High priority as state-level action	

HAZARD	Wildfire	**"Community Wildfire Protection Plans are a mechanism for communities to address their wildfire risk. These plans promote collaboration and local action, and can work in partnership with Firewise activities."** **-Firewise.Org**
ACTION	Implement WUI Summits with local jurisdictions wildfire mitigation educational programs to be delivered regionally to elected officials, emergency management personnel and mitigation planners with the intent to teach the CWPP process, acquaint jurisdictions with TxWRAP; introduce Firewise Communities concepts and assist with the development of wildfire mitigation projects.	
FEASIBILITY	Economically feasible	
STRATEGY CONTRIBUTION	Directs resources to greatest need through education, technical assistance, and tools	
RESPONSIBLE AGENCY	TFS	

PRIORITY	High priority as state-level action	
HAZARD	**Wildfire**	 **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. TxWRAP is comprised of a suite of applications tailored to support specific workflow and information requirements for the public, local community groups, government officials, professional hazard-mitigation planners, and wildland fire managers. Collectively these applications will provide the baseline information needed to support mitigation and prevention efforts across the state.**
ACTION	Develop TxWRAP enhancements specifically designed to facilitate the preparation of CWPPs and local wildfire mitigation projects. Will teach how to locate wildfire risk, define mitigation project areas, and establish relative cost-benefits for those projects for potential grant funding	
FEASIBILITY	Economically feasible	
STRATEGY CONTRIBUTION	Directs resources to greatest need through education, technical assistance, and tools	
RESPONSIBLE AGENCY	TFS	
PRIORITY	High priority as state-level action	

HAZARD	**Wildfire**	**For HMGP wildfire mitigation projects, applicants and sub applicants must comply with FEMA Mitigation Policy MRR-2-08-1; *Wildfire Mitigation Policy for the Hazard Mitigation Grant Program (HMGP)* dated September 8, 2008. MRR-2-08-1 is available at http://www.fema.gov/government/grant/hma/policy.shtm .**
ACTION	Develop guidebooks to facilitate wildfire mitigation along with providing technical assistance to develop mitigation projects. The guidebooks will identify the various fuel types and provide techniques for their mitigation. Technical assistance will include a detailed localized risk assessment with assistance from TFS.	
FEASIBILITY	Economically feasible	
STRATEGY CONTRIBUTION	Directs resources to greatest need through education, technical assistance, and tools	
RESPONSIBLE AGENCY	Texas A&M Forest Service	

PRIORITY	High priority as state-level action	

HAZARD	**Wildfire**	**Defensible Space can be described as:** • **An area around a structure where fuels and vegetation are treated, cleared off or reduced in order to slow the spread of wildfire towards the structure** • **Defensible space provides room for firefighters to safely defend your home during a wildfire**
ACTION	Encourage landscape/building codes by encouraging inter-local agreements between cities and ETJ coverage	
FEASIBILITY	Accomplished through workshop content and outreach; little financial requirement on part of state but requires long-term commitment	
STRATEGY CONTRIBUTION	Prevents losses to life and property, reduces need for response, and reduces long-term recovery	
RESPONSIBLE AGENCY	TDEM; TFS	
PRIORITY	High priority as state-level action	

HAZARD	**Windstorm, Earthquake, Hurricane, Fire**	**The Building Code Effectiveness Grading Schedule (BCEGS®) assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses from natural hazards.** **The concept is simple. Municipalities with well-enforced, up-to-date codes should demonstrate better loss experience, and insurance rates can reflect that. The prospect of lessening catastrophe-related damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously — especially as they relate to windstorm and**
ACTION	Encourage communities to review Building Code Effectiveness Grading System (BCEGS), with the intent of identifying opportunities for improving resiliency in infrastructure.	
FEASIBILITY	Accomplished through building-code enforcement at local level; promotes construction more hazard resistance buildings	
STRATEGY CONTRIBUTION	Prevents losses to life and property, reduces need for response, and reduces long-term recovery	
RESPONSIBLE AGENCY	TDEM; TDI	
PRIORITY	High priority as state-level action	

		earthquake damage. **The anticipated upshot: safer buildings, less damage, and lower insured losses from catastrophes.** **The BCEGS program assigns each municipality a BCEGS grade of 1 (exemplary commitment to building-code enforcement) to 10. ISO develops advisory rating credits that apply to ranges of BCEGS classifications (1-3, 4-7, 8-9, 10). ISO gives insurers BCEGS classifications, BCEGS advisory credits, and related underwriting information.** **http://www.isomitigation.com**

HAZARD	**Tornado and Windstorm**	**During a stronger tornado, such as an EF-2 and EF-3 strength storm, a property can be destroyed in seconds, according to the Insurance Institute for Business & Home Safety (IBHS). However, 77 percent of tornadoes have wind speeds of less than 110 mph, according to the National Climatic Data Center.** **http://www.disastersafety.org**
ACTION	Recommend, through training opportunities, that any publically owned building be built to withstand 120 mph wind speeds, based upon risk of event and cost effectiveness.	
FEASIBILITY	Identification of agency and message media; would need interagency cooperation and consistent message push; builds on 2010 action to require that state building be built to 120 miles per hour wind speed	
STRATEGY CONTRIBUTION	Reduces property damage and loss of life, and reinforces continuity of government	
RESPONSIBLE AGENCY	TDI; TDEM, Texas Facilities Commission	
PRIORITY	High priority as state-level action	

HAZARD	Tornado and Windstorm	
ACTION	Review standards for manufactured homes in areas of frequent weather events in order to evaluate practicality of home use and placement.	**TDHCA through its Manufactured Housing Division administers the Texas Manufactured Housing Standards Act and acts as HUD's state supervisory agent to administer certain aspects of the national Manufactured Housing Construction and Safety Standards Act of 1974.**
FEASIBILITY	Implementation will require additional collaboration with private (Federal Alliance for Safe Homes [FLASH]), insurance industry (Institute for Business and Home Safety [IBHS]), federal (NOAA), or research institutions (Texas Universities) to gather and analyze relevant data.	
STRATEGY CONTRIBUTION	Reduces losses to property and reduces loss of life	
RESPONSIBLE AGENCY	TDHCA	
PRIORITY	High priority as state-level action	

HAZARD	Tornado	
ACTION	Aim for 90 percent coverage of state by warning systems and educate citizens of the availability of different systems and their meaning	**Real time weather alerts are sent out for weather warnings, watches, tropical alerts, and other advisories as soon as they are issued by federal agencies including the National Weather Service. Alerts are sent to subscribers in the warned areas to a mobile device via text messages (SMS) or by mail.**
FEASIBILITY	Build upon existing programs; ongoing action from 2010 plan	
STRATEGY CONTRIBUTION	Allows for ten percent initiative funding through HMGP to funnel to mitigation projects that reduce loss of life and property	
RESPONSIBLE AGENCY	TDEM	
PRIORITY	High priority as state-level action	

HAZARD	Tornado	**Texas Individual Safe Room Rebate program reimburses**

ACTION	Recommend in mitigation workshops safe room construction and retrofits in residential, commercial and mobile home parks and advertise the availability of in-home sheltering designs	**a home owner or developer for 50 percent of the cost to install an individual safe room in an existing or planned home, up to a cap of $3,000. Individuals may not apply directly to the state. Their city or community must apply for funds on their behalf. The Safe Room Rebates are funded with FEMA supplied mitigation grants and are subject to availability.**
FEASIBILITY	Can build on HMA programs in place	
STRATEGY CONTRIBUTION	Allows for 10 percent initiative funding through HMGP to funnel to mitigation projects that reduce loss of life and property	
RESPONSIBLE AGENCY	TDEM	
PRIORITY	High priority as state-level action	

HAZARD	**Dam/Levee Failure**	**The Proposed Federal Water Resources Development Act reauthorizes the National Dam Safety Act and will establish a National Levee Safety Program.** **At the federal level, the Army Corps of Engineers certifies and recertifies levees that qualify as flood protection.** **TWDB is a co-operating technical partner with the NFIP for the revision of Texas flood maps. The results of COE levee certification are included in new map production.**
ACTION	Recommend that levees used as a flood protection method for residential development meet best practice standards.	
FEASIBILITY	Very feasible, requires additional state coordination and executive level decision	
STRATEGY CONTRIBUTION	Decreases vulnerabilities over time by limiting probability of flood occurrence. Decreases need for response and recovery	
RESPONSIBLE AGENCY	State agencies with a role in flood mitigation including DPS, TWDB, and TCEQ	
PRIORITY	High priority as state-level action	

HAZARD	**Coastal Erosion**	**The priority areas for restoring beach and dune systems are those dune complexes severely**
ACTION	Restore natural beach and dune system through beach nourishment and dune	

	restoration	**damaged or destroyed by Hurricane Ike.**
FEASIBILITY	Program would require funding; the GLO has completed successful beach nourishment and dune restoration projects at locations along the Gulf	
STRATEGY CONTRIBUTION	Minimizes damage to homes and critical infrastructure, providing the best defense against coastal storms	
RESPONSIBLE AGENCY	GLO	
PRIORITY	High priority as state-level action	

HAZARD	**Coastal Erosion**	
ACTION	Restore and protect coastal wetlands and marshes	**Coastal wetlands are transitional areas of vegetation and soils located between uplands and open marine water environments that are typically saturated or periodically inundated by tidal waters.**
FEASIBILITY	The GLO is working with a technical advisory committee. Additional work will start in mid-2013 to examine possible solutions	
STRATEGY CONTRIBUTION	Provide habitat for wildlife; enhance water quality and serve as buffers for reducing storm surges, floods and shoreline erosion	
RESPONSIBLE AGENCY	GLO	
PRIORITY	High priority as state-level action	

In addition to the above state identified actions, a sampling of actions captured from local mitigation plan reviews across the state are addressed below. Both grant funded and non-funded local actions are pivotal to the state meeting its goals. TDEM affects potential funding to certain types of projects by prioritizing HMGP sub-applicants' projects as High Priority if that sub-applicant submits a project that mitigates the hazard from which HMGP receives its percentage of funding under that federal disaster declaration, as well as addressing the factors of long term sustainability of the action, its feasibility, and cost-effectiveness. PDM sub-applications are also prioritized along the same factors.

On an ongoing basis, TDEM considers a local action as High Priority if the action results in a permanent solution to the mitigation of damage. The top example of a permanent solution is the removal of flood risk properties and the return of the land to open space. The state also considers an action as High Priority if that action directs development through the use of land use ordinances and strengthened building codes. These actions reduce state-wide response and recover efforts to the greatest effect. By continuing to identify these types of action and their benefits in presentations and training content, TDEM expects more of these types of actions to be addressed in future local plans. These types of actions are designated with an *.

Flooding
*Adopt a No Adverse Impact policy
*Acquire flood prone properties and return land to open space
*Review and upgrade floodplain management ordinances
Increase drainage capacity in sites that are subject to flooding
Work with state and federal agencies to maintain current hazard data maps
Construct retention ponds to minimize flash flooding
Install low water crossing barriers similar to railroad crossing barriers
Elevate flood prone properties when acquisition is not feasible
Hurricane/Tropical Storms
*Mandate and inspect to ensure standard tie-downs of mobile homes
Restore the natural beach and dune system through dune restoration
Restore coastal wetlands and marshes
Remove houses seaward of the line of vegetation and above mean-high tide elevation
Construct hurricane shelters for the public
Strengthening emergency operation center roofs with enforced materials
Wildfire
*Implement fuel reduction programs
*Implement defensible space programs
*Establish building codes to comply with fire resistant materials and building standards
Establish and implement burning standards
Implement ordinance requiring fire extinguishers for all homes and businesses
Tornado
*Require mobile home parks to provide safe rooms
Promote and provide expanded coverage options for standard peril and windstorm insurance coverage
Promote and provide enhanced warning capabilities
Construct tornado safe rooms
Strengthen emergency operation center roofs with enforced materials
Promote awareness concerning risks of tornadoes
Drought
*Develop xeriscape landscape use requirements
*Develop an enforcement plan for implementing mandatory water rationing
Investigate and obtain new water sources
Educate residents about water conservation and landscape planting practices to preserve water supplies
Educate the public about extreme heat/drought safety and health issues
Windstorm
*Write and enforce building code and mobile home installation codes that will minimize damage from high winds
Provide warning and pre-sheltering for RV residents during high wind events
Provide standards for burial of electrical, telephone, cable lines and other utilities
Advise residents of older (pre-HUD) manufactured home of the potential of high winds and the accompanying risk to life and property
Strengthening emergency operation centers windows with hurricane shutters
Strengthening emergency operation center roofs with enforced materials
Extreme Heat
Conduct public information campaigns to remind citizens to hydrate and avoid direct exposure to the sun between the peak UV hours of 1 p.m. and 4 p.m. can reduce the loss of life

Encourage utilities to forgive or defer high power bills during extreme high temperatures
Create cooling or heating centers to assist the public
Earthquake
*Strengthen building codes to protect against earthquakes
Inform architects and planners that distant earthquakes can affect large and sensitive structures in northeastern Texas. Sensitive structures -- dams, towers, very tall buildings, bridges and highway overpasses -- should be constructed with the possibility of earthquakes in mind
Expansive Soils
Promote use of proven engineering solutions to residential buildings on expansive clays such as: • foundations built on pilings or basement walls are sufficiently deep to get below the active layer • use several feet of compacted fill • use of grade beams to stiffen slabs, foundation, and irrigation • surround structures with waterproof paving
Hailstorm
Provide sheltering for supplies and equipment at critical facilities
Promote use of roofing materials that better resist hail damage
Land Subsidence
Develop surface water treatment plant and or purchase credits from another entity to decrease groundwater dependence
Severe Winter Storm
Inform public of the dangers of severe winter storms and encourage people to plan in advance for the occurrence of severe winter storms. Advise public to become familiar with the National Weather Service bulletins
Encourage communities to ensure equipment for plowing and sanding is operational and that they have adequate personnel to be ready when needed. Also to distribute NWS bulletins on severe weather
Educate public to protect exposed pipes and exterior plumbing with insulation and/or a heat source
Lightning
Educate public about dangers of lightning strikes, how to avoid being struck and how to protect your home from damage
Encourage insurance authorities to require premium discounts for customers who install lightning protection systems

IDENTIFICATION OF FUNDING SOURCES

The state continues to avail itself of federal mitigation funding opportunities. Additional sources of funding from private and local sources are consistently sought. The main funding sources for mitigation projects since 2010 were sourced through the Texas Division of Emergency Management and the Texas Water Development Board for their administration of the Federal Emergency Management Agency's Hazard Mitigation Assistance Programs.

Texas Division of Emergency Management

http://www.txdps.state.tx.us/dem/Mitigation/index.htm

Federal Emergency Management Agency PDM and HMGP Programs:

TDEM's Mitigation staff administers FEMA's **Pre-Disaster Mitigation grant program**, and the post-disaster **Hazard Mitigation Grant Programs**.

Type: The Pre-Disaster Mitigation (PDM) grant program provides funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event.

Uses: Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations.

Applicants: to state agencies, local jurisdictions, Indian tribal governments, and public universities.

Availability: PDM grants are to be awarded on a competitive basis annually.

Type: The Hazard Mitigation Grant Program (HMGP) provides grants to state and local governments to implement long-term hazard mitigation measures after a major disaster declaration.

Uses: The purpose of HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster.

Applicants: State agencies, local jurisdictions, tribal governments, public universities, and eligible private nonprofits.

Availability: HMGP grants are awarded post-federally declared disaster.

Texas Water Development Board

http://www.twdb.texas.gov/financial/programs/index.asp

Federal Emergency Management Agency Flood Mitigation Assistance Program

Type: Grant

Uses: Planning assistance to communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program (NFIP). Eligible work includes: acquisition of insured structures and real property; relocation or demolition of insured structures; dry flood proofing of insured structures; elevation of insured structures; minor, localized structural projects that are not fundable by state or other federal programs; and beach nourishment activities such as planting of dune grass.

Applicants: Political subdivisions, including any authorized tribal or native organization, that has zoning and building code jurisdiction over a particular area having special flood hazards, and is participating in the NFIP. Communities that are suspended or on probation from the NFIP are not eligible.

Availability: Dollar limits apply to each application.

Clean Water State Revolving Fund

http://www.twdb.state.tx.us/assistance/financial/fin_infrastructure/cwsrffund.asp

Type: Loan. Additional subsidies available for disadvantaged communities.

Uses: Planning, acquisition and construction, wastewater treatment, storm water and nonpoint source pollution control, and reclamation and reuse projects.

Applicants: Political subdivisions. Individuals are eligible to apply for non-point source pollution control projects.

Availability: An annual priority rating process applies to projects.

Drinking Water State Revolving Fund

Type: Loan. Additional subsidies available for disadvantaged communities.

Uses: Planning , acquisition and construction of water related infrastructure, including water supply and source water protection.

Applicants: Community water system owners and nonprofit non-community water system owners are eligible to apply for the funding. This includes political subdivisions of the state and private individuals.

Availability: An annual priority rating process applies to projects.

Rural Water Assistance Fund

Type: Loan

Uses: Planning, acquisition and construction of water and wastewater related infrastructure. May also be used to obtain service or to finance consolidation or regionalization.

Applicants: Political subdivisions and nonprofit water supply corporations.

Availability: Limited funds.

State Participation Program - Regional Water and Wastewater Facilities

Type: Deferred interest obligation to repurchase Texas Water Development Board's (TWDB) interest in facility (state has a temporary ownership interest in a facility. State's ownership is purchased by applicant as their customer base grows).

Uses: Construction of regional water or wastewater construction project when the local sponsors are unable to assume debt for the optimally sized facility.

Applicant: Political subdivisions of the state and water supply corporations which are sponsoring construction of a regional water or wastewater project can apply for funding.

Availability: Limited funds.

Water Infrastructure Fund

Type: Loans - subsidized and deferred.

Uses: Projects must be recommended water management strategies in the most recent TWDB approved regional water plan or approved State Water Plan. Funds may not be used to maintain a system or to develop a retail distribution system.

Applicants: Political subdivisions of the state and water supply corporations.

Availability: Limited funds. A semi-annual priority rating process applies.

Texas Water Development Fund

Type: Loan

Uses: Planning, acquisition and construction of water related infrastructure, including water supply, wastewater treatment, storm water and nonpoint source pollution control, flood control, reservoir construction, storage acquisition, and agricultural water conservation projects, and municipal solid waste facilities.

Applicants: Political subdivisions of the state and nonprofit water supply corporations.

Availability: Limited funds.

Economically Distressed Areas Program

Type: Grant, loan, or a combination grant and loan.

Uses: To bring water and wastewater services to economically distressed areas (designated by TWDB) where the present water and wastewater facilities are inadequate to meet the minimal needs of residents. The program includes measures to prevent future substandard development.

Applicants: Political subdivisions and nonprofit water supply corporations, provided they meet certain program requirements.

Availability: Limited funds.

Agricultural Water Conservation Grants

Type: Grant (up to 100 percent

Uses: Demonstrations, education, research, technical assistance, and technology transfer. Grants may also be made to political subdivisions for agricultural water conservation projects for purchase and installation (on public or private property) of metering devices to measure irrigation water use in order to quantify effects of different water conservation strategies.

Applicants: State agencies and political subdivisions of the state

Availability: Annual funding opportunity; solicitations appear in Texas Register.

Agricultural Water Conservation Loans

Type: Loan

Uses: Conservation projects that 1) improve water use efficiency of water delivery and application, or 2) prepare irrigated land for conversion to dry land farming, or 3) prepare dry land for more efficient use of natural precipitation, or 4) purchase and install on public or private property devices designed to indicate the amount of water withdrawn for irrigation use, or 5) brush control activities conducted under Chapter 203 of Agriculture Code, or 6) other conservation projects defined by TWDB rules.

Applicants: Eligible applicants include political subdivisions of the state, institutions of higher education, interstate compact commissions, and nonprofit water supply corporation (Chapter 69 of Water Code). Banks and farm credit system may apply for link deposit funds to make loans available to individuals.

Availability: Limited funds.

Groundwater Conservation District Loan Program

Type: Loan

Uses: Finance the startup costs (salaries and payroll taxes, utilities, travel, insurance, building and office leases, office supplies and furniture, telephone and computer equipment, and legal and professional fees) of groundwater conservation districts.

Applicants: District or authority created under the Texas Constitution, Section 52, Art. III, or Section 59, Article XVI, that has the authority to regulate the spacing of water wells, the production from water wells, or both. The district must be a newly confirmed district or legislatively created district that does not require a confirmation election.

Availability: Limited funds.

Regional Facility Planning Grant Program

Type: Grants

Uses: Studies to evaluate and recommend the most feasible alternatives to meet regional (two or more participating entities or service areas) water supply and wastewater facility needs, estimate the costs associated with implementing the recommendations, and identify any institutional arrangements that may be necessary to provide regional water supply and wastewater services. Regional systems often have inherent operational advantages or economies of scale over stand-alone systems.

Applicants: Political subdivisions with the legal authority to plan, develop, and operate regional facilities, including nonprofit water supply corporations.

Availability: Annual application process published with request for proposals.

Regional Water Planning Group Grants

Type: Grant

Uses: Planning activities for the long-term (50-year) water supply needs of Texas. Tasks eligible for funding include determining future water demands, availability of current and future water supplies, identifying needs for additional supplies, recommending management strategies to meet water needs, and developing a regional water plan every five years.

Applicants: Political subdivisions pre-designated by the 16 regional water planning groups in the state.

Availability: Typically two requests for proposals occur during the five-year planning cycle.

Water Research Grant Program

Type: Grant

Uses: Water research that addresses one of the Texas Water Development Board's designated research topics published in its most recent request for proposals.

Applicants: Individuals, political subdivisions of the state, and nonprofit water supply corporations are eligible to apply for funding.

Availability: Annual application process published with Request for Proposals.

Texas General Land Office: GRANT AND FUNDING PROGRAMS

The Texas General Land Office is able to maximize state funding for coastal projects by seeking matching funds from local and federal partners. The Texas General Land Office has already secured more than five times the $25 million appropriated by the state Legislature for upcoming coastal projects, for a total of $135.4 million.

Coastal Erosion Planning and Response Act (CEPRA) – Since 2000, the Texas General Land Office's Coastal Erosion Planning and Response Program has received $62 million in state funding and another $62 million in matching funds from federal and local governments, funding more than 200 coastal erosion projects.

Coastal Impact Assistance Program (CIAP) – Will provide more than $168 million to Texas. Funding comes from the federal government as compensation for damages caused by drilling in federal waters in the Gulf of Mexico.

Coastal Management Program (CMP) – Awards approximately $2.2 million annually in grants. CMP goal is to ensure the long-term environmental and economic health of the Texas coast.

Beach Maintenance Reimbursement Fund – Administered by the Texas General Land Office, typically allocates $750,000 per year to help communities maintain beaches.

Coastal and Estuarine Land Conservation Program (CELCP) –
http://www.tpl.org/tier3_cd.cfm?content_item_id=10569&folder_id=191

Communities can apply for up to three projects per year, with federal grants for any single project not to exceed $3 million.

Natural Resources Conservation Service (NRCS)

http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/

Natural Resources Conservations Service offers voluntary programs to eligible landowners and agricultural producers to provide financial and technical assistance to help manage natural resources in a sustainable manner. Through these programs the agency approves contracts to provide financial assistance to help plan and implement conservation practices that address natural resource concerns or opportunities to help save energy, improve soil, water, plant, air, animal and related resources on agricultural lands and non-industrial private forest land.

Our financial assistance programs include the following:

The Agricultural Management Assistance (AMA) provides financial and technical assistance to

agricultural producers to voluntarily address issues such as water management, water quality, and erosion control by incorporating conservation into their farming operations.

The Agricultural Water Enhancement Program (AWEP) is a voluntary conservation initiative that provides financial and technical assistance to agricultural producers to implement agricultural water enhancement activities on agricultural land to conserve surface and ground water and improve water quality.

Conservation Innovation Grants (CIG) is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging Federal investment in environmental enhancement and protection, in conjunction with agricultural production.

The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length.

The Wildlife Habitat Incentive Program (WHIP) is a voluntary program for conservation-minded landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and tribal land.

Housing and Urban Development (HUD)

Community Development Block Grant

http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs

The CDBG program is a flexible program that provides communities with resources to address a wide range of unique community development needs. Beginning in 1974, the CDBG program is one of the longest continuously run programs at HUD. The CDBG program provides annual grants on a formula basis to 1209 general units of local government and states.

Texas Department Agriculture (TDA)

TDA administers the CDBG Program for Rural Texas.

http://texasagriculture.gov/GrantsServices/RuralEconomicDevelopment/RuralCommunityDevelopmentBlockGrantCDBG/About.aspx

Information about CDBG is also available by contacting local Housing Authorities in metropolitan areas where they exist.

HOME

http://www.hud.gov/offices/cpd/affordablehousing/programs/home/

HOME is authorized under Title II of the Cranston-Gonzalez National Affordable Housing Act, as amended. Program regulations are at 24 CFR Part 92. The HOME program final rule is available electronically. Additional information about the HOME program can be found by visiting the HOME program web pages.

Texas Department Housing and Community Affairs (TDHCA)

TDHCA administers the Home program in Texas.
http://www.tdhca.state.tx.us/home-division/

Texas Center for Environmental Quality (TCEQ)

Nonpoint Source Grant Program

http://www.tceq.texas.gov/waterquality/nonpoint-source/grants/grant-pgm.html

Nonpoint Source Management Program

http://www.tceq.texas.gov/assets/public/comm_exec/pubs/sfr/068_12.pdf

The TCEQ and the Texas State Soil and Water Conservation Board (TSSWCB) administer federal grants for activities that prevent or reduce nonpoint source pollution. Grants are awarded annually and fund projects for up to three years. The TCEQ usually solicits grants in the summer of each year. Opportunities to apply are published on this Web page and Electronic State Business Daily The grants are made available through a federal program authorized under Section 319 of the Clean Water Act. See descriptions of active projects funded through the TCEQ's Nonpoint Source Program (NPS).

Congress enacted CWA §319(h) in 1987, establishing a national program to control NPS water pollution. Through §319(h), federal funds are provided annually through the EPA to states for the implementation of each state's NPS Management Program. Based on Congressional appropriations, EPA allocates 319(h) funds by formula to the states. The §319(h) funding in Texas is divided equally between the TCEQ and the TSSWCB. Each agency independently administers its portion of the grant. Each agency annually solicits projects from collaborating entities across the state. Each agency identifies priority areas and activities and ranking criteria for each funding cycle based on this Management Program, the most recent IR, and the WAP process.

Environmental Protection Agency (EPA): Water & Grants Funding

http://water.epa.gov/grants_funding/

American Recovery and Reinvestment Act (ARRA) of 2009 - ARRA provided significant funding for states to finance high priority water infrastructure projects through a $2 billion appropriation to the DWSRF (see below) program and a $4 billion appropriation to the CWSRF (see below) program. EPA's CWSRF & DWSRF ARRA Implementation webpage provides information on the status of ARRA implementation as well as guidance and resources for states and other stakeholders.

Beach Grants - Learn about BEACH Act grants awarded to eligible coastal and Great Lakes states, territories, and tribes to develop and implement beach monitoring and notification programs.

Catalog of Federal Funding - Search this database of financial assistance sources (grants, loans, cost-sharing) available for a variety of watershed protection projects

Clean Water State Revolving Fund – (See also Texas Water Development Board) The Clean Water State Revolving Fund (SRF) provides attractive, low-cost funding for projects that improve water quality, renew wastewater infrastructure, and support local economies. The independent, revolving loan funds in all 50 states and Puerto Rico administer the SRF program, providing financial assistance to local communities.

Drinking Water State Revolving Fund (DWSRF) - (See also Texas Water Development Board) The Safe Drinking Water Act, through the DWSRF, makes funds available to drinking water systems to finance infrastructure improvements. The program also emphasizes providing funds to small and disadvantaged communities and to programs that encourage pollution prevention as a tool for ensuring safe drinking water.

Federal Funding for Water/Wastewater Utilities in National Disasters (Fed FUNDS) - Fed FUNDS features federal disaster funding programs for water and/or wastewater utilities to obtain information on federal disaster funding programs from Federal Emergency Management Agency (FEMA), EPA, U.S. Department of Agriculture (USDA), Housing and Urban Development (HUD), and Small Business Administration (SBA). Using Fed FUNDS, a utility can easily identify appropriate funding opportunities, gain insight on the application process, access customized forms to document costs, download successful utility applications, and contact utility funding mentors.

PPG Performance Partnership (PPG) Grants - Learn how states and certain interstate agencies can combine two or more environmental program grants into a single PPG to reduce administrative costs and direct EPA grant funds to priority environmental problems or program needs.

Section 106 Water Pollution Control Grant Program - Section 106 of the Clean Water Act authorizes the EPA to provide federal assistance to states and interstate agencies to establish and implement ongoing water pollution control programs.

Targeted Watersheds Grants Program - Established in 2003, the Targeted Watersheds Grant program is designed to encourage successful community-based approaches and management techniques to protect and restore the nation's watersheds.

US/Mexico Border - EPA's U.S.-Mexico Border Water Infrastructure Program provides grant assistance to U.S. and Mexican communities located within 60 miles of the border for the development and construction of high-priority drinking water and wastewater facilities. The program furthers EPA's mission of protecting human health and the environment by providing critical resources for what are often an area's first drinking water and basic sanitation services.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
http://www.epa.gov/agriculture/teme.html

CERCLA's goal is to provide for liability, compensation, cleanup and emergency response for hazardous substances released into the environment and the cleanup of inactive hazardous waste disposal sites. Any person in charge of a "facility" (e.g., an agricultural establishment or agribusiness) must notify EPA's National Response Center of any non-permitted releases of any CERCLA hazardous substances above threshold amounts. Releases could be to any environmental medium including atmosphere, soil, surface water, or groundwater.

CERCLA & Hazardous Materials Assistance Program
http://www.fema.gov/pdf/government/grant/cercla_guidance.pdf

Purpose is to support programs and activities of state, tribal, and local governments designed to improve capabilities associated with oil and hazardous materials emergency planning and exercising. This program provides the guidelines and process for implementing any assistance provided in support of hazardous materials initiatives. FEMA provides technical and financial assistance through the states to support the states, Indian tribal and local governments in oil and gas emergency planning and exercising.

Corporation for National and Community Service (CNCS)

The Corporation for National and Community Service (CNCS), a federal agency, provides strong support, expertise, and trained and dedicated volunteers to help communities to prepare for, mitigate, respond, and recover from natural and man-made disasters. CNCS supports nonprofits, educational institutions, faith-based organizations and other groups in engaging citizens in meeting economic, health, social, and environmental needs caused by disasters. This includes a range of activities, such as volunteer coordination, feeding operations, home repairs, environmental clean-up, needs assessments, client casework, and long-term recovery.

From forest fires and floods, to hurricanes and tornadoes, to terror attacks and oil spills, participants in CNCS programs have provided critical support to millions of Americans affected by disasters since 1994. Reflecting the agency's growing expertise and commitment in disaster services, the CNCS board of directors made disaster services one the agency's focus areas for its 2011-2015 strategic plan. These activities cover the full range of disaster services from response, to long-term recovery, preparedness, and mitigation.

Sample Disaster Project Activities

- Volunteer coordination
- Shelter operations
- Debris removal
- Warehouse management
- Installing accessibility improvements on homes and shelters
- Case management
- Disaster recovery center support
- Volunteer reception center support
- Long-term recovery committee support
- Volunteer base camp setup and operation

- Public information outreach
- Operations center setup and support
- Special needs assistance
- Home construction and repair
- Public facilities renovation
- Call center support, setup and operations
- Needs assessment
- Pet shelter operations
- Preparedness education

Federal Emergency Management Agency (FEMA)

National Preparedness Grant Program (Technological Hazard)

http://www.fema.gov/pdf/government/grant/fy2013_npgp_grant_program_overview.pdf

The FY 2013 NPGP will:

- Focus on the development and sustainment of the core capabilities identified in the National Preparedness Goal
- Use the capability estimation process employed by applicants and verified by DHS to determine capability and resource deficiencies to inform the competitive process
- Build a robust national preparedness capacity based on cross-jurisdictional and readily deployable state and local assets

Emergency Management Program Grant (EMPG)

http://www.fema.gov/txt/government/grant/2014/fy14_empg_foa.txt

The purpose of the FY 2014 Emergency Management Preparedness Grants (EMPG) Program is to provide grants to states to assist state, local, tribal and territorial governments in preparing for all hazards, as authorized by the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5121 et seq.). Title VI of the Stafford Act authorizes FEMA to make grants for the purpose of providing a system of emergency preparedness for the protection of life and property in the United States from hazards and to vest responsibility for emergency preparedness jointly in the federal government and the states and their political subdivisions. The federal government, through the EMPG Program, provides necessary direction, coordination, and guidance, and provides necessary assistance, as authorized in this title so that a comprehensive emergency preparedness system exists for all hazards. The FY 2014 EMPG plays an important role in the implementation of Presidential Policy Directive – 8 (PPD-8) by supporting the development and sustainment of core capabilities to fulfill the NPG.

The EMPG Program plays an important role in the implementation of PPD-8 by supporting the development and sustainment of core capabilities. Core capabilities are essential for the execution of each of the five mission areas outlined in the National Preparedness Goal. The development and sustainment of these core capabilities are not exclusive to any single level of government or organization, but rather require the combined effort of the whole community. The FY 2014 EMPG

Program supports all core capabilities in the prevention, protection, mitigation, response, and recovery mission areas based on allowable costs (through May 31, 2014).

Examples of tangible outcomes from the EMPG Program include building and sustaining emergency management capabilities through:

- Building and sustaining core capabilities identified in the NPG
- Approved emergency plans
- Completion of Threat and Hazard Identification Risk Assessment (THIRA)
- Development and maintenance of multi-year training and exercise plans (TEPs)
- Targeted training and verification of personnel capability
- Whole community approach to security and emergency management.

Fire Management Assistance Grant Program

http://www.fema.gov/fire-management-assistance-grant-program

Fire Management Assistance is available to states, local and tribal governments for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands, which threaten such destruction as would constitute a major disaster.

The Fire Management Assistance declaration process is initiated when a state submits a request for assistance to the Federal Emergency Management Agency (FEMA) regional director at the time a "threat of major disaster" exists. The entire process is accomplished on an expedited basis and a FEMA decision is rendered in a matter of hours.

The Fire Management Assistance Grant Program provides a 75 percent federal cost share and the state pays the remaining 25 percent for actual costs.

Before a grant can be awarded, a state must demonstrate that total eligible costs for the declared fire meet or exceed either the individual fire cost threshold (applies to single fires) or the cumulative fire cost threshold (recognizes numerous smaller fires burning throughout a state).

Eligible firefighting costs may include expenses for field camps; equipment use, repair and replacement; tools, materials and supplies; and mobilization and demobilization activities.

Assistance to Firefighter Grants (AFG)

http://www.fema.gov/assistance-firefighters-grant-program-info

The primary goal of the AFG is to meet the firefighting and emergency response needs of fire departments and nonaffiliated emergency medical service organizations. Since 2001, AFG has helped firefighters and other first responders to obtain critically needed equipment, protective gear, emergency vehicles, training, and other resources needed to protect the public and emergency personnel from fire and related hazards.

Staffing for Adequate Fire and Emergency Response Grants (SAFER)

http://www.fema.gov/assistance-firefighters-grant-program-info

The SAFER was created to provide funding directly to fire departments and volunteer firefighter interest organizations in order to help them increase the number of trained, "front line" firefighters available in their communities. The goal of SAFER is to enhance local fire departments' abilities to comply with staffing, response and operational standards established by the NFPA and OSHA (NFPA 1710 and/or NFPA 1720 and OSHA 1910.134). For details visit www.nfpa.org/SAFERActGrant.

Fire Prevention & Safety Grants (FP&S)

http://www.fema.gov/assistance-firefighters-grant-program-info

The FP&S are part of the Assistance to Firefighters Grants (AFG), and are under the purview of the Grant Programs Directorate in FEMA. FP&S Grants support projects that enhance the safety of the public and firefighters from fire and related hazards. The primary goal is to target high-risk populations and reduce injury and prevent death. In 2005, Congress reauthorized funding for FP&S and expanded the eligible uses of funds to include firefighter safety research and development.

The federal share of assistance is not less than 75 percent of the eligible cost for emergency measures and permanent restoration. The grantee (usually the state) determines how the non-federal share (up to 25 percent) is split with the subgrantees (eligible applicants).

National Dam Safety Program

http://www.fema.gov/about-national-dam-safety-program

For 30 years, the Federal Government has been working to protect Americans from dam failure through the National Dam Safety Program (NDSP). The NDSP, which is led by FEMA, is a partnership of the states, federal agencies, and other stakeholders to encourage individual and community responsibility for dam safety. The NDSP, which was formally established by the Water Resources and Development Act of 1996, includes grant assistance to the states.

Grant Assistance to the States

http://www.fema.gov/protecting-our-communities/plan-ahead-dam-failure/grant-assistance-states

The primary purpose of the National Dam Safety Program (NDSP) is to provide financial assistance to the states for strengthening their dam safety programs. The states use NDSP funds for the following types of activities:

- Dam safety training for state personnel;
- Increase in the number of dam inspections;
- Increase in the submittal and testing of emergency action plans;
- More timely review and issuance of permits;
- Improved coordination with state emergency preparedness officials;
- Identification of dams to be repaired or removed;
- Conduct of dam safety awareness workshops and creation of dam safety videos and other outreach materials.

Homeland Security Grant Program (HSGP)

http://www.fema.gov/fy-2012-homeland-security-grant-program

Homeland Security Grant Program (HSGP) plays an important role in the implementation of Presidential Policy Directive – 8 (PPD-8) by supporting the development and sustainment of core capabilities to fulfill the National Preparedness Goal (NPG). The following are descriptions of each HSGP component programs. HSGP is comprised of three interconnected grant programs:

- **State Homeland Security Program (SHSP)**
- **Urban Areas Security Initiative (UASI)**
- **Operation Stone Garden (OPSG)**

Together, these grant programs fund a range of preparedness activities, including planning, organization, equipment purchase, training, exercises, and management and administration.

State Homeland Security Program (SHSP)

SHSP supports the implementation of state Homeland Security Strategies to address the identified planning, organization, equipment, training, and exercise needs to prevent, protect against, mitigate, respond to, and recover from acts of terrorism and other catastrophic events. SHSP also provides funding to implement initiatives in the State Preparedness Report.

UASI program funds address the unique planning, organization, equipment, training, and exercise needs of high-threat, high-density urban areas and assists them in building an enhanced and sustainable capacity to prevent, protect against, mitigate, respond to, and recover from acts of terrorism.

OPSG funds are intended to enhance cooperation and coordination among local, tribal, territorial, state, and federal law enforcement agencies in a joint mission to secure United States borders along routes of ingress from international borders to include travel corridors in s tates bordering Mexico and Canada, as well as states and territories with international water borders.

Intercity Passenger Rail Security Grant Program (IPR) – *Technological Hazard*

http://www.fema.gov/intercity-passenger-rail-amtrak

The Intercity Passenger Rail (IPR) - Amtrak Program provides funding to Amtrak to develop security enhancements for eligible intercity passenger rail operations. IPR plays an important role in the implementation of Presidential Policy Directive – 8 (PPD-8) by supporting the development and sustainment of core capabilities to fulfill the NPG.

Non-Profit Security Grant Program (NSGP) - *Technological Hazard*
http://www.fema.gov/preparedness-non-disaster-grants/urban-areas-security-initiative-nonprofit-security-grant-program

Nonprofit Security Grants Program (NSGP) provides funding support for target hardening and other physical security enhancements and activities to nonprofit organizations that are at high risk of a terrorist attack and located within one of the specific FY 2012 UASI-eligible urban areas. NSGP plays an important role in the implementation of the Presidential Policy Directive – 8 by supporting the development and sustainment of core capabilities to fulfill the National Preparedness Goal.

Port Security Grant Program (PSGP) - *Technological Hazard*
http://www.fema.gov/port-security-grant-program

PSGP provides funding for transportation infrastructure security activities to implement Area Maritime Transportation Security Plans and facility security plans among port authorities, facility operators, and state and local government agencies required to provide port security services. PSGP is to support increased port-wide risk management; enhanced domain awareness; training and exercises; expansion of port recovery and resiliency capabilities; and further capabilities to prevent, detect, respond to, and recover from attacks involving improvised explosive devices and other non-conventional weapons; and competitively award grant funding to assist ports in obtaining the resources required to support the National Preparedness Goal's associated mission areas and core capabilities.

Transit Security Grant Program (TSGP) - *Technological Hazard*
http://www.fema.gov/transit-security-grant-program

TSGP provides funds to owners and operators of transit systems (which include intracity bus, commuter bus, ferries, and all forms of passenger rail) to protect critical surface transportation infrastructure and the traveling public from acts of terrorism and to increase the resilience of transit infrastructure. TSGP plays an important role in the implementation of PPD-8 by supporting the development and sustainment of core capabilities to fulfill the National Preparedness Goal (NPG).

Tribal Homeland Security Grant Program (THSGP) *- Technological Hazard*
http://www.fema.gov/tribal-homeland-security-grant-program

THSGP provides funding directly to eligible tribes to help strengthen the nation against risks associated with potential terrorist attacks. THSGP plays an important role in the implementation

of Presidential Policy Directive – 8 (PPD-8) by supporting the development and sustainment of core capabilities to fulfill the NPG.

First Responder Counter-Terrorism Training Assistance

U.S. Department of Homeland Security/National Fire Academy http://www.dhs.gov/ or http://www.dhs.gov/training-technical-assistance#1

The First Responder Counter-Terrorism Training Assistance Program provides training to enhance the capabilities of first responders in managing the consequences of terrorist acts. -In order to qualify for this benefit program, you must be or have been either a firefighter or an emergency response worker.

State and Local Homeland Security National Training Program

https://www.cfda.gov/?s=program&mode=form&tab=step1&id=766e87cee1ef902966cb8ce99c94b56c

Homeland Security National Training Program (HSNTP) provides funds to support nationwide training initiatives and further the mission of FEMA. Based upon their current activities and identified needs, the National Preparedness Directorate (NPD) will invite select organizations to be eligible to apply under this solicitation. Cooperative agreements will be awarded to these eligible applicants to design, develop, and deliver training content and support for federal, state, local, and tribal jurisdictions in accordance with FEMA doctrine and approved Homeland Security Strategies.

Continuing Training Grant (CTG) funds are available to develop and deliver innovative training programs that are national in scope and meet emerging training needs in our nation's communities. Funding will be provided in the form of cooperative agreements directly to the selected applicants to design, develop, and deliver training content and support for federal, state, local, and tribal jurisdictions in accordance with FEMA doctrine. Approved Homeland Security Strategies Training provided under these programs will address the DHS mission areas defined in the Quadrennial Homeland Security Review (QHSR). The QHSR outlines the strategic framework to guide the activities of participants in homeland security toward a common end. At a minimum this training will specifically address the following mission areas and PPD8:

- Preventing Terrorism and Enhancing Security;
- Safeguarding and Securing Cyberspace;
- Ensuring Resilience to Disasters.

U.S. Dept. of Agriculture – Natural Resources Conservation Service

Emergency Watershed Protection Program

http://**www**.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/ewp/

The purpose of the Emergency Watershed Protection (EWP) program is to undertake emergency measures, including the purchase of flood plain easements, for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood or any other natural occurrence is causing or has caused a sudden impairment of the watershed.

- Financial Assistance
- Agricultural Management Assistance
- Agricultural Water Enhancement Program
- Air Quality Initiative
- Cooperative Conservation Partnership Initiative
- Conservation Innovation Grants
- Conservation Stewardship Program
- Environmental Quality Incentives Program
- Emergency Watershed Protection Program
- Wildlife Habitat Incentive Program

NRCS Farm Bill Conservation Programs

http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/farmbill/2008

- Conservation programs under the 2008 Farm Bill are:
- Agricultural Management Assistance Program (AMA)
- Cooperative Conservation Partnership Initiative (CCPI)
- Conservation of Private Grazing Land Program
- Conservation Reserve Program (Farm Service Agency)
- Conservation Stewardship Program (CSP)

- Environmental Quality Incentives Program (EQIP)
- Agricultural Water Enhancement Program (AWEP)
- Conservation Innovation Grants (CIG)
- Farm and Ranch Lands Protection Program (FRPP)
- Grassland Reserve Program (GRP)
- Healthy Forest Reserve Program (HFRP)
- Small Watershed Rehabilitation Program
- Wetlands Reserve Program (WRP)
- Wildlife Habitat Incentive Program (WHIP)

Federal Agencies Providing Support During Environmental Emergencies

http://www.epa.gov/emergencies/content/partners/federal.htm

Department of Defense (DOD) provides technical assistance and, in emergency situations facilities for storage, treatment, and disposal of hazardous substances;

Department of Energy (DOE) provides technical guidance and support services for incidents involving radioactive releases;

Department of Labor (DOL) provides guidance on worker health and safety through the Occupational Safety and Health Administration (OSHA);

Federal Emergency Management Agency (FEMA) coordinates temporary relocation of individuals

Health and Human Services (HHS) provides site-specific health threat advisories for removal actions through the agency for Toxic Substance and Disease Registry (ATSDR) and technical guidance regarding worker health and safety through the National Institute for Occupational Safety and Health (NIOSH).

The National Pollution Funds Center (NPFC) manages funds for the Oil Spill Liability Trust Fund (OSLTF) and the portion of the Superfund used by the U.S. for response to hazardous substance released in the coastal zone. The NPFC is an independent unit of the U.S. Coast Guard.

Scientific Support Coordinators for t**he National Oceanic and Atmospheric Administration (NOAA) Office of Response and Restoration** work to remediate damage to coastline and marine resources caused by oil and hazardous substance releases. Their scientists analyze and identify solutions to environmental contamination.

The U.S. Coast Guard District Response Group (DRG) provides a framework for the Coast Guard districts to organize their response operations. The DRG consists of all Coast Guard units, personnel and equipment within a district's boundary, all pre-positioned response equipment strategically located in the district, and the District Response Advisory Team (DRAT).

The U.S. Coast Guard National Strike Force provides specialized materials and staff to assist other organizations in responding to hazardous substance emergencies. Their services include communications, technical advice and assistance, specialized equipment, training, and contingency planning.

The U.S. Navy Superintendent of Salvage and Diving (SUPSALV) maintains equipment and expertise for supporting responses to open-sea pollution incidents. Specialized capabilities include salvage, firefighting, and petroleum, oil and lubricants offloading.

Other federal agencies may also provide support when the National Response Team is activated.

DisasterAssistance.gov: Access to Disaster Help and Resources

http://www.disasterassistance.gov/disaster-assistance/browse-by-federal-agency#.UYPVGKKG0k8

Federal Agencies with Assistance Programs

- U.S. Department of Agriculture
- U.S. Department of Education
- U.S. Department of Health and Human Services
- U.S. Department of Homeland Security
- U.S. Department of Housing and Urban Development
- U.S. Department of Justice
- U.S. Department of Labor
- U.S. Department of the Interior
- U.S. Department of the Treasury
- U.S. Department of Veterans Affairs

Federal Agencies with Assistance Programs

- U.S. Office of Personnel Management
- U.S. Postal Service
- U.S. Small Business Administration
- U.S. Social Security Administration

Other Funding Sources

NOAA Community Based Restoration Program
http://www.habitat.noaa.gov/restoration/programs/crp.html

Five Star Restoration Program
http://www.epa.gov/owow/wetlands/restore/5star/

Gulf of Mexico Program
http://www.epa.gov/gmpo/about.html

North American Wetlands Conservation Fund
http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm

Shell Marine Habitat Program
http://www.shell.us/home/content/usa/environment_society/respecting_the_environment/marine_habitat/

Wetlands Program Development Grants
http://yosemite.epa.gov/R10/ECOCOMM.NSF/webpage/wetland+grants

National Coastal Wetlands Conservation Grant Program
http://www.fws.gov/coastal/CoastalGrants/

U.S. Fish and Wildlife Service's Texas Coastal Program
http://www.fws.gov/texascoastalprogram/

Grant Program for Measuring Nonpoint Source Pollution
http://www.tceq.state.tx.us/compliance/monitoring/nps/grants/grant-pgm.html

Texas Outdoor Recreation Grant Programs
http:/www.tpwd.state.tx.us/business/grants/trpa/#outdoor.html

Section 4 - TECHNICAL ASSISTANCE

TDEM Implementation of Two-County Plan Maximum Policy

Effective May 2010, TDEM began to implement its "two-county maximum" policy on submittals of local plans in response to growing concern over the cumbersome planning, review and approval cycle of large regional plans. By limiting each plan to a more manageable size, TDEM predicts local jurisdictions will:

- Retain more ownership of their plans

  and

- Demonstrate more local involvement during the planning and review process.

Emergency Management Colleagues:

Effective May 30, 2010, the State will begin implementation of its "two-county maximum" policy on submittals of local mitigation action plans. This policy applies to both original and updated plans.

The State originated this policy in response to a growing concern over the cumbersome planning, review and approval cycle for large regional plans. When the length of the planning process expands with the size of the area, plans fail to gain timely State and FEMA approval. Although hazards do cross city limits and county lines, the State expects that more localized planning will better reflect the conditions of Texas communities.

By limiting each plan to a more manageable size, the State believes the local jurisdictions will retain more ownership of their plan. As the boundaries of the planning area contract, the more commonality the jurisdictions will find among its hazards and its solutions. Nor will communities continue to be penalized by non- or underperforming local partners during the planning cycle. COGs and River/Drainage Authorities may continue to pursue grants for large regional plans, but the State will require them to submit for content approval broken up into the smaller areas.

Any plan or update not submitted to TDEM for review, in hardcopy, by May 30 must adhere to this policy. Plans submitted before May 30 will be expected to adhere to the policy at their next five-year update. Waivers of this policy may be requested, with justification, on a case-by-case basis.

Ceiling on Amount Available for Mitigation Planning Grants

In January 2012 TDEM implemented funding ceilings on planning grant applications to:

- Fund a multitude of eligible sub-applicants rather than a chosen few from a limited grant allotment;
- Manage cost expectations for developing a plan;
- Encourage multi-jurisdictional county wide plans with community participants.

State Priority:

The State planning priority is a multi-jurisdictional county level plan that includes vital community participants such as cities, independent school districts, hospital complexes and special water-drainage-electrical type districts.

Financial Guidelines:

New or updated planning applications cannot exceed $50,000 federal share for primary participant and $5,000 for each additional participant, with a maximum of $100,000 federal share. Planning grant applications in which the number of participants exceeds 10 should contact the state mitigation section for additional funding guidance.

Individual non-jurisdictional planning applications, such as special districts, schools, hospitals, etc., are limited to $15,000 federal share and are a secondary priority.

Planning grant applications requesting non pre-approved amounts over these limits will only be considered after those meeting the above guidelines. Sub-applicants may be offered a reduced federal share based on the planning grant funding available and applications submitted.

FEMA Implementation of Updated Review Standards and Tools

The two-county maximum policy works well with the transition to new planning standards implemented by FEMA in 2012.

In 2011 FEMA headquarters announced development of a new process for local mitigation plan reviews and approval based on comparing the intent of the 44 CFR 201.6 requirements with the local plan content addressing them. Although the CFR is not revised, the content standards become more stringent. New guidance is developed, and a two-part Plan Review Tool, is introduced to replace the Crosswalk. The purpose of the new process is to:

- Align with the law and regulations
- Initiate a performance rather than a prescriptive approach to the planning requirements
- Improve consistency of reviews and minimize subjective interpretation
- Increase focus on risk reduction strategies
- Increase documentation of representative participation

All local mitigation plans sent to FEMA after September 31, 2012 must comply with the new review process regardless of where they were in any previous review process. During the yearlong transition to the new process, TDEM aggressively advertised and instructed on the new process in its workshops and training and through public outreach. TDEM also requested FEMA Region 6 technical assistance with its current plan review queue (more than 40 plans) with the goal of

reviewing and receiving Approvable Pending Adoption (APA) for as many plans as possible during the transitional period.

A new FEMA manual for local plan developers was introduced in June 2013 to replace the Local Mitigation Planning Guidance (June 2008). A revised FEMA Local Mitigation Plan Review Guide for both the state and FEMA mitigation planners is also available for local developers to review from the FEMA website. The relevant sections for plan development are posted on the TDEM website.

A major difference between the Crosswalk and the Plan Review Tool is its organization into two sections. The first section of the Regulation Checklist addresses only the mandatory requirements outlined in the CFR. The second part, the Plan Assessment, addresses how to develop a deeper more robust plan. The Plan Assessment allows for comment on methods and resources to make the plan more comprehensive.

The added effect of the Two-County Max policy is that it works well with the transition to the new planning standards implemented by FEMA in 2012.

TECHNICAL ASSISTANCE TRAINING

Emergency Management Coordinators (EMC), by default, are those usually tasked with the job of developing local mitigation plans. As most EMC duties center around preparedness and response to emergency situations, mitigation planning requires an adjustment in mindset.

Teaching mitigation workshops continues to be TDEM's strongest technical assistance tool for local jurisdictions. Workshops have proven to be very useful tools in helping EMCs develop local mitigation programs.

Hazard Mitigation workshops are provided through the TDEM Mitigation Section. These workshops are designed to provide information to inform mitigation professionals of new mitigation strategies and requirements. Formal mitigation courses are provided by TDEM. Information related to courses is located on www.preparingtexas.org.

G-710 Mitigation Planning Course

The course teaches how to develop and update local mitigation action plans. It covers the complete process from building the local mitigation team thru conducting hazard analysis and developing local mitigation goals and measures. The course is intended to educate members of emergency management on their role in mitigation planning.

G-393 Mitigation for Emergency Managers

This course is designed to enable the non-technical emergency worker to acquire skills in the use of mitigation. The course provides training in how to perform mitigation activities fundamental to reducing and eliminating long-term risk from hazards. It addresses the important roles of the emergency program manager (or other local government representative) in mitigation: motivator, coordinator, and monitor. This workshop is taught as a segment of TDEM's Professional Development Academy.

The Mitigation Section also provides instruction and classes on mitigation at conferences throughout the year and welcomes the invitation to speak at local, regional or statewide conferences.

General Land Office Technical Assistance

GLO has been instrumental in the development of resources for coastal mitigation planners.

Funding

Currently there are three sources of federal funding for producing mitigation plans. TDEM continues to provide funding to local jurisdictions under HMGP and PDM grants. TWDB's Flood Mitigation Assistance (FMA) program funds the flood mitigation portion of local all-hazard mitigation plans. This grant program operates on an annual basis.

DR 1780	8 planning applications
DR 1791	29 planning applications
DR 1999	13 plan applications approved
DR 1931	3 plan applications approved
DR 4029	4 plan applications approved
PDM FY11	0 plan applications approved
PDM FY12	6 plan applications approved
PDM FY13	no final numbers of approved
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2010 TDEM received 11 plan approvals	
2011 TDEM received 23 plan approvals	
2012 TDEM received 32 plan approvals	

Local Plan Integration

State Review Process

TDEM advises local plan developers to allow two years to develop a mitigation plan: six to 12 months to draft and one year to review and receive approvable pending adoption (APA) status. Grant period of performances reflect this two-year window. All plans, whether funded or unfunded by grants are given the same scheduling consideration. The TDEM review process takes approximately 45-60 days for local mitigation plans, depending on current workload and the size of plans being reviewed.

The TDEM mitigation section uses dedicated staff with specialized training to review local plans utilizing FEMA standards and procedures. There are normally 20-40 plans circulating at various stages of review. Time required for the initial review can take between two to four weeks. TDEM is not responsible for approval of local plans. TDEM assumes the role of consultant, to assist local jurisdictions edit and revise initial draft documents prior to submittal to FEMA for approval. Many plans do not pass the initial state review. Revisions may be required to meet programmatic guidelines. The TDEM reviewer utilizes the Local Mitigation Plan Crosswalk and Local Mitigation Plan Review Tool Regulation Checklist as a guide. Comments will be returned to the jurisdiction on the checklist with comments for suggested revisions. Once the corrections are completed and returned, TDEM mitigation staff will provide a secondary review. After revisions have been made the corrected mitigation plan will be forwarded to FEMA for approval. Frequent communication between the state and local jurisdictions reduces delays and increases success of the review process. The average time for review is six months.

Coordination to Link Local Plans

After a local plan is approved by FEMA, the plan is archived as a reference document for the development of the next update to the plan. The repository currently houses around 90 current single jurisdictional, multi-jurisdictional, regional, and special district plans. During an HMGP grant window, strategies in local plans are considered for their conformance to the state's priorities and application selection process. The implementation of local strategies, in conformance with the goals of the plan, is ultimately the state's strategy.

Previously local plans incorporated a larger number of jurisdictions in the planning process. The transition to smaller local plans necessitates collecting additional vulnerability and loss data. Statistical information may not be uniformly available and qualitative data is often in dissimilar in presentation.

Many communities may not have the resources to maintain records of verifiable loss estimations or the funds and technical expertise to properly collect this information. This is a requirement in 44 CFR.6(c)(ii)(B). This issue illustrates the disparity of available information.

TDEM does not currently have a data collection and analysis system that compensates for differences in reporting data. The temporary solution for this update was to send a questionnaire to each county. Although responses continue to be based on best information available, the questionnaire collected information in a consistent format. The questionnaire provided statistics regarding local capability and hazard risk. Local data obtained from this questionnaire contributed to the vulnerability and risk exposure portion of the state plan.

201.4(c)(2) states that "this overview will allow the state to compare potential losses throughout the state and to determine their priorities for implementing mitigation measures under the strategy, and to prioritize jurisdictions for receiving technical and financial support in development more detailed local risk and vulnerability assessments.

Planning Grants

TDEM prioritizes its planning grant allotments (HMGP allows up to 7 percent of the disaster grant to be put toward mitigation plan development) on whether the plan is a multi-jurisdictional plan or a single-jurisdictional plan. As multi-jurisdictional plans demonstrate a culture of cooperation across jurisdictional boundaries, they are prioritized over single entity plans. A DPS Strategy Implementation Plan measurement of mitigation planning performance is to reach an 80 percent measurement of the state's population being covered by a local mitigation plan. Therefore, in outreach efforts those larger metropolitan areas are targeted for encouragement to make application for grant funding.

Texas plans to use the seven percent HMGP set-aside funds for grants to develop federally required mitigation action plans.

Applications submitted for FMA planning grants, awarded to fund the flood mitigation section of a all-hazards mitigation plan, are evaluated and prioritized based on the communities need for planning and the number of structures within the planning area that appear on FEMA's repetitive loss list.

Project Grants

HMGP and PDM Programs

Any hazard mitigation program receiving funds from the federal hazard mitigation grant program are required to:

- Support the goals and strategies of the State Hazard Mitigation Plan
- Prevent repetitive losses
- Protect strategic areas and geologically hazardous areas

The following factors are considered when prioritizing mitigation projects:

- Impact from disaster;
- Repetitive loss history from the FEMA repetitive loss inventory;
- Type of hazard to be mitigated
- Project type and feasibility
- Benefit cost analysis
- Appropriate management of previous grant funds

Flood Mitigation Assistance Program

Applications submitted to the TWDB for FMA project grants are reviewed and prioritized using an established evaluation system based on FEMA criteria and requirements. The highest priority is given to applications where structures affected by the project are on the FEMA repetitive loss list. Projects could include buyout and removal of these structures or protecting the structures by elevating or by structural measures such as regional detention or minor channel. Next would be to recommend those proposed projects reflecting the best or highest benefit-cost ratio. Other factors that can be used to evaluate and prioritize applications are if the proposed project is a regional detention project and would be protecting many more houses than just the ones on the repetitive loss list.

Other Programs

Projects funded under other state agencies, including TFS and GLO, will follow their own internal operating procedures and the rules of the funding program they administer when it comes to prioritizing projects for funding.

In conclusion, through a combination of factors, the state prioritizes grant applications in consideration of:

- High risk (priority to applications from impacted areas); repetitive loss properties (FMA and HMGP place high priority rating on these applications);
- Most intense development pressures (TDEM targets high population areas for planning grant outreach);

- Maximizing benefits in accordance with cost benefit review (TDEM uses a combination of inputs that addresses many STAPLEE dimensions (social, technical, administrative, political, legal, economic, and environmental).

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APPENDICES

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APPENDIX A – Severe Repetitive Loss Strategy

The following is the State of Texas Repetitive Loss Strategy prepared by the Texas Water Development Board (TWDB) and the Texas Division of Emergency Management (TDEM).

BACKGROUND

The appendix has been prepared to address certain federal requirements that would allow the state of Texas to receive an increased federal cost share of up to 100 percent for mitigation grants funded under the Flood Mitigation Assistance (FMA) program. Meant to serve as a stand-alone document in this regard, this appendix will provide detail concerning the state's flood risk as it pertains to Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties and will present mitigation strategies to reduce future losses to RL and SRL properties.

FEMA has defined repetitive loss property to include any property which has two or more flood insurance claims of $1,000 or more within a 10-year period.

FEMA's definition of severe repetitive loss properties includes single or multifamily residential properties that are covered under an NFIP flood insurance policy and that meet one of the following criteria:

1) Properties that have incurred flood-related damage for which four or more separate claim payments have been made, with the amount of each claim (including building and contents payments) exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000.

2) Properties for which at least two separate claims payments (building payments only) have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the building.

In both instances, at least two of the claims must have been within 10 years of each other; claims made within 10 days of each other are counted as a single claim.

The FY 2013 Hazard Mitigation Unified Guidance Document (FY 2013 Guidance) includes RL and SRL definitions for those properties which anticipate receiving the increased Federal cost share of up to 100 percent for mitigation grants funded under the FMA program. In order to receive an increased federal cost share, properties must meet one of the definitions below (consistent with the legislative changes made in the Biggert-Waters Flood Insurance Reform Act of 2012):

A severe repetitive loss property is a structure that:

(a) Is covered under a contract for flood insurance made available under the NFIP; and

(b) Has incurred flood related damage –

(i) For which four or more separate claims payments have been made under flood insurance coverage with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or

(ii) For which at least two separate claims payments have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

A repetitive loss property is a structure covered by a contract for flood insurance made available under the NFIP that:

(a) Has incurred flood-related damage on two occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and

(b) At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

In order to be eligible for an increased Federal cost share of up to 100 percent under the FMA program, the Texas Mitigation Plan must meet the repetitive loss requirements identified in 44 CFR §201.4 (c)(3)(v). The FEMA-approved plan must identify the specific actions that the state has taken to reduce the number of repetitive loss properties, must include those properties identified as being severe repetitive loss properties, and must specify how the state intends to reduce the number of repetitive loss properties in the future. This requirement supplements the risk assessment and mitigation strategy portions of the plan required under 44 CFR §201.4(c)(2) and (3) by specifically identifying goals, capabilities, and actions that will reduce the number of repetitive loss properties, including severe repetitive loss properties. The mitigation strategy is based on the state's risk assessment as required under 44 CFR§201.4(c)(3)(ii). Therefore, the state must address repetitive loss structures in its risk assessment, where applicable. For example, in its overview of Estimating Potential Losses by Jurisdiction under 44 CFR §201.4(c)(2)(iii), the state may analyze potential losses to repetitive loss properties based on estimates provided in local risk assessments. The plan should refer generally to geographic areas where concentrations of repetitive loss properties are located for the purpose of identifying and prioritizing areas for mitigation projects. Alternatively, the plan may list the number of repetitive loss properties with aggregate repetitive loss data.

Pursuant to 44 CFR §201.4(c)(3)(i), the state's hazard mitigation goals must support the selection of activities to mitigate and reduce potential losses to structures susceptible to flood damage, including repetitive loss properties. In addition, the state and local capability assessments required under 44 CFR §201.4(c)(3)(ii) must include an evaluation of policies, programs, and capabilities that allow for the mitigation of repetitive losses from flood damage. The state must also describe those specific actions that it has implemented to mitigate repetitive losses, and specifically those actions taken to reduce the number of severe repetitive loss properties as a subset of all repetitive loss properties in the state. Finally, based on the findings of the risk assessment, the state

must identify those actions in the statewide mitigation strategy that will specifically address repetitive loss properties, including those that are severe repetitive loss properties. These requirements supplement the mitigation actions requirement set forth in 44 CFR §201.4(c)(3)(iii). Mitigation actions should be tied to the state's hazard mitigation goals and objectives and should address the means to achieve them. Moreover, mitigation activities should have been identified during the planning process, and local plans should be consistent with such statewide activities.

As part of the mitigation strategy, the plan must also identify any of the current funding sources, including any potential funding sources that will be pursued in order to fund proposed mitigation actions for repetitive loss properties. This supplements the identification of funding requirement established in 44 CFR §201.4 (c)(3)(iv).

The state plan must describe the strategy to be taken to ensure that local jurisdictions with severe repetitive loss properties take actions to reduce the number of these properties, including the development of local mitigation plans. This supplements the Coordination of Local Mitigation Planning portion of the plan described in 44 CFR §201.4(c)(4). At a minimum, the state must include severe repetitive loss in the description of its process for providing funding and address the technical assistance that may be provided to prepare these mitigation plans pursuant to 44 CFR §201.4(c)(4)(i), and the state must also furnish its criteria for prioritizing communities that have such properties for purposes of future planning and project grant assistance in accordance with 44 CFR §201.4(c)(4)(iii). Other strategies for encouraging local communities to mitigate severe repetitive loss properties should be demonstrated through specific actions identified in the mitigation strategy.

RISK ASSESSMENT

In order to adequately identify and profile the flood hazards that occur throughout Texas, a general overview of the physical character of the state is necessary. A state the size of Texas, which contains over 267,000 square miles making up roughly seven percent of the contiguous United States, exhibits varied characteristics in both climate and physiography. The following sections provide a description of the general physiography and climate of the state, as well as its population characteristics as they apply to an assessment of risks associated with the flood hazard.

PHYSIOGRAPHY

Four principal physiographic regions of the central United States occur in Texas (Figure 2-1). The Basin and Range Province of the Rocky Mountains extends into Far West Texas and includes the Davis and Guadalupe Mountains, the Big Bend area, and the Upper Rio Grande Valley. The Great Plains lie to the east and flank the Rocky Mountains. The Great Plains include the panhandle area of Texas (High Plains), and extend into the plateau areas located as far south as the Rio Grande River and the Balcones Escarpment. The Interior Lowlands Region lies adjacent to and east of the Great Plains extending from Canada south into north-central Texas. The boundary of the Interior Lowlands in Texas is marked by the Caprock Escarpment along its western perimeter, the Balcones Escarpment along its eastern limit, and the northern extent of the plateau area and Llano

Basin of Central Texas along its southern boundary. Lastly, the Gulf Coastal Plain covers the eastern third of the state and is bounded along the west by the Balcones Escarpment from the Rio Grande River near the city of Del Rio, eastward to near San Antonio where the trend turns roughly north by north-east towards north-central Texas extending past the Dallas area and across the Red River (Jordan, et. al, 1984; Texas Almanac, edited by Alvarez, 2006). The physiographic regions are reflective of the underlying geology of the state, which also serves as the parent material from which the properties of specific soil groups are derived. In addition, the boundaries of the physiographic regions correspond to the primary ecoregions of Texas denoting areas exhibiting similarities in ecological and biological diversity (after McMahon, et al., 2001 as modified by Texas Parks and Wildlife Dept., 2004).

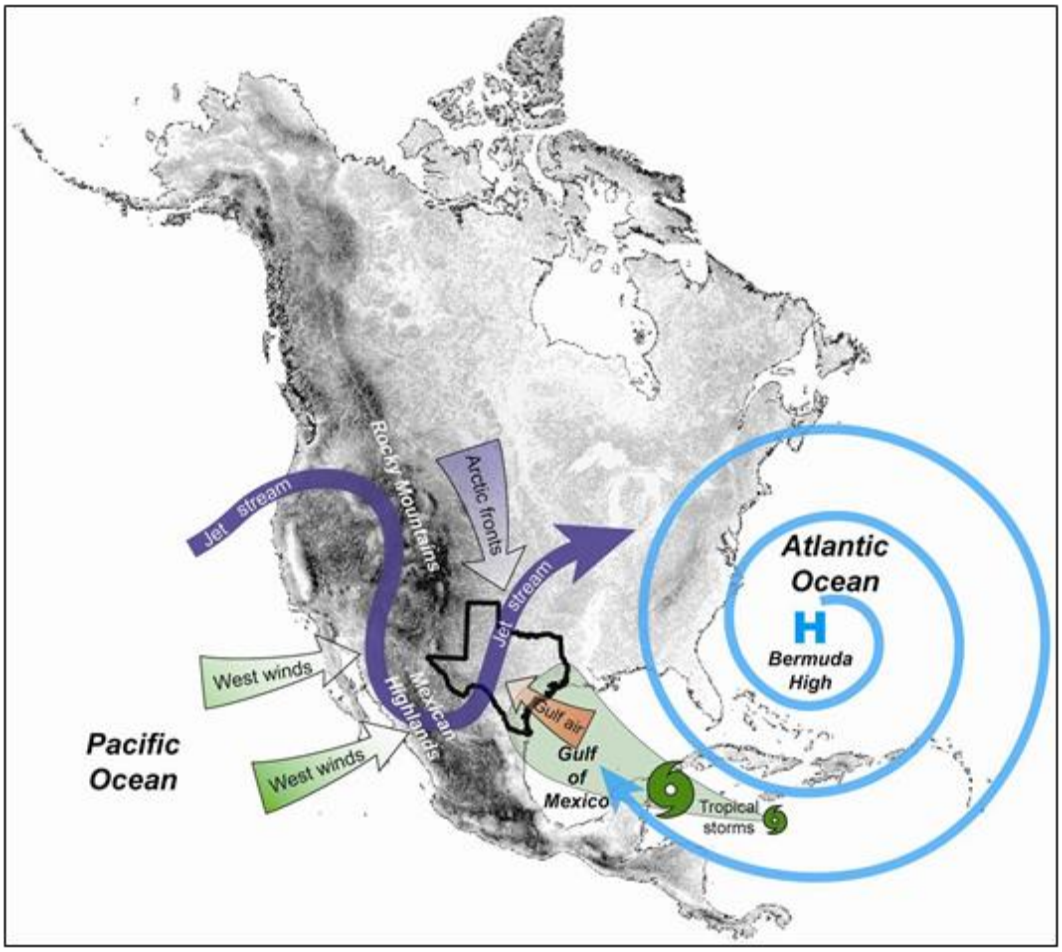
Figure 2-1: Physiographic Map of Texas

CLIMATE

Texas climate is as varied as its landscape. Variability is due primarily to interactions between the state's geographic location and the movement of seasonal air masses, such as arctic fronts, subtropical west winds, the jet stream, tropical storms and a subtropical high pressure system known as the Bermuda High (Figure 2-2). The Gulf of Mexico is a dominant geographical feature, moderating temperatures along the Gulf Coast and providing the major source of moisture for the state. The Rocky Mountains direct the

arctic cold fronts southerly into the state during the late fall, winter and early spring months. Pacific moisture is carried into the state by subtropical depressions moved eastward by the westerlies during the summer. During the spring and fall months, warm, dry air from the high plains of northern Mexico is pulled into the state by the jet stream where it collides with humid air from the Gulf of Mexico being funneled in by the western limb of the Bermuda High resulting in the formation of severe thunderstorms and tornadoes (TWDB, 2007; Bomar, 1995; Slade and Patton, 2003).

Figure 2-2: Interaction of Seasonal Air Masses & North American Geography Affecting Texas Climate



Source: Texas Water Development Board, 2007

POPULATION

In order to evaluate the level of risk associated with a particular hazard, the geographical characteristics of the hazard in terms of the statistical nature of its occurrence in a particular area as well as the aerial expanse of the hazard effects is required. In addition, risk itself will be relative to the population that will be exposed to the hazard and its effects. This section describes the population throughout the state in terms of existing

population (most recent numbers), past population changes, and future population projections. Existing population and current trends are based on the year 2010 census (source: U.S Census Bureau); however, additional data, as available, was also used in the analysis. The population projections presented are taken from the 2012 State Water Plan, developed by the Texas Water Development Board, and are based upon TWDB analysis. The state's population in 2010, based on U.S. Census Bureau data, was just above 25.1 million. This was a nearly 21 percent growth rate, which was the fastest in the nation, from the 2000 census count of 20.8 million. Data projections through 2020 indicate that, based on a growth rate of 17.9 percent, the population will increase to 29,650,388. Of the 254 counties in Texas, populations range from Loving County, with less than 100 people, to Harris County which has a population of more than 4.1 million people. Of the 254 counties in Texas, 175 gained population while 79 lost population between the 2000 and 2010 census. The majority of the counties experiencing growth were located in the eastern portion of the state or along the Interstate Highway-35 corridor.

Population trends can be described in various ways depending on how the data is compiled; for example, trends can be based on evaluations performed at the city or county level, or by using Metropolitan Statistical Areas (MSAs), which are stand-alone metropolitan areas comprised of one or more counties. Alternatively, an analysis of population trends can be based on Primary Metropolitan Statistical Areas (PMSAs) or Consolidated Metropolitan Statistical Areas (CMSAs). CMSAs are metropolitan areas with a population of more than one million and are comprised of two or more PMSAs (Texas Almanac, edited by Alvarez, 2006).

In terms of assessing or evaluating risks, population statistics compiled by PMSA or MSA are very useful, but proposing mitigation strategies would require the evaluation of populations at the city and county level, or perhaps even further based on individual watersheds or neighborhoods, depending on the specific hazard. There are five PMSA and MSA areas with populations greater than 1 million, six MSAs with populations ranging from 250,000 to 1 million, and 15 MSAs ranging from 100,000 to 250,000 in population. Listed below are the higher population centers of the state along with their associated counties:

<u>Population greater than 1,000,000</u>
- Houston PMSA (Chambers, Fort Bend, Harris, Liberty, Montgomery, and Waller Counties)
- Dallas PMSA (Collin, Dallas, Denton, Ellis, Henderson, Hunt, Kaufman, and Rockwall Counties)
- Fort Worth PMSA (Hood, Johnson, Parker, and Tarrant Counties)
- San Antonio MSA (Bexar, Comal, Guadalupe, and Wilson Counties)
- Austin MSA (Bastrop, Caldwell, Hays, Travis, and Williamson Counties)

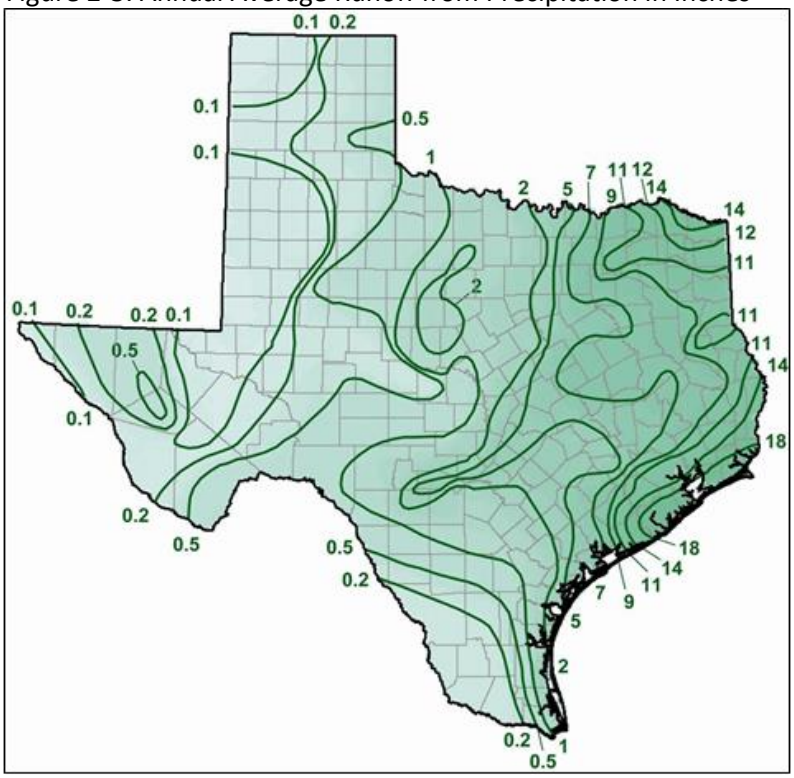
<u>Population of 250,000 to 1,000,000</u>
- El Paso MSA (El Paso and Hudspeth Counties)
- McAllen MSA (Hidalgo County)

•Beaumont-Port Arthur MSA (Hardin, Jefferson and Orange Counties)
•Corpus Christi MSA (Aransas, Nueces and San Patricio Counties)
•Brownsville-Harlingen MSA (Cameron County)
•Killeen MSA (Bell, Coryell, and Lampasas Counties)

RIVER BASINS OF TEXAS

As provided in the 2012 State Water Plan, *Water for Texas*, there are 15 major river basins within the state and eight coastal basins, each with varying hydrological regimes and water supply capabilities. Each of the basins has several unique features, both climatic (such as precipitation and evaporation), as well as physiographic (geology, slope, soil type, vegetation and land use practices), which contribute to the nature of runoff from the basins (Figure 2-3). Table 2.1 provides a summary of the major river basins and includes the pertinent watershed area, river length and average flow.

Figure 2-3: Annual Average Runoff from Precipitation in Inches



Source: Texas Water Development Board, 2007

Table 2-1: Features of Major River Basins in Texas

River Basin	Total Area (Sq Mi)	Area in Texas (Sq Mi)	River Length (Miles)	Length in Texas (Mi)	Average Flow (Ac Ft/Yr)
Brazos	45,573	42,865	840	84	6,074,000
Canadian	47,705	12,865	906	21	196,000
Colorado	42,318	39,428	865	86	1,904,000
Cypress	3,552	2,929	90	7	493,700
Guadalupe	5,953	5,953	409	40	1,422,000
Lavaca	2,309	2,309	117	11	277,000
Neches	9,937	9,937	416	41	4,323,000
Nueces	16,700	16,700	315	31	539,700
Red	93,450	24,297	1,360	69	3,464,000
Rio Grande	182,215	49,387	1,896	88	645,500
Sabine	9,756	7,570	360	36	5,864,000
San Antonio	4,180	4,180	238	23	562,700
San Jacinto	3,936	3,936	85	8	1,365,000
Sulphur	3,767	3,580	222	22	932,700
Trinity	17,913	17,913	550	55	5,727,000

IDENTIFYING AND PROFILING THE HAZARD

A review of past federal declarations and available local mitigation action plans will demonstrate that the Texas Mitigation Plan addresses the risks associated with the following 15 hazards to which Texas is vulnerable: floods, tornadoes, hurricanes, drought, wildfires, coastal erosion, dam or levee failures, earthquakes, expansive soil, extreme heat, hailstorms, land subsidence, severe winter storms, windstorms, and lightning. Of the 86 major disaster declarations in Texas, based on FEMA major disaster declaration data from 1953 to 2011, 80 of those were due to severe storms, tropical storms, hurricanes, or flooding. Of those 80 major disaster declarations, which all included flooding, 37 of the declarations were made solely as a result of flooding events.

Runoff is the portion of rainfall which, in combination with other factors, may contribute to the streamflow of any surface drainage way and when runoff exceeds the carrying capacity of the stream or drainage, flooding occurs. Runoff is a product of two major factors, climate and physiography. An understanding of the interrelation of these factors, as well as site specific data pertaining to these factors, is necessary in evaluating the flood hazard of an area and in assessing mitigation strategies for that area. Climatic factors may include precipitation, evaporation, transpiration and interception. Physiographic factors would include the characteristics of the watershed such as size, shape and slope of the basin's drainage area, the general land use within the basin, and may also include characteristics of the drainage way itself such as the geometry of the channel.

Historically, floods are one of the most frequently occurring, destructive and costly natural hazards facing Texas. Few areas in the state are completely free from the threat of floods. Flooding can occur during any season of the year. Winter and early spring floods are typically caused by the seasonal rainfall patterns while summer floods (except for those associated with hurricanes and tropical storms) are caused by super-cell thunderstorms that generally affect only small, localized areas. Floods may be caused by large-scale weather systems that can generate prolonged rainfall events, by locally intense thunderstorms, or by coastal storms such as hurricanes and tropical storms. The Central Texas area is considered to be one of the most flash flood prone regions in the nation, due primarily to a combination of climatic factors and the specific physiography of the area. Damage due to flooding can range from water damage to structures and their contents to the complete destruction of the structures with a total loss of all contents. Roads and infrastructure may be undermined and damaged. Riverbank erosion, injury and loss of life are additional consequences of flooding incidents. On the average, Texas suffers approximately 400 floods annually, more than twice the number of the second-highest state (ascertained by local data relating to events resulting in damages of at least $50,000). FEMA's Repetitive Loss data indicates that between 1978 and 2013, $1,819,869,331.61 in Repetitive Loss flood insurance claim payments were made in Texas.

The most obvious tool a local entity can use to assess the risks associated with flood hazard is to review the Flood Insurance Rate Map (FIRM) created by FEMA. These were created and exist on an individual county basis. It is not the intent at this time to include a statewide review of the existing local FIRM maps or to conduct a mapping needs assessment for all the counties or even a status of FEMA's Map Modernization activities. Instead the state wishes to recognize the importance of this tool in assessing flood hazards. Future updates to this plan may provide a more detailed assessment of the flood hazard mapping activities.

Additional detail concerning flood hazards in Texas, as well as other hazards can be found in The Texas Hazard Mitigation Package (at www.thmp.info - an online digital geographic data resource for hazard analysis in Texas). The Texas Hazard Mitigation Package is organized so that users can quickly assess their potential exposure to natural hazards by viewing summary maps depicting the historical frequency of those hazards by county.

Another useful tool in assessing the relative risk associated with the flood hazards would include a review of the location of Repetitive Loss (RL) structures. A general discussion of the number and location of RL structures as well as Severe Repetitive Loss (SRL) properties is provided in the following sub-section.

REPETITIVE LOSS (AND SEVERE REPETITIVE LOSS) PROPERTIES

Repetitive Loss (RL) and Severe Repetitive Loss (SRL) data is available through FEMA and is based on flood insurance damage claims by property and by community. This information will not necessarily be indicative of the total damage associated with any

particular event, but may demonstrate the relative risk by depicting a concentration of data in particular geographic locations.

The most recent data from FEMA's Web Data Exchange database of RL and SRL structures (through February 2013) shows 20,604 RL properties within the state, which are located in 143 of the state's 254 counties. A breakdown of the statewide data indicates that approximately 46 percent of the RL properties are located in Harris County. Nearly 71 percent of the entire RL list occurs within Harris County and the three counties contiguous to Harris County: Galveston, Brazoria and Montgomery counties. The total flood insurance claim payments associated with RL properties is approximately $1,819,869,331.61 statewide. Payments on claims arising from Harris County RL properties are approximately $999,191,437.14 and account for nearly 55 percent of the total statewide RL payments.

The occurrence of SRL properties throughout the state mirrors the occurrence of RL properties. Of the 20,604 RL properties statewide, 3,792 (or 18 percent) are SRL properties. These properties are located in 82 of the 254 counties of the state. Harris County has the greatest number of SRL properties with 2,268 or almost 60 percent of the total number of SRL properties. Harris County and the three contiguous counties, Galveston, Brazoria, and Montgomery counties, have a combined 2,958 SRL properties accounting for 70 percent of the total number of SRL properties statewide. NFIP claim payments associated with SRL properties total approximately $710 million or nearly 40 percent of the total RL claim payments. Table 2-2 provides a summary of repetitive loss and severe repetitive loss data.

Table 2-2 Repetitive Loss and Severe Repetitive Loss Properties in Texas (mitigated and non-mitigated property data)

County Name	Total RL Payments	Losses	Properties	Total SRL Payments	Losses	Properties
ANDERSON COUNTY	$3,018.09	2	1	$0.00	0	0
ANGELINA COUNTY	$2,450,894.07	117	37	$203,305.28	10	2
ARANSAS COUNTY	$4,598,360.96	290	88	$2,047,769.37	79	10
ATASCOSA COUNTY	$91,201.76	4	1	$91,201.76	4	1
AUSTIN COUNTY	$745,913.07	26	11	$0.00	0	0
BANDERA COUNTY	$826,110.00	33	12	$145,977.65	5	2
BASTROP COUNTY	$418,039.01	14	5	$155,620.56	4	1
BAYLOR COUNTY	$21,403.61	2	1	$0.00	0	0
BEE COUNTY	$409,497.00	14	5	$195,397.42	6	1
BELL COUNTY	$4,049,888.01	92	41	$193,592.41	2	1
BEXAR COUNTY	$6,488,849.87	363	136	$2,912,140.64	55	12

County Name	Total RL Payments	Losses	Properties	Total SRL Payments	Losses	Properties
BLANCO COUNTY	$39,644.52	2	1	$0.00	0	0
BOSQUE COUNTY	$119,186.41	8	3	$0.00	0	0
BOWIE COUNTY	$1,045,946.98	66	13	$440,389.12	27	2
BRAZORIA COUNTY	$87,936,969.97	4581	1510	$32,513,225.44	1276	229
BRAZOS COUNTY	$1,145,428.03	68	24	$625,898.77	21	4
BROOKS COUNTY	$794,627.42	32	7	$731,225.73	22	3
BROWN COUNTY	$3,150,608.71	121	39	$1,669,325.64	52	10
BURLESON COUNTY	$30,129.19	4	1	$0.00	0	0
BURNET COUNTY	$653,586.11	30	10	$189,226.98	4	1
CALDWELL COUNTY	$1,129,364.17	41	20	$0.00	0	0
CALHOUN COUNTY	$750,973.22	80	34	$0.00	0	0
CAMERON COUNTY	$7,682,458.03	476	177	$1,851,199.29	85	14
CASS COUNTY	$399,889.64	10	3	$294,486.63	5	1
CHAMBERS COUNTY	$3,837,926.85	173	59	$638,357.28	29	5
CHEROKEE COUNTY	$92,691.11	6	3	$0.00	0	0
CLAY COUNTY	$460,778.56	6	2	$0.00	0	0
COLLIN COUNTY	$10,115,503.69	448	150	$3,633,232.58	142	25
COLORADO COUNTY	$36,762.46	2	1	$0.00	0	0
COMAL COUNTY	$25,499,796.06	305	132	$7,874,245.71	67	23
COOKE COUNTY	$4,017,970.45	134	50	$883,672.90	35	10
DALLAS COUNTY	$9,953,704.19	407	131	$3,727,121.03	104	19
DAWSON COUNTY	$51,022.47	4	2	$0.00	0	0
DENTON COUNTY	$3,026,276.66	209	72	$954,188.86	55	10
DEWITT COUNTY	$1,841,275.77	82	26	$1,059,706.37	42	9
DUVAL COUNTY	$59,596.10	4	2	$0.00	0	0
EASTLAND COUNTY	$40,466.42	2	1	$0.00	0	0
ECTOR COUNTY	$169,714.60	8	4	$0.00	0	0
EL PASO COUNTY	$494,721.36	33	11	$303,209.47	13	2
ELLIS COUNTY	$2,631,775.70	73	27	$1,763,163.20	34	10
FANNIN COUNTY	$25,518.09	6	3	$0.00	0	0
FAYETTE COUNTY	$589,261.29	14	6	$0.00	0	0
FISHER COUNTY	$55,325.70	2	1	$0.00	0	0
FORT BEND COUNTY	$6,808,869.66	315	130	$1,669,285.50	46	10
GAINES COUNTY	$13,536.43	3	1	$0.00	0	0
GALVESTON COUNTY	$224,926,593.19	9000	2651	$84,352,708.18	2725	461
GOLIAD COUNTY	$229,308.48	7	3	$0.00	0	0
GONZALES COUNTY	$2,068,797.20	60	25	$601,707.75	9	4
GRAY COUNTY	$87,715.10	2	1	$0.00	0	0

County Name	Total RL Payments	Losses	Properties	Total SRL Payments	Losses	Properties
GRAYSON COUNTY	$4,052,307.15	153	44	$2,176,038.17	45	8
GREGG COUNTY	$598,218.73	59	18	$333,727.95	19	3
GRIMES COUNTY	$15,422.78	2	1	$0.00	0	0
GUADALUPE COUNTY	$62,677,465.33	1138	423	$26,864,246.29	338	87
HALL COUNTY	$16,477.57	2	1	$0.00	0	0
HARDIN COUNTY	$13,201,211.51	579	157	$6,758,315.86	261	41
HARRIS COUNTY	$999,191,437.14	31770	9516	$446,317,493.12	12946	2268
HARRISON COUNTY	$675,787.73	43	17	$80,489.94	7	2
HASKELL COUNTY	$429,925.51	52	17	$199,858.42	11	2
HAYS COUNTY	$1,297,804.43	48	23	$145,612.25	2	1
HENDERSON COUNTY	$1,101,824.00	21	4	$1,036,594.63	12	2
HIDALGO COUNTY	$3,763,545.02	290	112	$1,135,042.51	58	12
HILL COUNTY	$58,738.30	5	2	$0.00	0	0
HOOD COUNTY	$322,699.63	15	6	$71,116.16	5	1
HOPKINS COUNTY	$152,022.80	11	5	$0.00	0	0
HOWARD COUNTY	$56,416.59	4	2	$0.00	0	0
HUNT COUNTY	$189,458.42	8	4	$0.00	0	0
JACKSON COUNTY	$620,990.92	43	13	$121,123.62	6	1
JASPER COUNTY	$621,600.53	33	13	$140,740.77	5	1
JEFFERSON COUNTY	$66,768,624.16	3036	986	$21,550,725.98	737	127
JIM HOGG COUNTY	$11,894.62	2	1	$0.00	0	0
JIM WELLS COUNTY	$291,008.34	26	11	$0.00	0	0
JOHNSON COUNTY	$1,079,572.21	62	26	$186,808.33	10	3
JONES COUNTY	$3,399,636.86	183	66	$241,629.73	19	4
KAUFMAN COUNTY	$53,900.89	11	3	$0.00	0	0
KENDALL COUNTY	$996,984.33	36	14	$119,707.90	8	2
KERR COUNTY	$289,692.01	21	9	$0.00	0	0
KLEBERG COUNTY	$181,551.72	32	10	$0.00	0	0
LAMAR COUNTY	$131,626.91	15	5	$0.00	0	0
LAMPASAS COUNTY	$104,847.84	4	2	$0.00	0	0
LAVACA COUNTY	$140,537.82	15	3	$59,485.56	11	1
LEE COUNTY	$156,318.07	2	1	$0.00	0	0
LIBERTY COUNTY	$13,046,553.90	736	245	$4,646,871.01	230	47
LIMESTONE COUNTY	$2,267,600.66	120	37	$971,300.65	49	9
LIVE OAK COUNTY	$384,509.04	21	10	$0.00	0	0
LLANO COUNTY	$426,767.22	27	12	$0.00	0	0
LUBBOCK COUNTY	$173,298.74	17	7	$0.00	0	0
MADISON COUNTY	$88,819.62	8	2	$65,775.34	6	1

County Name	Total RL Payments	Losses	Properties	Total SRL Payments	Losses	Properties
MARION COUNTY	$428,986.65	24	7	$165,662.00	12	2
MARTIN COUNTY	$61,407.32	2	1	$0.00	0	0
MATAGORDA COUNTY	$6,302,622.57	459	154	$2,747,415.33	123	25
MAVERICK COUNTY	$196,988.82	18	8	$58,808.90	3	1
MCLENNAN COUNTY	$1,144,857.09	73	20	$423,263.56	24	2
MEDINA COUNTY	$246,855.13	14	6	$0.00	0	0
MENARD COUNTY	$70,183.82	8	4	$14,182.95	2	1
MIDLAND COUNTY	$427,273.52	23	9	$171,553.55	4	1
MILAM COUNTY	$39,176.26	2	1	$0.00	0	0
MITCHELL COUNTY	$18,097.50	2	1	$0.00	0	0
MONTAGUE COUNTY	$434,780.22	28	12	$205,730.97	10	4
MONTGOMERY COUNTY	$89,875,893.03	3298	979	$0.00	0	0
NACOGDOCHES COUNTY	$777,617.49	65	23	$130,734.65	5	1
NAVARRO COUNTY	$130,450.40	11	4	$0.00	0	0
NEWTON COUNTY	$597,201.90	40	15	$314,892.26	18	5
NOLAN COUNTY	$32,082.74	5	2	$0.00	0	0
NUECES COUNTY	$12,404,253.25	725	255	$4,743,263.72	152	26
ORANGE COUNTY	$30,428,811.41	1159	344	$10,356,116.07	408	61
PALO PINTO COUNTY	$231,425.54	22	9	$0.00	0	0
PANOLA COUNTY	$34,663.34	3	1	$0.00	0	0
PARKER COUNTY	$917,885.11	55	21	$471,783.76	15	3
POLK COUNTY	$2,119,746.39	68	22	$972,190.57	30	6
POTTER COUNTY	$3,539,864.27	146	55	$53,893.32	9	1
RANDALL COUNTY	$266,898.35	27	6	$85,397.50	10	1
REAL COUNTY	$418,655.80	24	11	$0.00	0	0
RUSK COUNTY	$136,367.23	13	5	$81,906.59	4	1
SAN JACINTO COUNTY	$1,839,066.19	121	50	$426,743.16	26	7
SAN PATRICIO COUNTY	$3,776,522.23	341	143	$667,308.98	38	7
SAN SABA COUNTY	$35,130.39	6	2	$0.00	0	0
SHACKELFORD COUNTY	$11,173.49	2	1	$0.00	0	0
SMITH COUNTY	$1,047,567.23	63	17	$516,345.02	17	2
SOMERVELL COUNTY	$427,843.39	28	9	$200,039.18	11	2
STARR COUNTY	$36,359.44	4	2	$0.00	0	0
STEPHENS COUNTY	$32,605.12	6	1	$0.00	0	0
TARRANT COUNTY	$18,164,787.55	650	227	$8,343,485.83	172	34
TAYLOR COUNTY	$404,105.03	11	5	$0.00	0	0

County Name	Total RL Payments	Losses	Properties	Total SRL Payments	Losses	Properties
TOM GREEN COUNTY	$52,191.09	6	3	$0.00	0	0
TRAVIS COUNTY	$19,212,950.97	683	242	$6,856,477.72	182	40
TRINITY COUNTY	$508,695.61	29	8	$274,186.36	11	2
TYLER COUNTY	$1,256,596.78	61	23	$190,562.21	12	3
UPSHUR COUNTY	$24,781.49	2	1	$0.00	0	0
UVALDE COUNTY	$1,064,294.58	15	7	$0.00	0	0
VAL VERDE COUNTY	$657,517.50	22	11	$0.00	0	0
VICTORIA COUNTY	$4,168,994.78	148	49	$2,401,364.04	60	13
WALKER COUNTY	$1,440,666.09	100	33	$577,048.71	35	8
WALLER COUNTY	$1,988,546.48	84	26	$895,836.93	36	6
WASHINGTON COUNTY	$5,378.22	3	1	$0.00	0	0
WEBB COUNTY	$977,586.09	57	19	$286,773.84	22	3
WHARTON COUNTY	$1,571,884.16	82	33	$214,378.88	8	3
WICHITA COUNTY	$5,160,290.61	414	139	$653,333.36	44	7
WILLACY COUNTY	$450,556.96	38	18	$130,722.85	7	3
WILLIAMSON COUNTY	$2,108,915.53	96	32	$902,613.75	27	5
WILSON COUNTY	$485,854.22	16	7	$151,400.26	4	1
WISE COUNTY	$221,057.62	13	6	$0.00	0	0
YOUNG COUNTY	$277,344.86	29	10	$0.00	0	0
ZAVALA COUNTY	$23,028.27	6	2			
	Total	**Total**	**Total**	**Total**	**Total**	**Total**
	$1,819,869,331.61	**65881**	**20604**	**$709,658,702.49**	**21284**	**3792**

ASSESSING LOCAL VULNERABILITIES AND ESTIMATING COUNTY-LEVEL LOSSES FOR RL AND SRL PROPERTIES

For purposes of this appendix, several of the local hazard mitigation plans which were developed for those communities with the greatest numbers of repetitive loss structures were reviewed and evaluated. In addition, several multi-jurisdictional plans were also reviewed and evaluated. For example, local plans prepared for city of Houston, city of Beaumont, Jefferson County Drainage District No. 6 and unincorporated Harris County, as well as multi-jurisdictional plans prepared for Harris County and most of its incorporated communities (excluding city of Houston, but including Harris County Flood Control District), Houston-Galveston Area Council of Governments and the Southeast Texas Regional Planning Commission, were used as a basic resource to evaluate the local vulnerability and loss estimates associated with the assessment of risks due to flooding and repetitive loss structures. In addition, FEMA has provided summaries of calculated avoidable damages of all the severe repetitive loss properties within the state which proved to be invaluable in evaluating local risks when used in combination with local vulnerability data. In general, local jurisdictional plans for the primary repetitive loss

communities have identified flood prone areas and general occurrences, or pockets, of repetitive loss properties as part of their risk assessments.

In the future, TWDB will coordinate with TDEM and local repetitive loss communities as local plans are updated to ensure that the updates include an evaluation of NFIP repetitive loss properties existing within their jurisdiction.

MITIGATION STRATEGIES

Mitigation strategies should be developed based on the risk assessment performed on a particular hazard in a specific area. Goals and strategies relating to flood hazards, as well as mitigating the risks associated with these hazards for repetitive loss properties have been identified in the state's plan. Federal regulations and FEMA guidance provide that in order to meet its requirements, the plan must include an evaluation of those strategies that allow for the mitigation of repetitive losses from flood damage. State mitigation policies as well as pertinent laws, regulation, and related programs are adequately addressed within the State Hazard Mitigation Plan and are therefore not further discussed in detail in this appendix.

HAZARD MITIGATION GOALS

Hazard mitigation is defined as any action taken to eliminate or reduce the long-term risk to life and property from natural and human-caused hazards. It is viewed as a long-term, ongoing management process that consists of a variety of both pre-incident and post-incident actions.

Effective mitigation is characterized by requirements for both planning and implementation activities. Mitigation is a complementary part of any effective comprehensive emergency management program, and to be effective, any hazard mitigation effort must have identifiable goals. These goals are as follows:

- to reduce or eliminate hazardous conditions that cause the loss of life;
- to reduce or eliminate hazardous conditions that inflict injuries;
- to reduce or eliminate hazardous conditions that cause property damage; and
- to reduce or eliminate hazardous conditions that degrade important natural resources.

These hazard mitigation goals were assessed during the 2013 update of the State Hazard Mitigation Plan. The assessment began with the TDEM mitigation staff reviewing the goals and the progress that have been made since 2010 to achieve them. The efforts of TDEM to educate emergency management professionals by holding TDEM mitigation workshops in combination with continued state participation in the Hazard Mitigation Grant Program (HMGP) and the Pre-Disaster Mitigation (PDM) grant program, have allowed the state to successfully advance mitigation activities.

TWDB continues to coordinate with TDEM staff concerning TWDB's administration of the Flood Mitigation Assistance (FMA) program. The goals associated with this program are focused directly at a specific hazard, floods, rather than at the broader, multi-hazard

goals addressed in the state plan. The program goals for TWDB's FMA program are directed at reducing the number of Repetitive Loss and Severe Repetitive Loss damaged structures and their associated claims on the National Flood Insurance Fund. In addition, by administering the FMA program, TWDB continues to pursue program goals by reducing or eliminating claims under the NFIP through mitigation activities. It is through the implementation of local mitigation projects that the state achieves its goals. Therefore, the state continues to support the various federal grant programs so that this federal funding may reach the local communities, thereby providing incentive to communities to implement proposed mitigation activities.

STATE CAPABILITY ASSESSMENT

The purpose of the Texas Mitigation Plan is to motivate state governmental agencies, as well as the public and private sectors to minimize the effects of hazards by establishing priorities for hazard mitigation programs. The state has funding programs that are available to communities that need assistance with mitigation planning and implementation. These funds primarily come from the federal government through FEMA mitigation programs such as the Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation (PDM), and the Flood Mitigation Assistance (FMA) program.

Specific to the FMA program, additional information with regard to the Texas Water Development Board (TWDB) has been provided in the following section, expanding on the State Capability Assessment provided in the Texas Mitigation Plan. TWDB has successfully coordinated flood mitigation activities with several of the larger RL communities of the state. As RL numbers within these communities decrease, TWDB will initiate communication with other communities with RL and SRL properties while working with any communities who may approach TWDB for assistance to proactively address their RL problems through planning and project implementation. FEMA's Web Data Exchange database of RL and SRL structures, organized by jurisdiction, is used in order to prioritize applications and track program successes. The Texas Hazard Mitigation Plan contains additional detail concerning the TDEM Capability Assessment associated with their administration of the HMGP and PDM programs; this information will not be duplicated in this appendix.

TEXAS WATER DEVELOPMENT BOARD (TWDB)

TWDB is the state agency charged with collecting and disseminating water-related data, assisting with regional planning, preparing the State Water Plan which addresses the development of the state's water resources, and administering cost-effective financial assistance programs for the construction of water supply, wastewater treatment, flood control and agricultural water conservation projects.

TWDB administers the Flood Mitigation Assistance (FMA) program which provides pre-disaster mitigation funds to eligible communities of the state. Project grants for specific eligible activities are available under the FMA program. Planning grants are also available under FMA for communities to prepare (or update) the flood hazard portion of the community's Hazard Mitigation Plan. Both programs reimburse a portion of TWDB expenses to administer the programs and manage contracts for grants awarded. The

standard cost share for FMA grants is 75 percent federal and 25 percent local, with TWDB serving as the pass through agency for all funds. TWDB has prepared this appendix so that it is eligible for an increase in the federal share of the program from 75 percent up to 90 percent for RL properties and from 75 percent up to 100 percent for SRL properties.

TWDB also provides Flood Protection Planning grants from the State of Texas' Research and Planning Fund with $900,000 available each year for award. The Flood Protection Planning grant fund serves as an invaluable tool in addressing the need for mitigating RL properties. These grants are available to political jurisdictions for developing watershed based flood protection plans which evaluate the flood hazards within those watersheds and then develop structural and nonstructural strategies which will effectively mitigate the risks resulting from those identified flood hazards. Flood Protection Planning grants require a 50/50 cost share between the state and local jurisdictions and are awarded annually through a solicitation request for applications.

TWDB also administers the Fund Development Program, which provides loans for the planning, design, and construction of water supply, wastewater, and flood control projects. Structural flood protection improvements may include construction of storm water retention basins, the enlargement of stream channels public beach re-nourishment, the control of coastal erosion, and the modification or reconstruction of bridges. Non-structural flood protection improvements may include the acquisition of floodplain properties for use as public open space, the acquisition and removal of buildings located within a floodplain, the relocation of those residents inhabiting buildings removed from a floodplain, for flood warning systems, and for the development of floodplain management plans. An environmental review is conducted for all construction projects.

The Texas Natural Resources Information System (TNRIS) is a division of TWDB and is responsible for producing, archiving, and distributing geographic data to agencies, businesses, and the public. TNRIS supports hazard mitigation planning and implementation in three ways: (a) TNRIS provides data to organizations for planning or response activities; (b) TNRIS actively assists TWDB by developing, locating and preparing data for a specific needs or projects; and (c) TNRIS houses the State Critical Facility Database for TDEM mitigation. TNRIS has collected significant base map data which is available to communities as well as to the public. This data includes digital aerial photographs, soil surveys, and transportation, political boundaries, surface water, and elevation maps and data. TNRIS also has census data, historical aerial photos, and paper maps from different state and local agencies. TNRIS is capable of providing personnel to the State Operations Center to assist with data management for tropical storm and emergency preparedness events. For example, TNRIS provided personnel to the FEMA field office during the Space Shuttle Columbia recovery to assist field crews with data integration and organization as well as map production.

TWDB's National Flood Insurance Program group conducts Community Assistance Visits (CAV), Community Assistance Contacts (CAC), and floodplain management training to assist communities with maintaining NFIP compliance and sound floodplain management

practices. The CAV is a scheduled visit to an NFIP community to conduct a comprehensive assessment of the community's floodplain management program and evaluating its knowledge and understanding of the requirements of the NFIP. The CAV also assists the community in understanding NFIP requirements when program deficiencies are discovered. The CAC is a brief visit to establish and maintain contact with an NFIP community to offer assistance and determine if any problems or issues exist. The CAC also provides the means to enhance working relationships with NFIP communities and to create a greater awareness of the NFIP and its requirements. Floodplain Management 101 workshops are offered to local officials and other interested parties which cover the NFIP and various flood loss reduction techniques and strategies, such as the Community Rating System. Standard training modules on the Texas Water Code, Elevation Certificates, FEMA requirements, community awareness, map reading, permitting, and ordinance comprehension is covered as appropriate. Providing training to local staff facilitates their coordination on federal flood mitigation funding programs for their repetitive loss communities as well as the local hazard mitigation planning requirements.

The following table (Table 2-3) summarizes federal assistance programs administered by TDEM and TWDB which, aside from the non-federal programs listed above, provide funding to local entities and program assistance integral to the mitigation of RL and SRL properties.

Table 2-3

Program	**Hazard Mitigation Grant Program (HMGP)**
Purpose	-Provides funding assistance to reduce or eliminate future risks to lives and property damage due to natural hazards or
Funding (percentage of	-Post-disaster, amount available dependent upon disaster damages
Effectiveness with RL or SRL	-Yes. Projects *may* be directed towards reducing losses associated
Program	**Pre-Disaster Mitigation (PDM) Program**
Purpose	-Provides funding for planning/risk analysis, or for mitigation projects to reduce or eliminate the effects of hazards
Funding	-Annual, national competition for funding consideration
Effectiveness with RL or SRL	-Yes. Projects *may* be directed towards reducing losses associated
Program	**Flood Mitigation Assistance (FMA) Program**
Purpose	-Provides funding for flood mitigation planning, or projects to reduce or eliminate the flood risk to
Funding	-Annual allocation to the state. Competitive application process, prioritization of applications consider RL and SRL properties, and
Effectiveness	-Yes. Application prioritization specific to RL and SRL properties

SPECIFIC ACTIONS TWDB HAS TAKEN TO REDUCE THE NUMBER OF RL AND SRL PROPERTIES

TWDB has administered FEMA's FMA program since 1997. TWDB has used FMA funding to reduce the flood risks associated with RL properties. All funds allocated to the state under FMA have been utilized to the fullest extent. TWDB prioritized the applications submitted for consideration under FMA with those projects which directly affected structures that are on FEMA's RL list. The current FMA grant program includes authorization to mitigate SRL structures which will also be prioritized in the FMA program. Cost-effectiveness is the second priority when evaluating applications under the program.

To date nine FMA contracts totaling $10,571,338.46 have been successfully completed with Harris County and Harris County Flood Control District that allowed for the buyout and removal of 107 RL properties. In addition to those projects, contracts have also been completed under the FMA program with the cities of Grand Prairie for $98,092 (for the buyout and removal of one RL property), Denton for $147,065 (for the buyout and removal of two RL properties) and Travis County for $557,300 (for the buyout and removal of four RL properties).

Also under FMA since 2004, eleven projects have been funded in the Beaumont area for total Federal funding in an amount of just less than $19 million. These projects, structural in nature, were developed and funded because of their demonstrated mitigation results, and technically feasible, environmentally sound, and cost effective actions. All 11 projects include minor structural activities such as detention, channelization and bridge or culvert enlargement or modification. Some of these projects have been completed, some are in various stages of implementation, and some have just been initiated. To summarize, these projects are protecting over 7,000 residential, commercial and public structures with 222 of these structures being RL properties and an additional 21 of these properties being SRL properties. Based on FEMA data through February 2013, these projects will significantly reduce the risks due to flooding associated with nearly 23 percent of the RL properties existing in Jefferson County and will reduce the number of SRL properties in the county by approximately 17 percent.

TWDB administered FEMA's SRL program from 2008 until 2012 (and currently has several SRL program projects in various stages of progress) when the task of mitigating SRL properties was included in the FMA grant program as authorized in the Biggert-Waters Flood Insurance Reform Act of 2012. TWDB will continue to mitigate SRL structures through the FMA grant program.

From 2008 thru 2011 the total SRL funding to TWDB for project grants was $84,875,468 for 15 projects. To date TWDB has begun work on seven SRL contracts with Harris County and Harris County Flood Control District totaling $41,628,660 that will allow for the buyout and removal of 260 SRL properties. Of the 260 SRL structures being mitigated, 54 were apartment buildings having a total of 698 units. In addition to those projects, SRL contracts are also underway with the cities of League City for $910,600 (for

the elevation of five SRL properties), Euless for $256,230 (for the buyout and removal of one SRL property), Arlington for $1,223,640 (for the buyout and removal of four SRL properties), Galveston County for $31,028,397 (for the elevation of 220 properties), Beaumont for $1,130,753 (for the buyout and removal of nine properties), Jefferson County Drainage District No. 6 for 7,413,898 (for a drainage project with 256 properties [2 SRL and 4 RL] in the benefit area with approximately 50 million in paid claims), and Mansfield for $1,283,290 (for the buyout and removal of eight SRL properties).
To summarize, these SRL projects are protecting approximately 765 residential, commercial, and public structures with 509 of these structures being SRL properties (54 of which were apartment buildings having a total of 698 units) and an additional four of these properties being RL properties.

TWDB's FMA and SRL projects, based on FEMA data through February 2013, mitigated approximately 7,500 structures which included 509 SRL structures and 345 RL structures which will significantly reduce the risks due to flooding associated with nearly 1.7 percent of the RL properties across the state and will reduce the number of SRL properties by approximately 13 percent.

Over the years, Texas has implemented numerous projects and millions of dollars of funding administered by TDEM that focused on the number one hazard in Texas – flooding. To address that hazard, the number one Texas mitigation strategy developed by the State Hazard Mitigation Team is the reduction of repetitive loss and substantially damaged properties. However, at the time the projects were implemented TDEM was focused on large disasters with large damages and the specific repetitive loss property statistics were not tracked. The largest problem in tracking these statistics was the design of the flood insurance database and the connectivity of property address changes as development occurred. FEMA and the state have worked continuously on the consolidation of multiple addresses and flood insurance loss records for each property. TDEM now validates the AW 501 (NFIP Repetitive Loss Update Worksheets) for all mitigated structures to support the continued accuracy of the repetitive loss database. This will allow improved future statistical analysis activities on repetitive loss structures in Texas. In reviewing completed projects the TDEM staff has determined that for projects completed since 2002, 333 RL properties have been mitigated with funding under the HMGP and 169 RL structures mitigated with PDM. The TWDB has created a database of identified RL and SRL properties and the estimated benefit cost ratios to support various mitigation options. Coordination between TWDB and TDEM will continue to focus on the application and evaluation of FEMA Hazard Mitigation Assistance (HMA) funding to reduce NFIP losses on RL and SRL properties.

<u>Mitigation Strategies for Texas to Reduce RL and SRL Properties—How Texas Plans To Reduce the Number of RL and SRL Properties</u>
Reducing the risks due to flooding associated with RL and SRL properties is a top priority for the state of Texas. Several actions specific to achieving these mitigation goals have been identified and include the following:

- Encourage the mitigation of RL and SRL properties at the local level, as this is important in achieving Texas' goal of reducing flood losses and specifically

decreasing claims associated with RL and SRL properties. This will be accomplished through direct communication with community leaders, as well as through numerous training and education programs conducted by TDEM and TWDB staff throughout the year;

- All mitigation programs, including the FMA program, will be promoted in RL communities by TWDB flood mitigation staff as part of their NFIP State Coordination activities, CAVs and CACs, as well as workshops performed by staff;
- TWDB and TDEM will continue to coordinate those program activities that both agencies administer that are associated with floodplain management and the mitigation of risks due to flooding;
- The acquisition and demolition of RL, SRL and substantially damaged homes that are in the floodplain/floodway is the first priority in the State of Texas Strategy Guidelines for HMGP mitigation projects. The latest State Hazard Mitigation Team (SHMT) review of these guidelines continues to focus on this activity as the number one mitigation strategy for both TDEM and TWDB. TDEM and TWDB will continuously encourage and support the development of project applications for all HMA funding opportunities that address the mitigation of RL and SRL properties;
- TDEM will review all projects funded under the HMGP and the PDM programs to evaluate RL and SRL properties which may have been mitigated. Results of this evaluation will be added to the database of mitigated properties maintained by FEMA through the AW-501 reporting process;
- TWDB will administer the FMA program to implement cost effective, environmentally sound projects, which will substantially reduce the risks due to flooding and the associated flood insurance claims under the NFIP. Projects which directly affect RL and SRL properties will continue to receive top priority;
- TWDB's primary flood mitigation goal for the FMA program is to better identify and mitigate structures located in the floodplain that have experienced repetitive losses and severe repetitive losses. Mitigation efforts will continue to be made with the already established contacts in Harris County and Jefferson County. Projects to reduce the number of RL and SRL properties would naturally be the highest priority. FEMA's Web Data Exchange database of RL and SRL structures, organized by jurisdiction, will be used in order to prioritize applications and track program successes;
- TWDB will coordinate with TDEM and repetitive loss communities as necessary to ensure that RL and SRL properties existing within their jurisdiction will be evaluated and mitigation actions directed towards these properties will be identified as part of the local plan update;

- When requested, TWDB will provide technical assistance to repetitive loss communities to review and evaluate the occurrence of RL and SRL properties within their jurisdiction.

Additional identification of specific actions or projects the state is promoting and implementing to mitigate SRL and RL properties includes;

- Acquisition of real property from property owners and demolition or relocation of buildings to convert the property to open space in perpetuity;
- Demolition or relocation of structures to areas outside of the floodplain or mitigation reconstruction, which is the demolition and rebuilding of structures, is permitted when traditional elevation cannot be implemented;
- Minor localized flood reduction projects to lessen the frequency or severity of flooding and decrease predicted flood damages. For projects funded under the Flood Mitigation Assistance (FMA) program, priority will be based on the number of NFIP insured properties included in the project area along with the number of RL and SRL properties;
- Elevation of existing structures to at least base flood levels or higher if required by local ordinance, using techniques in accordance with FEMA Program Guidance;
- Flood-proofing of existing non-residential structures in accordance with FEMA Program Guidance.

<u>Specific Mitigation Actions the State Plans to Implement to Mitigate RL and SRL Properties:</u>

ACTION ITEM # 1

Reduce the number of RL and SRL properties through acquisition of real property from property owners and demolition or relocation of buildings to convert the property to open space in perpetuity. The state will accomplish this action item by assisting local communities in obtaining mitigation grants through the FMA grant program. All projects requested to be funded under the FMA grant program will be reviewed by TWDB to determine if the project is cost-effective, environmentally sound, and technically feasible.

ACTION ITEM #2

Reduce the number of RL and SRL properties through demolition or relocation of structures to areas outside of the floodplain or through mitigation reconstruction. The state will accomplish this action item by assisting local communities in obtaining mitigation grants through FMA grant program. All projects requested to be funded under the FMA grant program will be reviewed by TWDB to determine if the project is cost effective, environmentally sound, and technically feasible.

ACTION ITEM #3

Reduce the number of RL and SRL properties through minor localized flood reduction projects designed to lessen the frequency or severity of flooding and decrease predicted flood damages. The state will accomplish this action item by assisting local communities

in obtaining mitigation grants through the FMA grant program. All projects requested to be funded under the FMA grant program will be reviewed by TWDB to determine if the project is cost effective, environmentally sound, and technically feasible.

ACTION ITEM #4
Reduce the number of RL and SRL properties through the elevation of existing structures to at least the base flood elevation or higher if required by local ordinance in accordance with FEMA requirements. The state will accomplish this action item by assisting local communities in obtaining mitigation grants through the FMA grant program. All projects requested to be funded under the FMA grant programs will be reviewed by TWDB to determine if the project is cost effective, environmentally sound, and technically feasible.

Harris, Galveston, Brazoria and Montgomery Counties account for 70 percent of the total number of SRL properties statewide and nearly 71 percent of the RL properties statewide. Therefore, RL and SRL properties located in these four counties will receive the highest prioritization of the above mentioned action items when and if the local jurisdiction applies for grants to mitigate their RL and SRL properties.

An evaluation of the local jurisdiction will be conducted by the state to determine the effectiveness of the proposed mitigation project, and the evaluation will include the availability of local staff to complete the project on time, previous experience with similar grants and projects, and the availability of local funds to meet the local match share.

Each of the above mentioned activities contributes to the overall mitigation strategy to reduce or eliminate hazardous conditions that result in the loss of life, inflict injury, causes property damage, or degrades important natural resources by removing people and structures from the known hazard area of the floodplain or to elevate such structures within the floodplain to a height greater than the expected base flood elevation.

PLAN MAINTENANCE PROCESS AND TECHNICAL ASSISTANCE
The Texas Hazard Mitigation Plan establishes a detailed process for maintaining and updating the state plan, including procedures to review the effectiveness of mitigation policies, goals and actions identified in the plan. The plan also address TDEM's technical assistance capabilities and coordination procedures with communities (or coalition of local entities formed for multi-jurisdictional planning purposes) that will enable them to prepare and amend their local hazard mitigation action plans. Provided within this section of the appendix will be maintenance activities specific to goals, programs, and mitigation actions associated with the flood hazard risk, and RL or SRL properties. Procedures implemented to evaluate actions directed at the mitigation of RL and SRL properties and results of that evaluation will be part of these activities.

FEMA's Web Data Exchange database will form the basis for prioritizing applications for financial assistance, for developing program marketing efforts, and for tracking the successes of projects funded by these programs. Data will be maintained and organized

on a community basis to ease prioritization and tracking efforts. Specific numbers of RL and SRL properties in all RL communities will be provided to the TWDB NFIP coordinators for those communities lying within each coordinators particular area of responsibility (The state has been divided geographically and the TWDB has assigned their staff responsibility for NFIP coordination within specific areas of the state.). Efforts within the RL communities will be prioritized based not only on the numbers of RL and SRL properties occurring within their jurisdictions but also on estimates of avoidable damages calculated by FEMA for specific RL properties. Efforts within the RL communities will be prioritized based not only on the numbers of RL and SRL properties occurring within their jurisdictions but also on estimates of avoidable damages calculated by FEMA for specific RL properties. Data will be reviewed quarterly as part of the TWDB reporting responsibilities under the FMA program. TWDB will coordinate with FEMA as necessary to update the Web Data Exchange. TWDB will coordinate with TDEM to ensure that both agencies are effectively using staff to efficiently promote the various funding programs available to the RL communities within the state and to provide technical assistance to those communities when requested. Finally, TWDB will also coordinate with TDEM to ensure that plan preparation (and updates) includes an assessment of RL and SRL properties within specific RL communities.

APPENDIX B – Questionnaire

GREETINGS LOCAL EMERGENCY MANAGEMENT TEAMS!

Summary Questionnaire: Local Hazards, Vulnerability & Capability

In order to improve the validity and relevancy of the State Hazard Mitigation Plan, The State Hazard Mitigation Team is requesting data from our local jurisdictions for the 2013 Update. Better data collection and better data will serve the state of Texas and all local jurisdictions when it comes to minimizing damage and losses due to hazards.

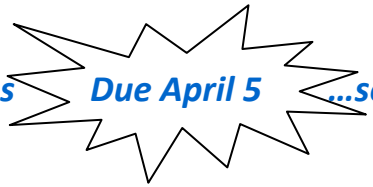
We are taking steps to streamline the state plan's update development and monitoring. In turn, we hope to provide local jurisdictions tools which streamline their own local plan development, monitoring, and updating. We believe this will provide better clarity on hazard-related vulnerabilities, damage projections, and, in turn, improve hazard mitigation plans and HMA funding applications.

The first step in this process is to answer this questionnaire. Please respond as best you can, with data you already have at your disposal. In some cases you may not have specific data. When in doubt give your best ESTIMATE or APPROXIMATION. Over time, we hope to simplify and improve this process. We know that your knowledge and your estimates of your jurisdiction will reflect a more accurate picture of the situation in your community.

We need your feedback by **APRIL 5**. ! This may seem like a short window; if you cannot return a completed questionnaire by **April 5**, please contact us to discuss. You can reply to this message or contact Carolyn Sudduth at Carolyn.sudduth@dps.texas.gov or 512-424-2483.

8 Questions: Fast! Many questions are in checklist form. Focus on the providing the best data available; we don't need a lot of description. In general we need:

- Update contact information and provide feedback.
- List the top hazards for your community and the vulnerability and impact estimates (structures and losses) based on your best current knowledge in table form.
- Indicate development and population changes affecting community risk.
- Briefly summarize local capacities to address your risk through mitigation actions (in table form).



Thanks in advance for your participation!

1. Contact

Provide information on the best contact in your jurisdiction regarding hazard mitigation planning

Name	*Title*	*Phone*	*E-mail*	*Disaster District No.*

2. FEMA Hazard Mitigation Plan

Provide information about your jurisdictions hazard mitigation plan

FEMA Approved?	*Expiration Date*	*Name of Plan*
☐Yes / ☐No		

3. TDEM Planning and Review Assistance

Indicate if your jurisdiction has used TDEM assistance in developing or reviewing your Local Hazard Mitigation Plan. Rate your experience.

		Rate Your Experience			
		Extremely Helpful	*Somewhat Helpful*	*Not Much Help*	*No Help*
TDEM Plan Dev. Assistance	☐Yes / ☐No	☐	☐	☐	☐
TDEM Plan Review Assistance	☐Yes / ☐No	☐	☐	☐	☐

4. Review the Hazard List

The preliminary 2013 Hazard Mitigation Plan Hazards are listed below. Please review and note any additions, recommendations or other comments.

Preliminary 2013 Hazard List				
(Riverine) Flooding	Wildfire*	Coastal Erosion	Hurricanes and Tropical Storms	Extreme Heat
Tornadoes	Dam/Levee Failure	Hailstorm	Severe Winter Storms	Expansive Soils
Drought	Earthquakes	Lightning	Windstorms	Land Subsidence
Additional or Comments:				

**Note Wildfire is Rural or Wildfire-Urban Interface, not urban alone.*

5. **Top 4 Local Natural Hazards and Exposure Data or Exposure Estimate**

Identify your top four local **natural** *hazards of concern, whether due to frequency of occurrence or severity of impact and your best estimate of number of structures, their total value, and percent of expected damage based on best available data. Rank hazards by either frequency or resulting damages.*

Natural Hazards	***List Top Local Hazards***	***Number of Structures at Risk in Hazard Area *****	***Value of Structures at Risk in Hazard Area (if known)***	***Percent (%) of Damage Expected for Mid-Range Severity Event***
Hazard #1				
Hazard #2				
Hazard#3				
Hazard#4				

***Most hazards can affect your entire planning area. Flood, Wildfire Urban Interface and Dam Inundation are more site specific. Consult your plan's hazard profile for location of these hazards in your area.*

6. **Top 4 Local *Technological* Hazards and Exposure Data or Exposure Estimate**

Identify your top four local ***Technological*** *hazards of concern, whether due to frequency of occurrence or severity of impact and your best estimate of number*

of structures, their total value, and percent of expected damage based on best available data. Rank hazards by either frequency or resulting damages. Technological hazards are hazards resulting from technological failures (e.g. industrial explosions, releases).

Technological Hazards	*List Top Local Hazards*	*Number of Structures at Risk in Hazard Area ***	*Value of Structures at Risk in Hazard Area (if known)*	*Percent (%) of Damage Expected for Mid-Range Severity Event*
Hazard #1				
Hazard #2				
Hazard# 3				
Hazard# 4				

***Most hazards can affect your entire planning area. Flood, Wildfire Urban Interface and Dam Inundation are more site specific. Consult your plan's hazard profile for location of these hazards in your area.*

7. Development and Risk Factor Changes

Indicate changes in population, structure inventory and damage or hazard frequency

Indicate (or Estimate) Change in Last 5 Years, since 2008				
Circle or Highlight Selection	***Increase***	***Decrease***	***No Change***	***If Change: How much***
Population	☐High/☐Medium/☐Low Shift	☐High/☐Medium/☐Low Shift	☐	☐High/☐Medium/☐Low
Structure Inventory	☐High/☐Medium/☐Low Shift	☐High/☐Medium/☐Low Shift	☐	☐High/☐Medium/☐Low
Damage &/or Hazard Frequency	☐High/☐Medium/☐Low Shift	☐High/☐Medium/☐Low Shift	☐	☐High/☐Medium/☐Low

8. Summary of Local Capability - Mitigation Policies, Programs and Capabilities

Building codes, zone, land use policies that affect property vulnerability, programs and policies that affect mitigation of vulnerable properties

SUMMARY OF LOCAL CAPABILITY		
Authority / Description	***Applicable to Your Community***	***Effectiveness in Mitigating Damages***
IRC (International Residential Code)	☐Yes / ☐No	☐High/☐Medium/☐Low/☐None
National Flood Insurance Program Compliance	☐Yes / ☐No	☐High/☐Medium/☐Low/☐None
Fire Protection Compliance	☐Yes / ☐No	☐High/☐Medium/☐Low/☐None
Cities zoning, building codes, upgraded NFIP ordinances	☐Yes / ☐No	☐High/☐Medium/☐Low/☐None
Internal Capacity	***Available to Your Community***	***Effectiveness in Mitigating Damages***
Local Budget	☐Yes / ☐No	☐High/☐Medium/☐Low/☐None
Administrative Staffing	☐Yes / ☐No	☐High/☐Medium/☐Low/☐None
Technical Staffing	☐Yes / ☐No	☐High/☐Medium/☐Low/☐None
Political Determination/Resolve	☐Yes / ☐No	☐High/☐Medium/☐Low/☐None

THANK YOU FOR YOUR PARTICIPATION!

This concludes the State of Texas Hazard Mitigation Plan, created in 2004 and updated in 2007, 2010, and 2013 by the Mitigation Section of the Texas Division of Emergency Management and the Mitigation Planning Team. For questions or concerns, please contact the Mitigation Section at the contact information below.

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