2017

Waller County
Hazard Mitigation Plan

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Acronym List

RHMP	Regional Hazard Mitigation Plan
HMAP	Hazard Mitigation Plan
H-GAC	Houston-Galveston Area Council
FEMA	Federal Emergency Management Agency
TDEM	Texas Division of Emergency Management
TX	Texas
CRS	Community Rating System
NFIP	National Flood Insurance Program
HMGP	Hazard Mitigation Grant Program
CHARM	Community Health and Resource Management
mph	miles per hour
NOAA	National Oceanic and Atmospheric Administration
NSSL	National Severe Storm Laboratory
OEM	Office of Emergency Management
ArcGIS	Geographic Information System
RL	repetitive loss
KBDI	Keetch-Byram Drought Index
WUI	Wildland Urban Interface
FM	Farm to Market road
PHSI	Palmers Hydrological Severity Index
USDA	United States Department of Agriculture
LAL	Lightning Activity Levels
NCDC	National Climate Data Center
CDC	Centers for Disease Control and Prevention
NCEI	National Centers for Environmental Information
SPIA	Sperry-Piltz Iace Accumulation
NWS	National Weather Service
LEP	Linear Extensibility Percent
COLE	Coefficient of Linear Extent

Part 1: Introduction

Part 1: INTRODUCTION

Waller County's previous Hazard Mitigation Plan was adopted in 2006 and updated in 2011 as part of a seven-county Regional Hazard Mitigation Plan (RHMP). Due to new regulation and planning recommendations, Waller County prepared a new countywide multi-jurisdictional Hazard Mitigation Plan (HMAP). Waller County partnered with the Houston-Galveston Area Council (H-GAC) for both the 2006 and 2011 plans and continued this partnership during the development and adoption of the HMAP.

Image source: https://www.wikipedia.org/

History

On April 28, 2006, the Federal Emergency Management Agency (FEMA) and the Texas Division of Emergency Management (TDEM) approved the first RHMP. H-GAC prepared the regional plan in coordination with FEMA and TDEM to ensure it met all applicable state and federal requirements. H-GAC updated the RHMP in 2011 to re-assess vulnerabilities and increase the number and diversity of mitigation action items. The plan includes a more robust assessment of natural hazards, newly uncovered vulnerabilities, more advanced analysis techniques, and a more effective and informed mitigation strategy.

Purpose of Plan

The purpose of Waller County's HMAP is to reduce the loss of life and property within the county and lessen the negative impacts of natural disasters. Vulnerability to several natural hazards has been identified through research, analysis, and public input. These hazards threaten the safety of residents and have the potential to damage or destroy both public and private property, disrupt the local economy, and impact the overall quality of life of individuals who live, work, and play in the county. While natural hazards cannot be eliminated, the effective reduction of a hazard's impact can be accomplished through thoughtful planning and action.

The concept and practice of reducing risks to people and property from known hazards is generally referred to as hazard mitigation. One of the most effective tools a community can use to reduce hazard vulnerability is developing, adopting, and updating a hazard mitigation plan as needed. A hazard mitigation plan establishes the broad community vision and guiding principles for reducing hazard risk, including the development of specific mitigation actions designed to eliminate or reduce identified vulnerabilities.

Scope of Plan

Waller County is in the east-central region of Texas, and scope of the HMAP includes the following participating jurisdictions:

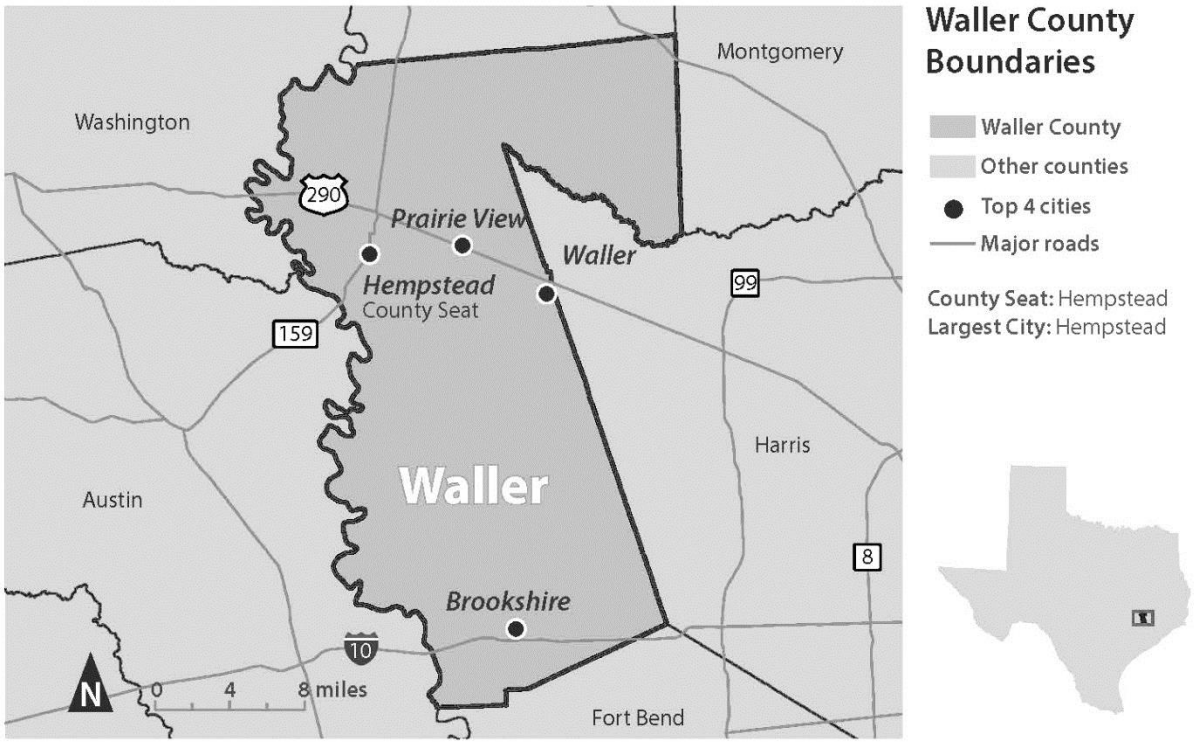
- Waller County (Unincorporated)
- City of Brookshire
- City of Hempstead
- City of Pattison
- Town of Pine Island
- City of Prairie View
- City of Waller

Presidential Declared Disasters

Waller County has persevered through many natural disasters. The table below lists the presidential declared disasters that the County has experienced since 2000. Each disaster is costly and challenging. The goal of this HMAP is mitigation and reduce the impact of future disasters.

Year	Disaster No.	Declaration Type	Incident Type	Title
1989	828	Major Disaster Declaration	Severe Storm	Severe Storms, Tornadoes & Flooding
1993	3113	Emergency Declaration	Drought	Extreme Fire Hazard
1994	1041	Major Disaster Declaration	Flood	Severe Thunderstorms and Flooding
1996	3117	Emergency Declaration	Fire	Extreme Fire Hazard
1998	1239	Major Disaster Declaration	Severe Storm	Tropical Storm Charley
1998	1257	Major Disaster Declaration	Flood	Flooding
1999	3142	Emergency Declaration	Fire	Extreme Fire Hazards
2001	1379	Major Disaster Declaration	Coastal Storm	Tropical Storm Allison
2005	3216	Emergency Declaration	Hurricane	Hurricane Katrina Evacuation
2005	3261	Emergency Declaration	Hurricane	Hurricane Rita
2005	1606	Major Disaster Declaration	Hurricane	Hurricane Rita
2006	1624	Major Disaster Declaration	Fire	Extreme Wildfire Threat
2008	3284	Emergency Declaration	Fire	Wildfires
2008	3290	Emergency Declaration	Hurricane	Hurricane Gustav
2008	3294	Emergency Declaration	Hurricane	Hurricane Ike
2008	1791	Major Disaster Declaration	Hurricane	Hurricane Ike
2011	2964	Fire Management Assistance Declaration	Fire	Riley Road Fire
2011	4029	Major Disaster Declaration	Fire	Wildfires
2015	4223	Major Disaster Declaration	Severe Storm	Severe Storms, Tornadoes, Straight-Line Winds and Flooding
2016	4269	Major Disaster Declaration	Flood	Severe Storms and Flooding
2016	4272	Major Disaster Declaration	Flood	Severe Storms and Flooding
2017	4332	Major Disaster Declaration	Hurricane	Texas Hurricane Harvey

Planning Area Map



The HMAP profiles the following hazards:

- Flooding
- Wildfire
- Severe Thunderstorms
- Drought
- Winter Weather
- Tornado
- Hail

The plan, developed in accordance with state and federal rules and regulations governing local hazard mitigation plans, was adopted by the participating jurisdictions and shall be routinely monitored and revised to maintain compliance with all state and federal regulations.

Part 2: Planning Process

Part 2: PLANNING PROCESS

This section includes a description of the process used by H-GAC, Waller County, and participating jurisdictions to develop the 2017 HMAP.

Overview

Hazard mitigation planning can be described as the means to break the repetitive cycle of disaster loss. A core assumption of hazard mitigation is that pre-disaster investments will significantly reduce the demand for post-disaster assistance by alleviating the need for emergency response, repair, recovery, and reconstruction.

Hazard mitigation planning is the process of identifying natural hazards, understanding community capabilities and resources, identifying and assessing hazard vulnerability and risk, and determining how to minimize or manage those risks. In partnership with Waller County, H-GAC approached the hazard mitigation planning process by establishing a Planning Team. The next step of the planning process was the assessment of hazards and how they can impact specific assets. H-GAC conducted a hazard analysis that was provided to the Planning Team and presented at a public meeting on October 18, 2017.

After hazard identification and analysis, communities considered their vulnerability to the identified threats. Crucial input from the participating jurisdictions and members of the public helped inform a vulnerability and risk assessment for the entire county. H-GAC used information gathered from meetings with the Planning Team, online participation and input from the participating jurisdictions, and natural hazard modeling techniques to produce a comprehensive vulnerability and risk assessment.

The planning process culminated in a Mitigation Strategy, i.e. identification of specific mitigation actions, which when viewed as a whole, represents a comprehensive strategy to reduce the impact of hazards. The Planning Team met on December 18, 2017, to begin the process of developing an overarching Mitigation Strategy, and a long-term approach to update and maintain the HMAP. Specific mitigation actions are identified in this plan and included in the Section 7. Responsibility for each mitigation action is assigned to a specific individual, department or agency along with a schedule for its implementation. Plan maintenance procedures (Part 8 of this plan) establish procedures to monitor progress, including the regular evaluation and enhancement of the Plan. Multijurisdictional coordination and integration of the HMAP into local planning mechanisms was also addressed. The established maintenance procedures ensure that the plan remains a dynamic and functional document over time.

Plan Development Resources

The Waller County HMAP was developed using existing plans, studies, reports, and technical information. Materials and historic data were used to inform participants throughout the planning process, evaluate and analyze hazards, and develop the mitigation strategy.

Plan Development Resources: Existing Documents and Data	
FEMA Disaster Declarations	FEMA Flood Map Services
H-GAC Land Use & Demography Database	Houston-Galveston Area Regional Plan
Harris County Flood Control District Watershed Studies	NOAA Storm Event Database
State of Texas Hazard Mitigation Plan	Texas A&M Forest Service Wildfire Reports
US Census American Fact Finder	USDA Census of Agriculture Reports
USGS Homeland Infrastructure Foundation-Level Data	2011 Regional Hazard Mitigation Plan

Planning Team

Waller County and H-GAC established the Planning Team in Fall 2017 in preparation for the first public meeting and hazard mitigation planning workshop held on October 18, 2017. Members were asked to attend all public meetings in person, but were provided an online alternative if they were unable to do so. Online materials, surveys, forms, and documentation are provided in Appendix A. Representatives from the County Office of Emergency Management served as liaisons between H-GAC and stakeholders, staff, and members of the public who were unable to attend the meetings.

Representative Name & Position/Title	Jurisdiction
Brian Cantrell, Emergency Management Coordinator	Waller County
Yancy Scott, County Engineer	Waller County
Trey Duhon, County Judge	Waller County
Earnest Kelley, Director of Public Works	City of Brookshire
Barbara Haffelfinger	City of Hempstead
Joe Garcia, Mayor	City of Pattison
Steve Nagy, Mayor	Town of Pine Island
Anthony Solomon, Chief of Police	City of Prairie View
Gene Schmidt, Superintendent of Public Works	City of Waller
J.R. Dollins III, President, Brookshire/Katy Drainage District	Brookshire/Katy Drainage District
Joey Kaspar, Senior Regional Planner	H-GAC
Amy Combs, Regional Planner	H-GAC

Meeting Dates & Details

October 18, 2017: Hazard Mitigation Kickoff Meeting

H-GAC and the Planning Team hosted a public meeting at the Waller County Commissioners Courtroom, 836 Austin St., Hempstead, TX, 77445. The purpose of the meeting was for H-GAC staff to gather feedback and input on the draft Hazard Analysis and discuss local vulnerabilities. The Planning Team and members of the community were given a presentation and provided large maps displaying the analysis of various hazards. Participants worked with H-GAC staff to improve the accuracy of the analysis and pinpoint the vulnerabilities of each hazard within their communities. Meeting participants also discussed their current ability to mitigate these threats and how to draft a mitigation action to address them. Prior to the meeting, community members and stakeholders were invited through press releases, public service announcements, and other advertisements in two media outlets, and on social media. See Appendix A for meeting agenda, attendees list, and press release.

December 18, 2017: Hazard Mitigation Strategy Meeting

H-GAC hosted a Planning Team meeting at its offices in Houston on December 18, 2017. The purpose of this meeting was to begin the development of a Mitigation Strategy and determine plan maintenance procedures. H-GAC staff gave a presentation on both topics and led a discussion about strategy development. Planning Team members outlined a Mitigation Strategy and refined their mitigation actions. See Appendix A for meeting agenda and sign-in sheet.

Stakeholders

Neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority regulate development, each contributed to the development of the HMAP. The chart below demonstrates the variety of stakeholders who participated and contributed:

Regional & Regulatory Stakeholders	Representative Position/Title	Contact Method
Brookshire/Katy Drainage District	President	Email
Houston-Galveston Area Council	Community and Environmental Planning Department	Email/Phone
Harris County Flood Control District	Floodplain Administer	Email
Office of Emergency Management	Waller County Emergency Management Coordinator	Email/Phone
Regional Homeland Security Council	H-GAC Public Services Planner	Email/Phone
Prairie View A&M University	Risk Management Services	Email
Neighboring Jurisdictions	**Representative Position/Title**	**Contact Method**
Austin County	Emergency Management Coordinator	Email/Phone
Montgomery County	Emergency Management Coordinator	Email/Phone
Harris County	Floodplain Manager, Flood Control District	Email/Phone
City of Katy	City Engineer, Floodplain Manager	Email/Phone
Local Stakeholders	**Representative Position/Title**	**Contact Method**
Waller County	Emergency Management Coordinator, County Engineer	Email/Phone
City of Brookshire	Director of Public Works	Email/Phone
City of Hempstead	City Secretary	Email
City of Pattison	Mayor and City Secretary	Email
Town of Pine Island	Mayor	Email
City of Prairie View	Chief of Police	Email/Phone
City of Waller	Superintendent of Public Works, City Secretary	Email

Participation & Public Input

Public input and participation is a crucial element of hazard mitigation planning. The public was invited to attend meetings in person, but the first meeting followed shortly after Hurricane Harvey. Feedback and input from the public during the October 18th Hazard Mitigation Kick-off meeting was used to identify vulnerabilities in each jurisdiction, identify valuable assets, and develop the risk assessment. Many residents and local staff were busy with recovery efforts at the time, and attendance was difficult. To ensure the public's ability to participate in the planning process, H-GAC hosted all HMAP-related materials online. Online surveys, resources, a mitigation action submittal portal, and a place to submit comments on the draft plan were made public on the H-GAC website (see detailed forms on Appendix A).

The email link was distributed to all participating jurisdictions and included in press releases used to advertise the public meetings:
http://h-gac.com/community/community/hazard/waller-county-hazard-mitigation.aspx

The Waller County Office of Emergency Management also distributed hardcopies of the surveys and forms to each participating jurisdiction that was unable to attend the public meeting on October 18th, 2017. These jurisdictions

then had the option to either mail in the packet to H-GAC's office for processing, or submit the online surveys. The data from capability assessment survey was used to develop the risk assessment and identify vulnerabilities. The online mitigation action portal allowed jurisdictions to submit their proposed projects, and later used to develop the mitigation strategy. County and City Certified Floodplain Managers (CFMs) also submitted surveys which helped develop the flood hazard analysis and mitigation strategies for flooding. The chart below demonstrates the method and type of participation by each jurisdiction.

Jurisdiction	Participated in Plan Maintenance Development	Participated in Mitigation Strategy Development	Online or Mail-in Participation:		
			Capability Assessment	Mitigation Actions	NFIP Survey
Waller County	x	x	x	x	x
City of Brookshire		x		x	x
City of Hempstead	x	x	x	x	x
City of Pattison	x	x	x	x	x
Town of Pine Island	x	x	x	x	n/a
City of Prairie View	x	x	x	x	x
City of Waller	x	x	x	x	x

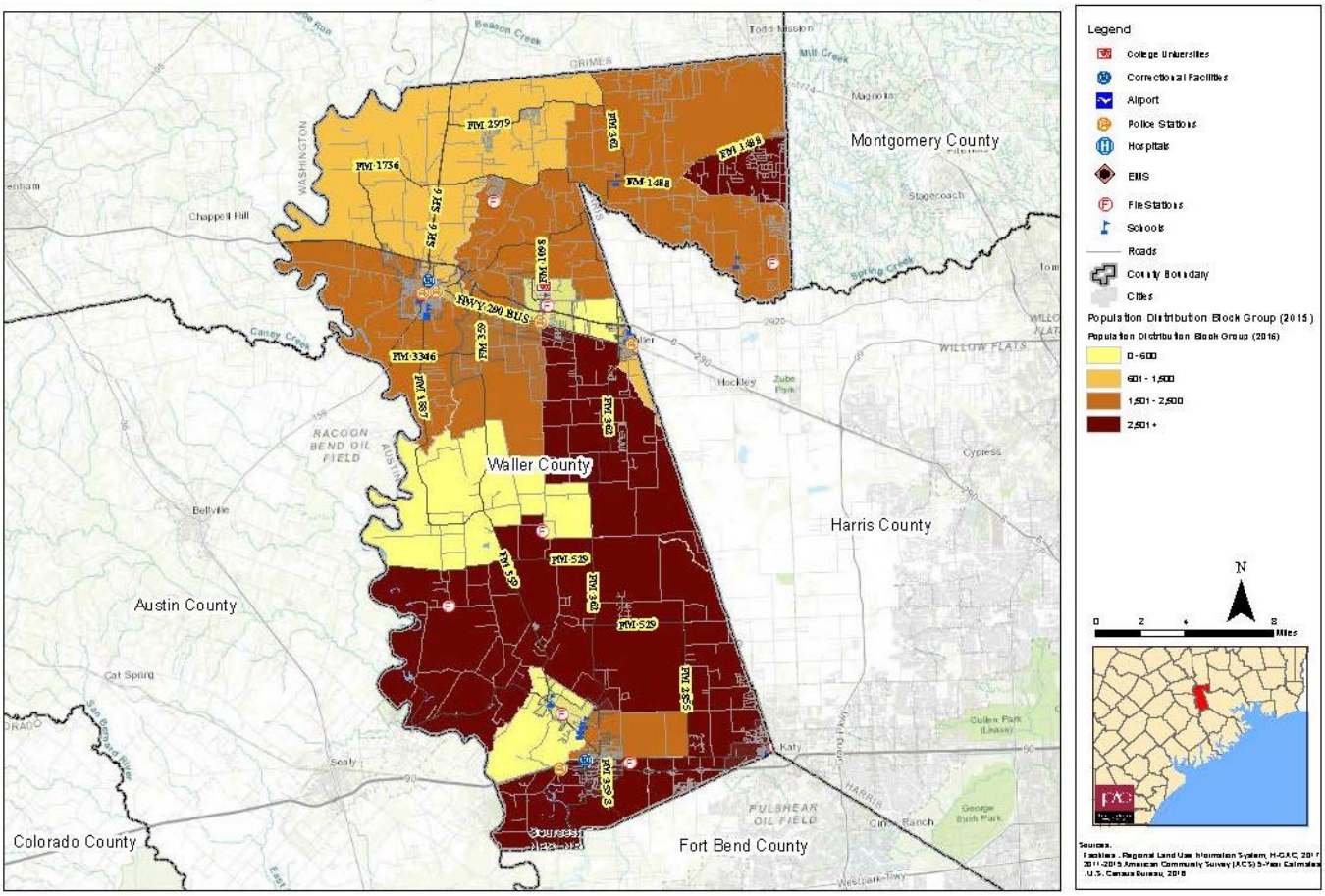
Part 3: County Profile

Part 3: COMMUNITY PROFILE

The majority of Waller County is in the Texas Gulf Coastal Plain with mostly prairies in the southern portion of the county and forests and hills in the county's northern end. The Brazos River defines the county's western boundary while the Spring Creek-Buffalo Bayou watersheds provide drainage for the eastern portion of the county. Major transportation corridors in the county include Interstate 10 and U.S. Highway 90 in the southern end. State Highways 290 and 6 cross in Hempstead, in the north-central portion of the county.

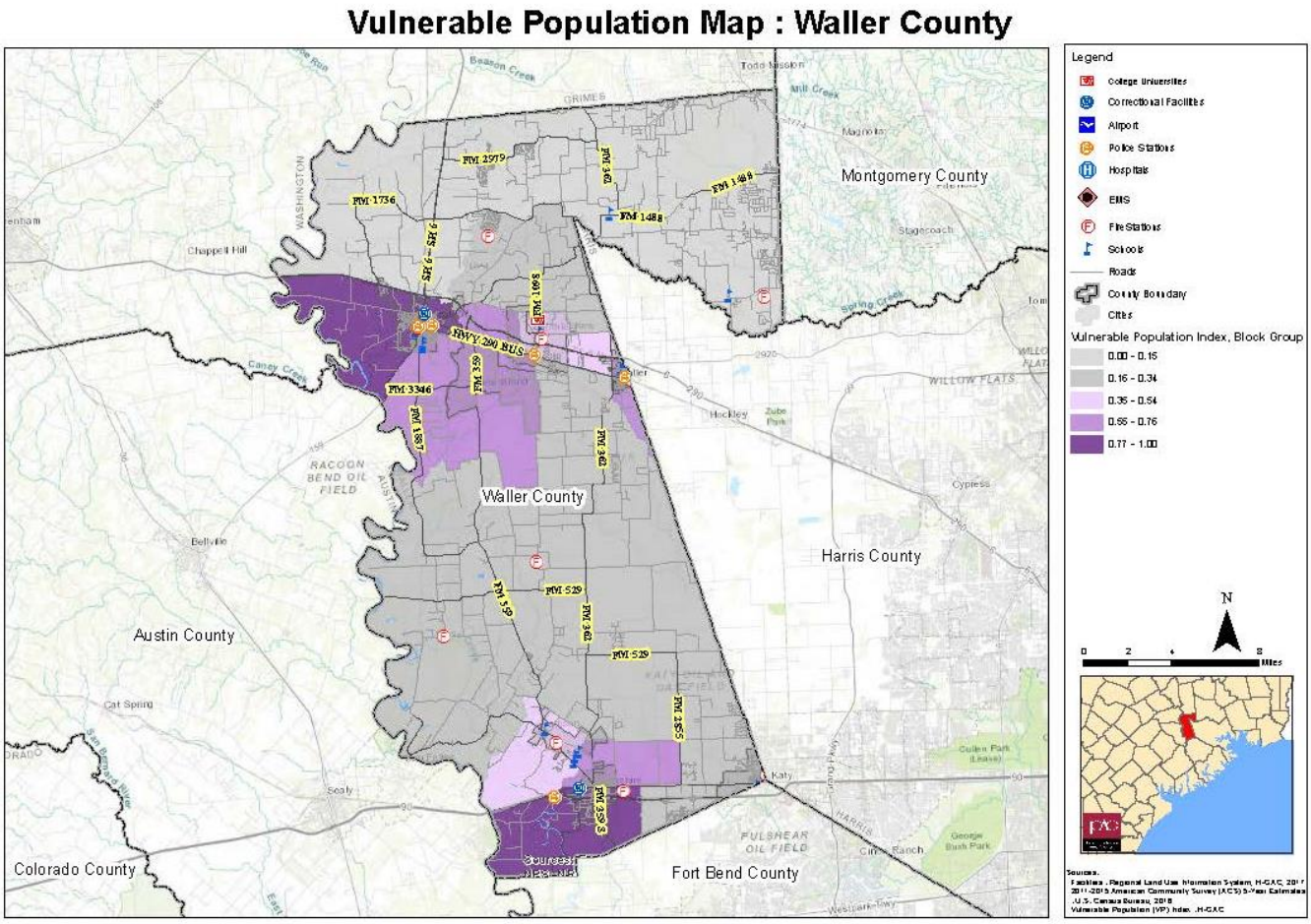
Waller County's 2016 estimated population is 50,115, and it's forecast grow to 120,000 by 2040.[iii] Hempstead is the county seat and largest community with an estimated population of 5,770, which is followed closely in population size by Prairie View (5,576).[iv] Other communities in the county include Brookshire (4,702), Katy (1,156), Pattison (472), Pine Island (988), and Waller (1,880).

Population Distribution : Waller County



Waller County's economy has transitioned from an agricultural economy to manufacturing and distribution sectors as primary employers. Nearly one quarter of the population is employed in the manufacturing sector.[vi] Educational services are the second largest employment sector. The City of Prairie View is home the Prairie View A&M, a land-grant, Historically Black University that is part of the Texas A&M system. Prairie View A&M had an enrollment of 8,762 in 2016, making it the largest population center in the county when in session.[vii] Available land along the Interstate 10 corridor has made Waller County a growing center of distribution and food processing for the Houston metropolitan area.

Households in Waller County have a median annual income of $51,300 and spend about 52% of their earnings on costs related to housing and transportation. The county also has a much higher share of households living in RVs and mobile homes (24 percent) compared to the State of Texas with only 8 percent.



The Vulnerable Population Index identifies areas throughout Waller County that may not have the means or the resources to act when a natural disaster occurs in Waller County. For the purposes of this plan, vulnerable populations include any households without a car, single female household with child/children in the home, individuals living below the poverty line, individuals who are disabled, individuals who are Hispanic, individuals who are non-Hispanic, and non-white, and individuals 65 years and older. The areas in the county with the greatest proportion of these individuals is defined as the most vulnerable areas in Waller County. Defining and mapping vulnerable populations provides the opportunity to demonstrate where perhaps the most need is throughout Waller County.

[i] Texas State Historical Association
[ii] U.S. Census
[iii] Houston-Galveston Area Council
[iv] U.S. Census
[v] Houston-Galveston Area Council
[vi] U.S. Census
[vii] Prairie View A&M
[viii] US Cluster Mapping
[ix] USDA Census of Agriculture
[x] Texas State Historical Association

Part 4: Hazard Identification

Part 4: HAZARD IDENTIFICATION

The State of Texas's Hazard Mitigation Plan has identified 5 major natural hazards that affect the region. These include hurricane, flood, wildfire, drought, and tornado[i]. The local planning team identified 7 natural hazards which could affect the county and local jurisdictions.

Other common hazards in the region not profiled are lightning, extreme heat, and dam and levee failure. The hazard analysis and stakeholders did not identify vulnerabilities or an occurrence of any damaging lightning strikes since 1996.

There were no documented occurrences of loss of life, agricultural loss, or other impacts caused by extreme heat in the Waller County. Stakeholders expressed the capability to assist and accommodate any vulnerable populations that find themselves at risk during a heat event.

There are 10 known dams and levees in Waller County. All of the dams have been classified as 'Low' in the hazard potential classification. Because there is no risk to dam or levee failure in Waller County, it will not be profiled in this plan.

Flooding

Flooding is one of the most frequently occurring, destructive, and costly natural hazards facing Texas.[ii] There are two main categories for floods: general and flash flooding. General flooding is typically a long-term event that can last from a couple of days to weeks. This type of flooding is characterized by an overflow of water from an existing waterway, including rivers, streams, and drainage ditches. Flash flooding is an event that typically lasts a few minutes to less than 6 hours. These floods are characterized by heavy rain that inundates waterways and infrastructure, such as bridges and roads. Either type of flooding is capable of destroying infrastructure, homes, and other structures, and pulling cars off roads. However, flash flooding typically is considered the most dangerous type of flooding, because of its "speed and the unpredictability"[iii]. Generally, the impact of flooding is intensified in urban areas because of less impervious surfaces and in suburban or rural areas because of building in vulnerable areas. While 100 and 500 year floodplains are identified throughout the county and local jurisdictions, flooding can occur outside of these areas.

Waller County is located approximately 68 miles inland from the Gulf of Mexico. The winds from Tropical Storms and Hurricane winds have substantially weakened, and have no impact on Waller County. The rains generated from tropical storms and hurricanes do have a significant impact on flooding. For this Hazard Mitigation Plan, flooding caused by Hurricanes and tropical storms will be profiled in flooding. Hurricanes Rita, Ike, and Harvey are recent examples of the type of flooding impact hurricanes and tropical storms have on the county and its local jurisdictions.

Wildfire

Wildfires are any non-structure fire, except prescribed fires that occur in wildland areas, including prairies or forest. as many as 90 percent of wildland fires in the United States are cause by humans and the other 10 percent are started by lava or lightning.[iv] In understanding that most wildfires are started by people, the Texas Forest Service assigns a high priority to year-round wildfire prevention activities that reduce risks to residents and property. Texas Forest Service prevention campaigns use radio, TV, print, and web-based products along with local outreach programs to increase wildfire awareness and deliver fire safety messages. Texas Forest Service works with local and county officials to keep them informed of fire danger and the likelihood of large damaging wildfires. In 2017, five Texans died due to wildfires in north Texas; Texas faced more than 21 million dollars in damages from wildfires throughout the state .[v]

Severe Thunderstorms

Thunderstorms are classified as severe when there is either 58 mile per hour (mph) winds and/ or hail that is one inch in diameter or greater. While there are over 100,000 thunderstorms annually throughout the United States, severe thunderstorms only account for 10 percent of thunderstorms in the United States.[vi] Hail, lightning, tornadoes, wind shear, and floods can be a part of thunderstorms. In the United States, flash flooding resulting from thunderstorms kills more people year than hurricanes, tornadoes, or lightning[vii]. Along the Gulf Coast, severe thunderstorms are more likely to occur in the afternoon and in spring and summer months.[4]

On occasion, thunderstorms can produce a microburst. Microbursts are a localized column of sinking air (downdraft) within a thunderstorm and is usually less than or equal to 2.5 miles in diameter. Microbursts are dangerous and destructive because of the sudden winds reaching up to 100 mph and the potential for significant rain or hail in wet microburst.[viii]

Drought

Drought varies greatly in length and extent. High temperatures, high winds, and low humidity can worsen drought conditions and can make areas more susceptible to wildfire. Human demands and actions, such as farming and animal grazing, can also hasten drought-related impacts. There are typically four types of drought: meteorological, agricultural, hydrological, and socio-economic. Meteorological droughts are typically defined by the level of dryness over a given period of time. Hydrological droughts are defined by the decline of soil/ground water or stream flow or lake/ river levels. Agricultural droughts refer to the impact of low rainfall and storm water or reduced ground water or reservoir levels needed for agriculture. Socio-economic drought considers the impact of drought conditions on supply and demand of some economic goods such as grains.[18, ix] There are a wide range of effects that can occur from drought, including decreased land prices, loss of wetlands, increased energy demand, and increase of mental health disorders.[x] Impacts seen in Texas from drought in the past, include wildfires, loss of agricultural crops including rice and wheat fields, and increase in energy cost and demand. [xi]

Winter Weather

A winter storm is any event in which the main type of precipitation is snow, sleet, or freezing rain, according to (NOAA), 70 percent of injuries related to winter storms are in automobiles. Winter storms form with cold air, lift, and moisture.[xii] While there are several types of winter storms, ice storms and snow flurries or showers with light accumulation are the most likely in the region. The main concerns with winter weather are road conditions and power outages.

Tornado

Tornadoes are a violently rotating column of air touching the ground, usually attached to the base of a thunderstorm.[xiii] However, tornadoes have formed during hurricanes and tropical storms. Tornadoes form when there is a change in a storm's speed and direction. Tornadoes can have wind speeds that range from 40 mph to 300 mph and move at 10 mph to 20 mph. However, tornadoes typically last a few minutes. The damage seen from a tornado is largely due to the strength of the winds, but strong hail and lighting often accompany tornadoes .[xiv]

Hail

Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into balls of ice. To be considered hail, frozen precipitation needs to be at least .2 inches. Size of hail can range from pea-sized (1/4 inch in diameter) to softball-sized (4 ½ inches in diameter). Quarter sized hail (1 inch in diameter) and above is considered severe by the National Oceanic and Atmospheric Administration's (NOAA) National Severe Storm Laboratory. Hail storms can result in significant damage to vehicles, buildings, and crops. Severe hail and hail swaths can result in an accumulation of hail on roadways and roofs, which may result in car accidents or roofs collapsing.[xv]. As of 2015, Texas had the highest level of hail loss claims throughout the country. According to the National Insurance Crimes Bureau, hail loss claims totaled 400,000 dollars in Texas from 2013 to 2015. However, damage from hail typically occurs in northern Texas rather than southern Texas.

References

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[ii] Texas Division of Emergency Management. (2013, October 15). *State of Texas Hazard Mitigation Plan 2013 Update*. Page 259. Retrieved from https://www.dps.texas.gov/dem/Mitigation/txHazMitPlan.pdf.

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[vi] National Weather Service. Severe Weather Safety Guide.

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[xiii] NOAA National Severe Storms Laboratory. Tornado Basics. Retrieved from: www.nssl.noaa.gov/education/svrwx101/tornadoes/.

[xiv] National Geographic. (2017,Sept. 2017). Tornadoes. *Tornado Facts and Information.* Retrieved from: www.nationalgeographic.com/environment/natural-disasters/tornadoes/.

[xv] *NOAA National Severe Storms Laboratory*, Hail Basics. Retrieved from: www.nssl.noaa.gov/education/svrwx101/hail/.

Part 5: Risk Assessment

Part 5: RISK ASSESSMENT

A Vulnerability Assessment is the process of identifying threats by natural hazards to the population and infrastructure. By identifying the greatest vulnerabilities within the County, it becomes possible to develop a Mitigation Strategy that effectively allocates resources for addressing the most serious vulnerabilities. For this assessment, the Planning Team conducted three main processes to identify the vulnerabilities within Waller County:

- Cataloging critical and valuable assets within the County.
- Conducting a capability assessment.
- Assessing the County's vulnerability to each hazard and ranking these hazards according to degree of risk.

H-GAC maintains a database of critical facilities. During a public meeting on October 18, 2017, Waller County officials reviewed and updated this list, including adding additional valuable assets within the community. Following this process, the Planning Team determined 98 facilities are considered critical or valuable assets, and 15,137 residential and commercial structures are considered critical or valuable assets. Through a Hazus analysis, the Planning Team identified residential and commercial units. Appendix B contains a comprehensive list of the facilities. The full Hazus analysis is catalogued in Appendix C. A summary of the facilities is provided below.

Critical Facilities & Valuable Assets

Asset Description	Quantity
CERCLA(Superfund) National Priorities List	1
Colleges and Universities	1
Correctional Facilities	2
Dam	10
Electric Substation	6
EMS	8
Fire Station	8
Local Emergency Operation Center	5
Police Station	19
Schools	13
Shelters	13
Toxic Release Inventory Facility	12
Residential Units	14,520
Commercial Units	617

Capability Assessment

The participating jurisdictions completed a capability assessment survey to collect data on hazards that affect communities, the communities' ability to mitigate damages from these hazards, and current plans or programs in place to help mitigate natural hazards. The jurisdictions also identified factors impacting their capability to address hazards in their communities. The Planning Team used information to assess the risk within each community and to determine a strategy to integrate the HMAP into their current planning mechanisms. A condensed version of the information is provided below.

List of Existing Plans & Regulations

HMAP: Hazard Mitigation Plan
DRP: Disaster Recovery Plan
FMP: Floodplain Management Plan
EOP: Emergency Operations Plan
COOP: Continuity of Operations Plan
SO: Subdivision Regulation
FDPO: Flood Damage Prevention Ordinance
COMP: Comprehensive Land Use Plan
CIP: Capital Improvements Plan

Jurisdiction	HMAP	DRP	FMP	EOP	COOP	SO	FDPO	COMP	CIP
Waller County	x		x			x	x		
Brookshire	x								
Hempstead	x					x		x	
Pattison	x	x				x			
Pine Island	x					x			
Prairie View	x	x	x	x	x	x			x
Waller	x		x	x		x	x	x	x

All participating jurisdictions identified an inadequate budget as a weakness that decreases their capability to implement mitigation strategies and reduce future damages. Each participating jurisdiction will apply for state and federal funding to help fund mitigation actions that reduce the impact of natural hazards, and work with elected officials and the public to increase their budget to meet their budgetary needs to improve infrastructure.

Waller County has identified the lack of a comprehensive stormwater management strategy and effective drainage plan as one of its greatest vulnerabilities. Waller County will consider instituting a county-wide drainage district, and explore a multi-jurisdictional partnership with the Harris County Flood Control District. They will also explore hiring a grants administrator to pursue state and federal infrastructure funding opportunities.

Brookshire will coordinate with a neighboring community, Katy, to improve their shared drainage district's practices to further decrease the damage caused by flooding in their communities.

Hempstead will work to improve their NFIP program by reevaluating their ordinances. Hempstead will look for opportunities to improve their NFIP regulations and reinforce the goals of the using through their zoning ordinances.

Pattison does not have a standardize fire code requirement in their development standards. The City will consider the adoption and implementation of stronger fire codes to reduce the effects fires caused by natural hazards on their community.

Pine Island is not an NFIP participant, and will consider joining the program.

Prairie View has identified a need for staff and resources to improve their current level of participation in the NFIP program. There is an opportunity to expand on and improve their current practices.

Waller has identified their current stormwater detention requirements as a deterrent to commercial and economic development in their community. The city will consider reducing detention requirements after increasing upstream stormwater management infrastructure to ensure protection of current and future development from flooding.

Risk Assessment Survey

The Planning Team ranked the hazards by scoring the frequency, impact, and vulnerability of each. Impact and vulnerability ratings were weighted more heavily than frequency scores when determining overall risk. Additionally, communities described the loss or damage, and provided specific data that expand on the descriptions provided below.

Frequency Ratings	Impact Ratings	Vulnerability Ratings
Rare and isolated occurrences; Unlikely to occur within the next 5 years.	**Negligible:** Less than 10 percent of property and population impacted in the planning area.	**Low:** Hazard results in little to no damage, and negligible loss of property, services, and no loss of life. Planning area is not vulnerable to this hazard.
Infrequent and irregular occurrences; Likely to occur once in the next 5-10 years.	**Limited:** 10 to 25 percent of property and population impacted in the planning area.	**Moderate:** Hazard results in some damage, and moderate loss of property, services, and potentially loss of life. Planning area is moderately vulnerable to this hazard.
Frequent and regular occurrences; Likely to occur within the next 5 years.	**Significant:** 25 to 75 percent of property and population impacted in the planning area.	**High:** Hazard results in extensive damage, and extensive loss of property, services, and potentially loss of life. Planning area is highly vulnerable to this hazard.
Consistent and predictable occurrences; Likely to occur more than once in the next 5 years.	**Extensive:** 75 to 100 percent of property and population impacted in the planning area.	**Extreme:** Hazard results in catastrophic damage, loss of property, services, and loss of life. Planning area is extremely vulnerable to this hazard.

Hazards Ranked by Risk

Each identified hazard poses a risk to Waller County. Ranking the hazards from greatest to lowest risk allows the communities to prioritize their resources and focus efforts where they are most needed.

Risk Rating	Ranking	Hazards
High	1	Flooding
	2	Wildfire
	3	Severe Thunderstorms
Moderate	4	Drought
	5	Winter Weather
Low	6	Tornado
	7	Hail

Part 6: Hazard Analysis

Part 6: HAZARD & VULNERABILITY ANALYSIS

Introduction

After the potential hazards in the county were identified, the Planning Team reviewed historic data and conducted an analysis in ArcGIS for each hazard. This analysis was presented at the October 18, 2017, public meeting. At this meeting, stakeholders provided many firsthand accounts of damage caused by natural disasters and confirmed the lack of damage from hazards not profiled in this plan. The result of that process has determined eight different natural hazards require mitigation efforts. The maps and the discussion that follow are a compilation of data analysis, historic information, and public feedback.

Part 6.1 Flooding

6.1 Flooding

Floodplains are the primary tool used by FEMA to determine areas at risk of flooding. The periodic flooding of lands adjacent to rivers, streams, and shorelines is a natural and inevitable occurrence that can be expected based upon established recurrence intervals. The recurrence interval of a flood is the average time interval, in years, that can be anticipated between flood events of a certain magnitude. Using the recurrence interval with land and precipitation modeling, forecasters can estimate the probability and likely location of flooding. These are expressed as floodplains. The most commonly used floodplain measurements are the 100-year floodplain and the 500-year floodplain. The 100-year floodplain has a 1 in 100 chances of flooding each year. The 500-year floodplain is estimated to have a 1 in 500 chances of occurring each year.

Flooding causes widespread and varying degrees of damage. The magnitude or extent of flood damage is expressed by using the maximum depth of flood water during a specific flood event. Structures inundated by 4-feet or more of flood water are considered an absolute loss. Other forms of loss. such as roads, bridges, agriculture, services, or death or injury are also summarized by jurisdiction in this plan.

Historic Occurrences

The National Oceanic and Atmospheric Administration (NOAA) collects historic climate data for the entire nation. NOAA's storm event data can be accessed on the National Climatic Data Center (NCDC) storm events database. A condensed version of the Waller County flood events data from 1996 - present is provided in the table below. Information about flooding due to Hurricane Harvey was not yet available when this plan was drafted.

Event Year	Fatalities	Property Damage (2015 Dollars)	Crops Damage (2015 Dollars)	Total Damage (2015 Dollars)
1997	0	$ 5,000.00	$ -	$ 5,000.00
1997	0	$ 5,000.00	$ -	$ 5,000.00
1997	0	$ 5,000.00	$ -	$ 5,000.00
1998	0	$ 15,000.00	$ -	$ 15,000.00
1998	0	$ -	$ -	$ -
1998	0	$ 1,000.00	$ -	$ 1,000.00
1998	0	$ 3,000.00	$ -	$ 3,000.00
1998	0	$ 3,000.00	$ -	$ 3,000.00
1998	0	$ 5,000.00	$ -	$ 5,000.00
2000	0	$ 50,000.00	$ -	$ 50,000.00
2001	0	$ -	$ -	$ -
2001	0	$ 10,000.00	$ -	$ 10,000.00
2002	0	$ 25,000.00	$ -	$ 25,000.00
2002	0	$ 20,000.00	$ -	$ 20,000.00
2006	0	$ 33,000.00	$ -	$ 33,000.00
2006	0	$ -	$ -	$ -
2012	0	$ 300,000.00	$ 10,000	$ 300,010.00
2015	0	$ 4,000.00	$ -	$ 4,000.00
2015	0	$ -	$ -	$ -
2015	0	$ -	$ -	$ -
2016	1	$ 6,700,000.00	$ 10,000	$ 6,700,010.00

Source: https://www.ncdc.noaa.gov/stormevents/

Waller County Disaster Declarations

There have been six federally declared flood disasters Waller County since 1953. These events are considered the most significant flood events in Waller County's recent history.

Declaration Date	Title	Disaster Number
10/18/1994	SEVERE THUNDERSTORMS AND FLOODING	1041
10/21/1998	TX-FLOODING 10/18/98	1257
04/25/2016	SEVERE STORMS AND FLOODING	4269
06/11/2016	SEVERE STORMS AND FLOODING	4272
08/25/2017	TX-HURRICANE HARVEY	4332

Source: https://www.FEMA.gov/

NFIP Participation

The National Flood Insurance Program (NFIP) is a voluntary program that aims to reduce the impacts of flooding by incentivizing communities to adopt and enforce floodplain management regulations. The NFIP provides affordable flood insurance for property owners, renters, and businesses in participating communities. This reduces the socio-economic impacts of flooding on communities through risk reduction via flood insurance, and reduces the physical impacts of flooding through beneficial floodplain regulation.

NFIP Participants in Waller County:
Waller County
Brookshire
Hempstead
Pattison
Prairie View
Waller

Each of the jurisdictions participating in the NFIP program has a certified floodplain manager on staff, and/or function under the regulatory umbrella of Waller County. To remain NFIP compliant, the CFM's office conducts jurisdiction wide permit review, grants or denies approval (in and out of the SFHA), makes floodplain determinations, conducts outreach, inspections, and produces flood studies.

Flood Damage Prevention Ordinance: Adopted Jan 13, 2009
Revised: February 28, 2013.

Resources and program compliance are the identified barriers for the NFIP program across Waller County. To improve their flood mitigation efforts and enhance their NFIP program, Waller County hired a Compliance Offer in 2017. This person is working directly with members of the community to bring their homes into compliance and ensure that NFIP regulation is adequately enforced. Waller County will continue to dedicate resources toward technical staff, continuing education, and training.

The Town of Pine Island does not participate in the NFIP program because they do not have the technical staff, budget, or resources required to participate and remain compliance with NFIP regulations.

Repetive Loss Properties

Consistent and destructive flooding is one of Waller County's greatest challenges. Many NFIP insured properties have flooded multiple times. Repetitive loss properties (RL) are those that have received at least two insurance payments of $1,000 or more from the NFIP within the last 10 years. Waller County has a total of 85 RL properties and SRL properties totaling $11,816,076.10 in insurance payouts in the past decade. A comprehensive list of all RL and SRL properties are located in Appendix D.

Jurisdiction	Residential RLPs	Non-Residential RLPs	SRL Properties	Total RLPs
Unincorporated Waller County	71	1	17	72
Brookshire	3	0	0	3
Hempstead	2	2	1	4
Pattison	1	0	0	1
Prairie View	6	0	0	6

Hazard Analysis & Vulnerability Identification

The hazard analysis uses historic hazard event data to determine the probability of an event occurring again within the next five years. The analysis calculates the average number of events in each jurisdiction annually and then multiplies by five.

The hazard analysis also provides hazard extent data for each participating jurisdiction. The greatest historic data is the most extreme data recorded during a storm or hazard event, and the extent data represents the worst damage a jurisdiction could experience. Information from stakeholders, FEMA, NOAA, and the Department of Homeland Security (DHS) are the sources of data for the analysis.

To identify vulnerabilities for each jurisdiction, this plan used the following methods:

- FEMA's Hazus analysis software
- GIS analysis of critical facilities in the floodplain; and
- Stakeholder identified vulnerabilities.

Hazus was used to determine the economic loss and calculate the buildings stock that's at risk of flooding in Waller County. Shelter needs were also projected using this method. The complete HAZUS report is located in Appendix C. H-GAC maintains a database of critical facilities in Waller County. Using GIS, this plan identifies any critical assets located within the 500-year floodplain. Stakeholders then provided valuable insight into additional vulnerabilities within their communities. These findings are provided in condensed charts for each jurisdiction.

Waller County (All participating jurisdictions)

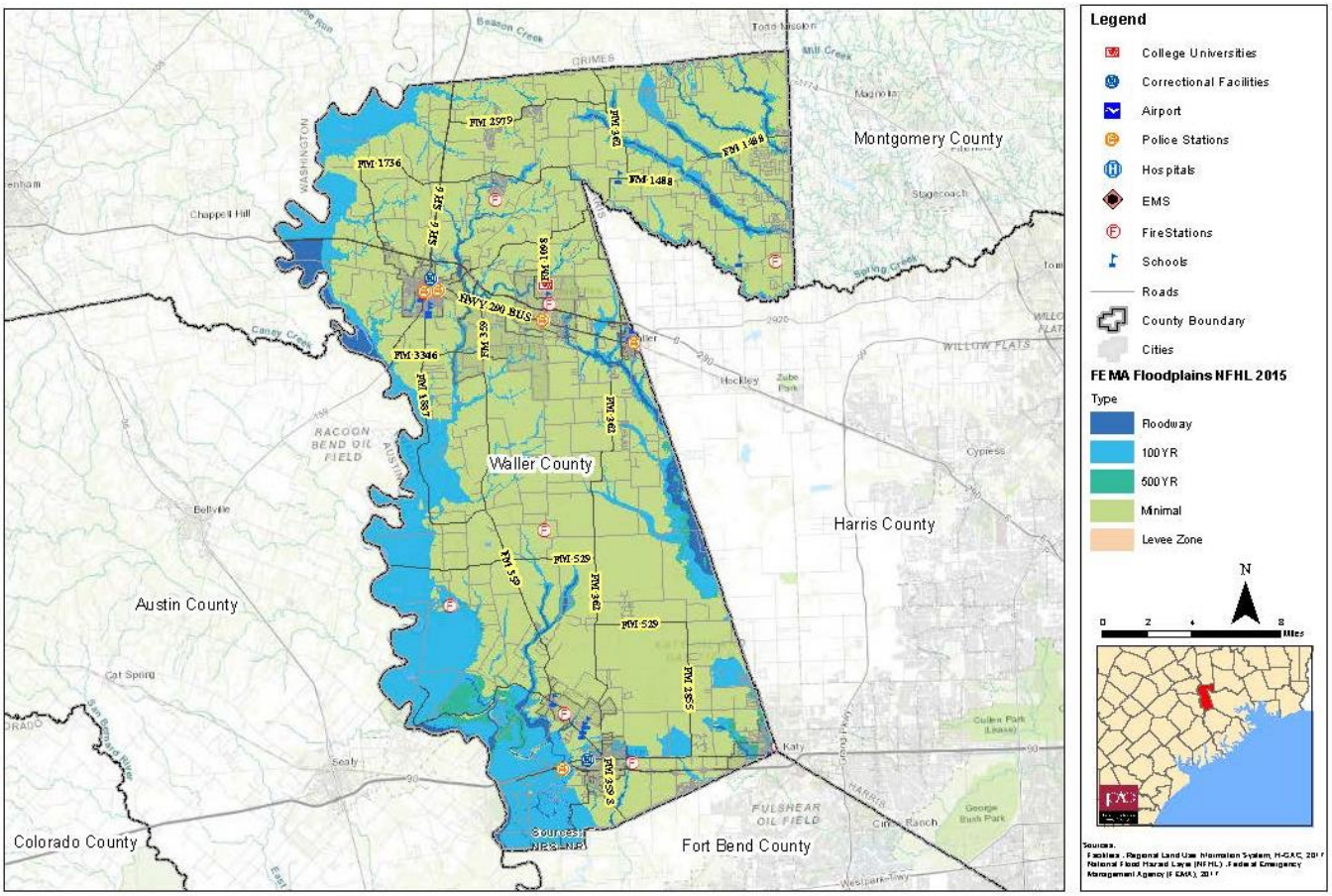
Identified Vulnerabilities:

- Community members and city staff expressed the concern of major infrastructure, roads and bridges, acting as physical barriers throughout the county, in past major flood events this:
    - Prevented water from certain areas, but also allowed for increased floodwaters in other areas
    - Led to rescuers not being able to reach communities where the main highway was the only way for first responders to reach people in need
- Individuals who reside or work within the 100 year or 500 year floodplain
- Communities without emergency shelters, local hospitals, or fire stations- relying on the county or larger jurisdiction for emergency services/ response
- Local farmers and other business owners whose shops or farmland flood

Identified Impacts:

- Major roadways blocked by floodwaters may create an increase of serious injuries or loss of life due to responders not being able to reach those injured or in danger
- Lack of shelters and emergency responders throughout the county may lead to an increase in response time which may lead to a loss of life or serious injury
- Economic and financial loss for cities and individuals including property loss and loss of economic activity from loss of major employers including industrial and farming activities

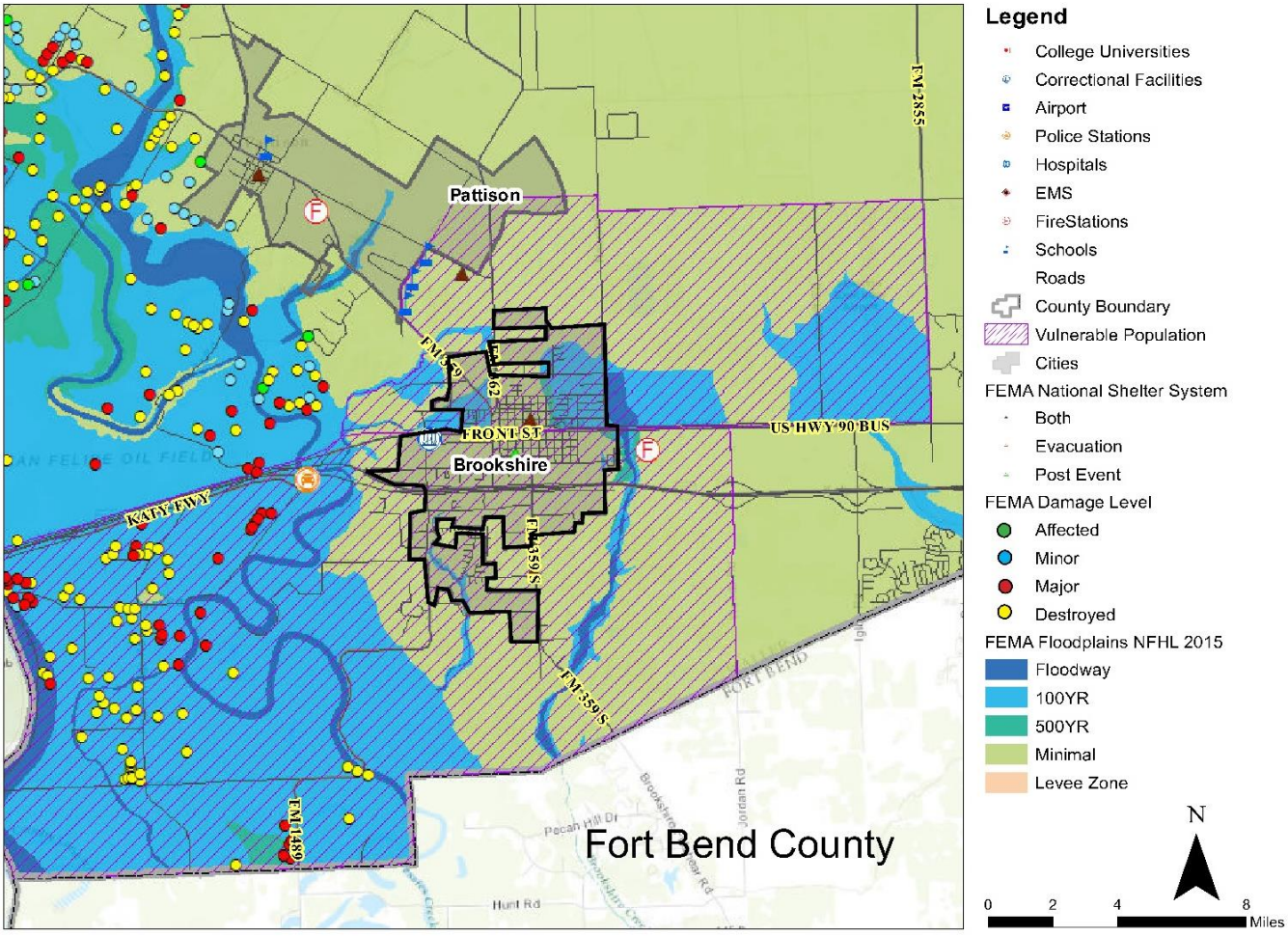
Waller County



Unincorporated Waller County			
Planning Area (Sq. mi):	487.7	**Occurrences since 1996:**	12
Area Affected:	20.9%	**Annual Event Average:**	0.57
Probability of Occurring in the next 5 years:	Very likely; 2.9 events estimated to occur within next 5 years.		
Greatest Occurrence:	Approximately 800 homes flooded during Hurricane Harvey flooding, and 2 feet of water in homes.		
Extent:	Up to 1,200 homes could flood, and up to 6 feet of water in homes.		

Vulnerability	Impact
2,868 residential structures are at risk.	$28.8 million in direct property damage.
I-10 becomes a barrier during major flood events, and water cannot drain properly. This causes upstream flooding.	Homes and businesses on the north side of the interstate flood, and are costly to repair or replace.
FM 362 and 359 flood and are major north/south routes through the county.	Flooded roadway prevents emergency response efforts and evacuations during major flood events.

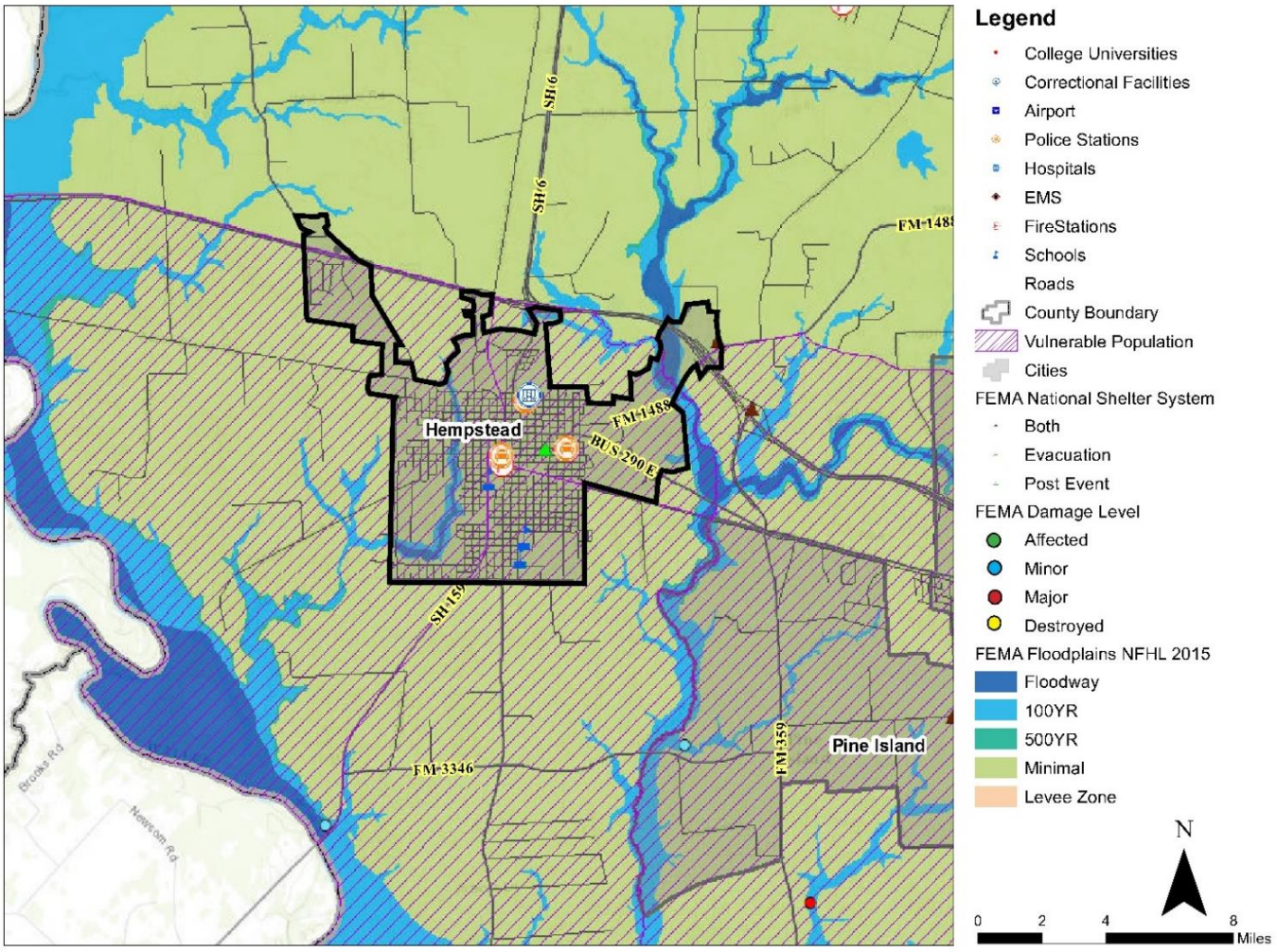
Brookshire



Brookshire			
Planning Area (Sq. mi):	3.5	**Occurrences since 1996:**	12
Area Affected:	11.38%	**Annual Event Average:**	0.57
Probability of Occurring in the next 5 years:	Very likely; 2.9 events estimated to occur within next 5 years.		
Greatest Occurrence:	4' of water in homes, and extensive road closures.		
Extent:	Up to 8' of water in homes, and impassible roads.		

Vulnerability	Impact
1 church that serves as a shelter is located in the floodplain.	Sheltering residents during major flood events would be interrupted at this location, and are costly to repair.
Museum flooded during Hurricane Harvey.	The museum will be very costly to repair, and many valuable cultural assets stored in the museum were destroyed.
Nursing home flooded during hurricane Harvey.	The residents of the nursing home are at risk during flood events, and the building repairs are costly.
146 residences at risk of flooding during 500-year event.	Displaced residents must be sheltered during major flood events, and the home repairs are costly.

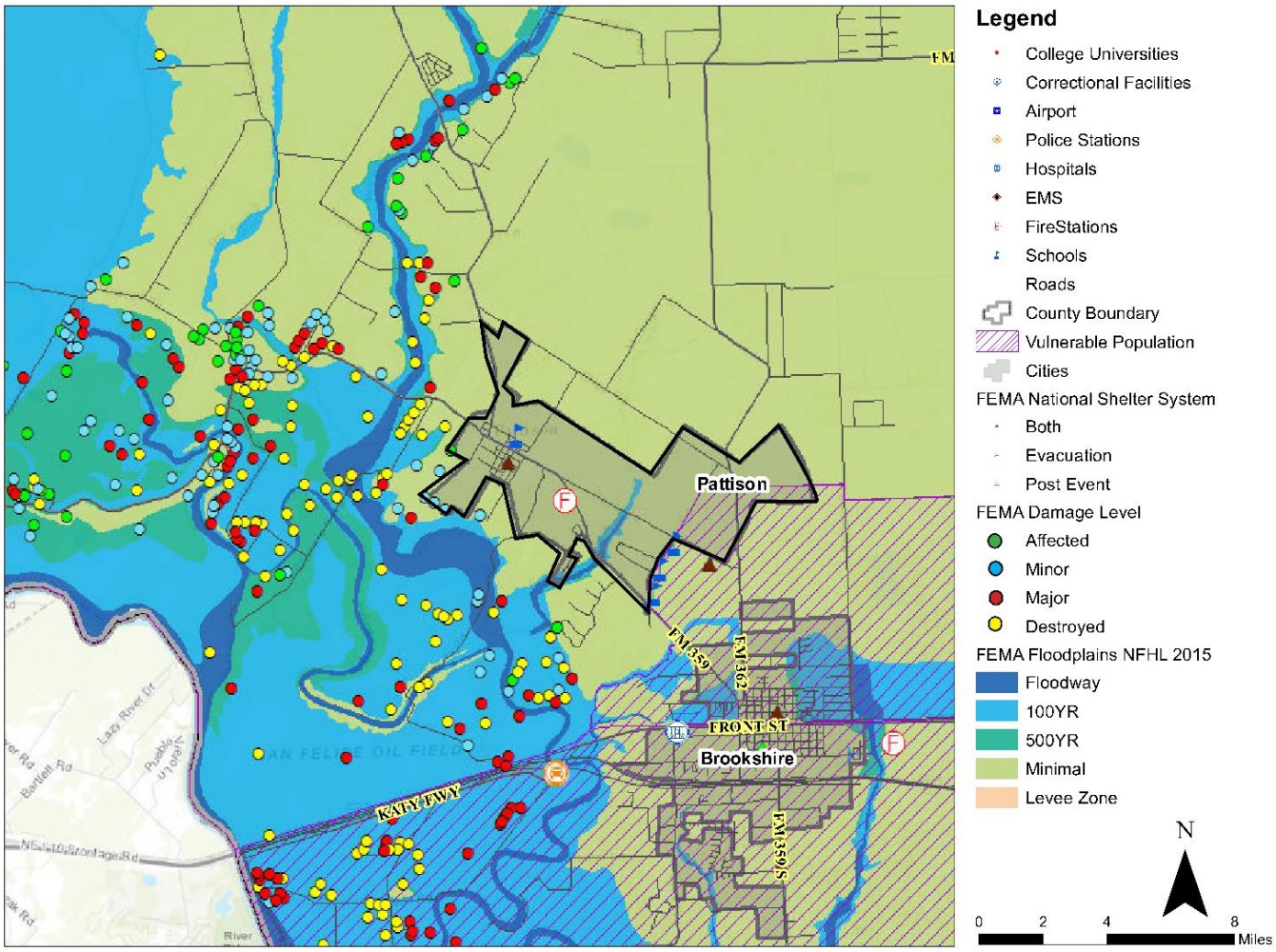
Hempstead



Hempstead			
Planning Area (Sq. mi):	5.0	**Occurrences since 1996:**	16
Area Affected:	6.21%	**Annual Event Average:**	0.76
Probability of Occurring in the next 5 years:	Very likely; 3.8 events estimated to occur within next 5 years.		
Greatest Occurrence:	2.4' of flood water over roadways, and up to 18 inches in homes.		
Extent:	Up to 4' of flood water over roadways, and up to 3' of flood water in homes.		

Vulnerability	Impact
268 residences at risk of flooding during 500-year event.	Displaced residents must be sheltered during major flood events, and repairs would be costly.
Criminal Investigation Building and Sherrif's office was flooded during Hurricane Harvey.	Disrupted services and loss of property.

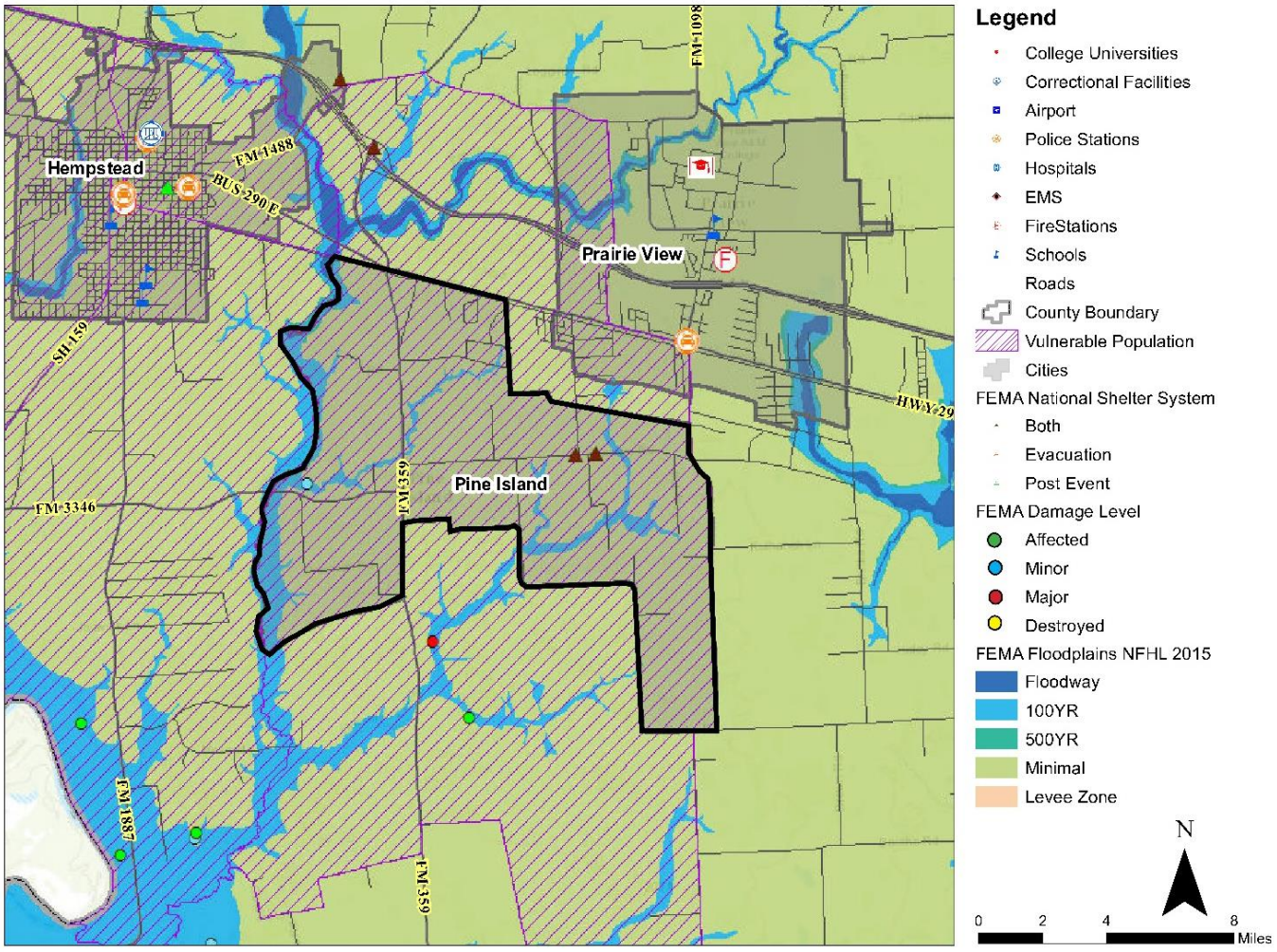
Pattison



Pattison			
Planning Area (Sq. mi):	3.2	**Occurrences since 1996:**	12
Area Affected:	5.9%	**Annual Event Average:**	0.57
Probability of Occurring in the next 5 years:	Very likely; 2.9 events estimated to occur within next 5 years.		
Greatest Occurrence:	2.52' of flood water over roadways, and 2' of flood water in homes.		
Extent:	Up to 5' of flood water over roadways, and 4' of flood water in homes.		

Vulnerability	Impact
Pattison Fire Department flooded during Hurricane Harvey.	Disruption of services during major flood events could result in loss of life.
66 residences at risk of flooding during 500-year event.	Displaced residents must be sheltered during major flood events, and repairs would be costly.
Sheet flow flooding from Hurricane Harvey was 6"-8" inches in many structures, but only minor inundation.	Costly repairs to structures throughout the city, but especially on the south side of town.

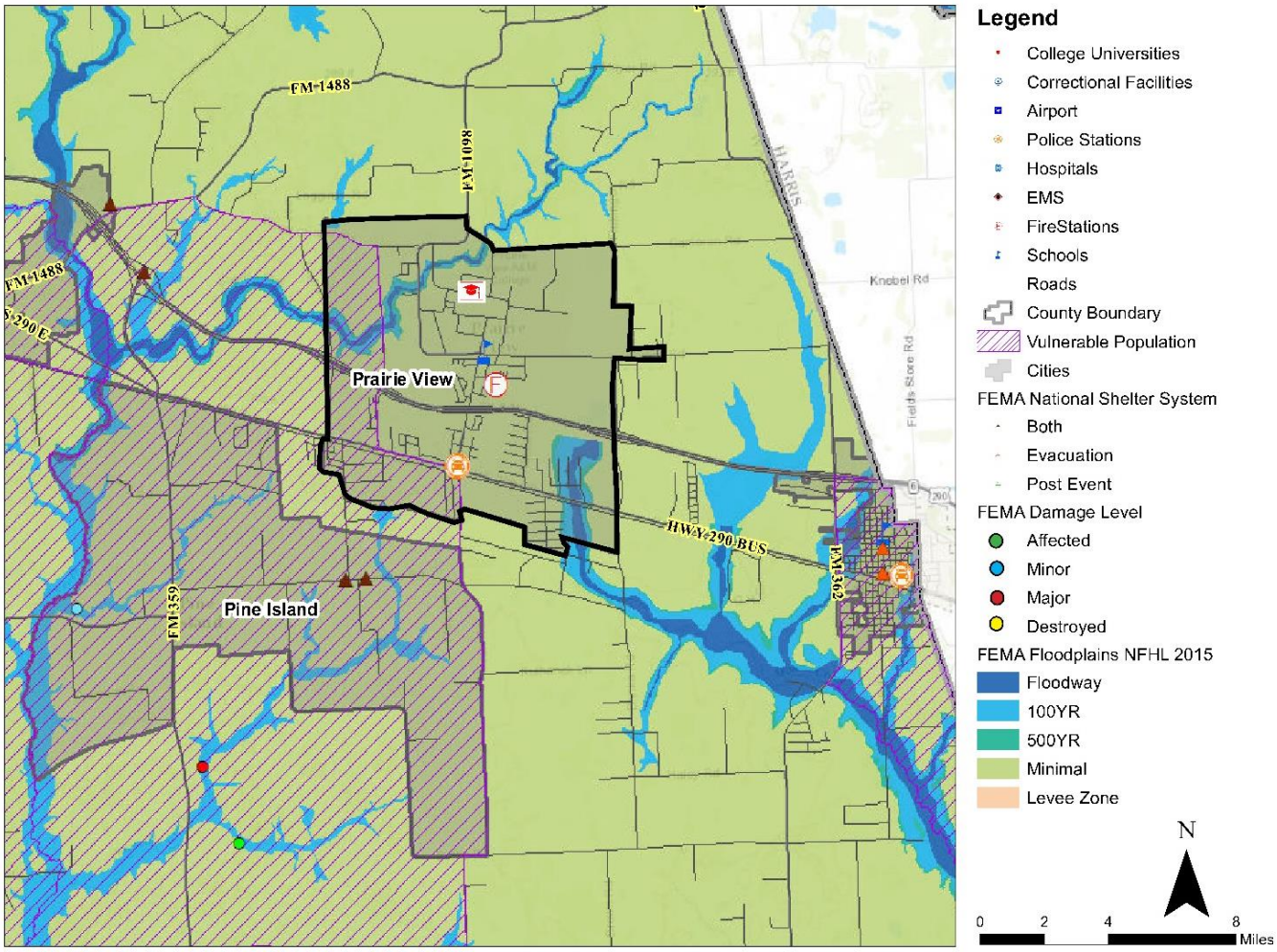
Pine Island



Pine Island			
Planning Area (Sq. mi):	9.3	**Occurrences since 1996:**	12
Area Affected:	7.52%	**Annual Event Average:**	0
Probability of Occurring in the next 5 years:	Very likely; 2.9 events estimated to occur within next 5 years.		
Greatest Occurrence:	3.89' of flood water in over roadways.		
Extent:	Up to 6' of flood water in over roadways, and 18" of flood water in homes.		

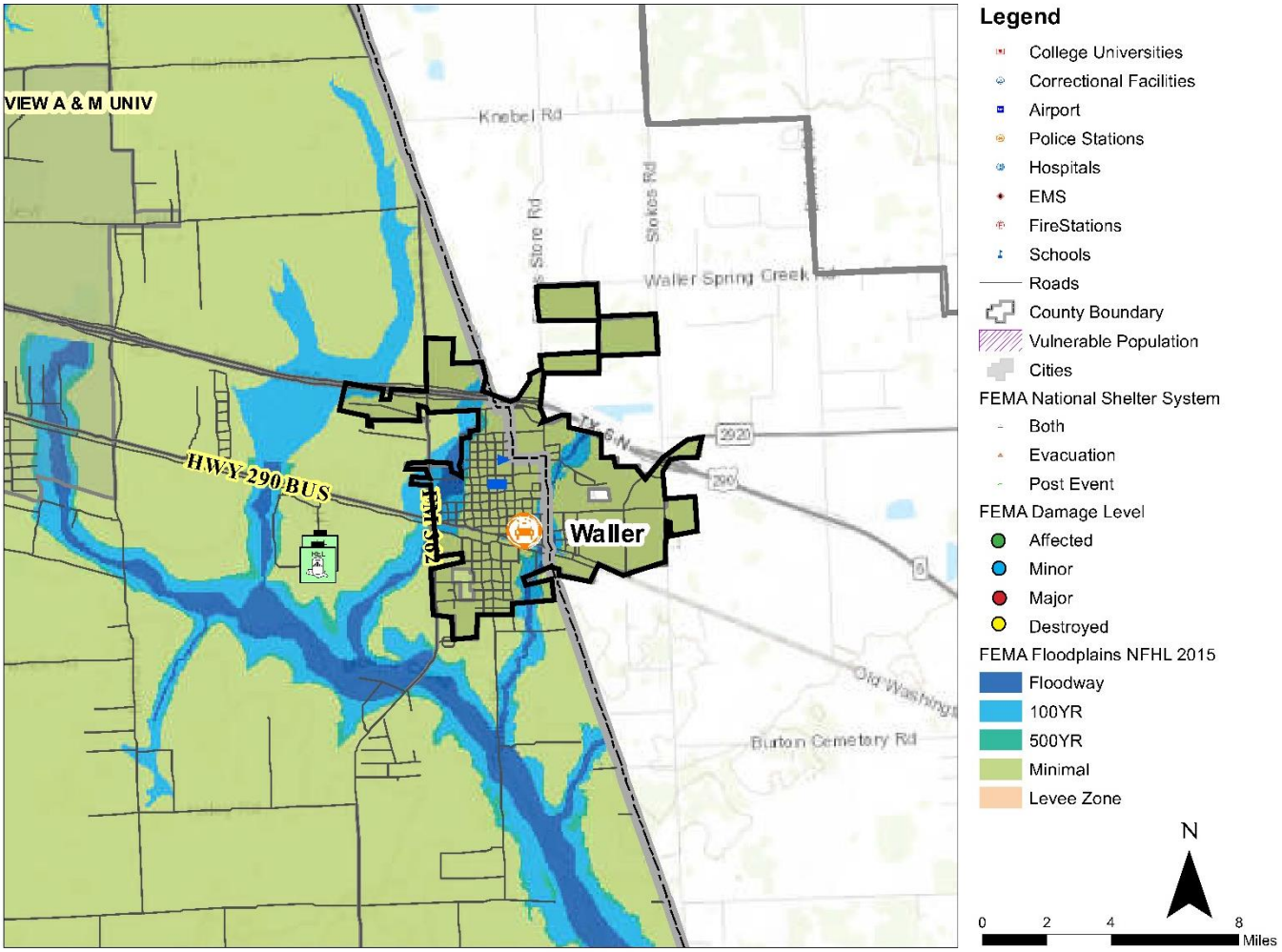
Vulnerability	Impact
Wastewater treatment facility has been damaged during flood events, and could be damaged again.	Costly to repairs and interruption of wastewater treatment services.
27 residences at risk of flooding during 500-year event.	Displaced residents must be sheltered during major flood events, and repairs would be costly.

Prairie View



Prairie View			
Planning Area (Sq. mi):	7.2	**Occurrences since 1996:**	13
Area Affected:	7.32%	**Annual Event Average:**	0
Probability of Occurring in the next 5 years:	Very likely; 3.1 events estimated to occur within next 5 years.		
Greatest Occurrence:	4.12' of flood water over roadways.		
Extent:	Up to 7' of flood water over roadways, and 2' of flood water in homes		
Vulnerability		**Impact**	
306 residences at risk of flooding during a 500-year event.		Displaced residents must be sheltered during major flood events, and home repairs are be costly.	

Waller



Waller			
Planning Area (Sq. mi):	2.07	**Occurrences since 1996:**	17
Area Affected:	6.5%	**Annual Event Average:**	0
Probability of Occurring in the next 5 years:	Very likely; 4.1 events estimated to occur within next 5 years.		
Greatest Occurrence:	1.25' of flood water over roadways.		
Extent:	Up to 5' of flood water over roadways, and 18" of flood water in homes.		

Vulnerability	Impact
113 residences at risk of flooding during 500-year event.	Displaced residents must be sheltered during major flood events, and home repairs are be costly.
One wastewater facility is located in a flood prone area and flooded during Harvey.	The facility is a critical facility. Regular waste water intake services are interrupted, and that is costly to repair.

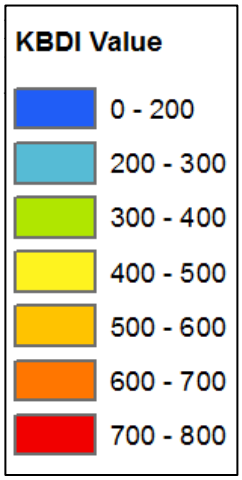
Part 6.2 Wildfires

6.2 Wildfire

A combination of the Keetch-Byram Drought Index (KBDI) and the Texas Wildfire Risk Assessment are used to assess the risk of wildfire. KBDI is an index that measures the daily water balance, precipitation, and moisture in the soil to determine the potential for wildfires. KBDI ranges from 0 to 800 units. Zero represents fully saturated soil or no indication of drought. A measurement of 800 is the maximum measurement for drought and indicates no moisture is present in the soil. In August 2011, the maximum KBDI value recorded in Waller County was 792. The minimum KBDI value, 41, was recorded in September of 2017. KBDI conditions can change rapidly based on short-term weather conditions, so the most extreme values should be considered when addressing wildfire risk.

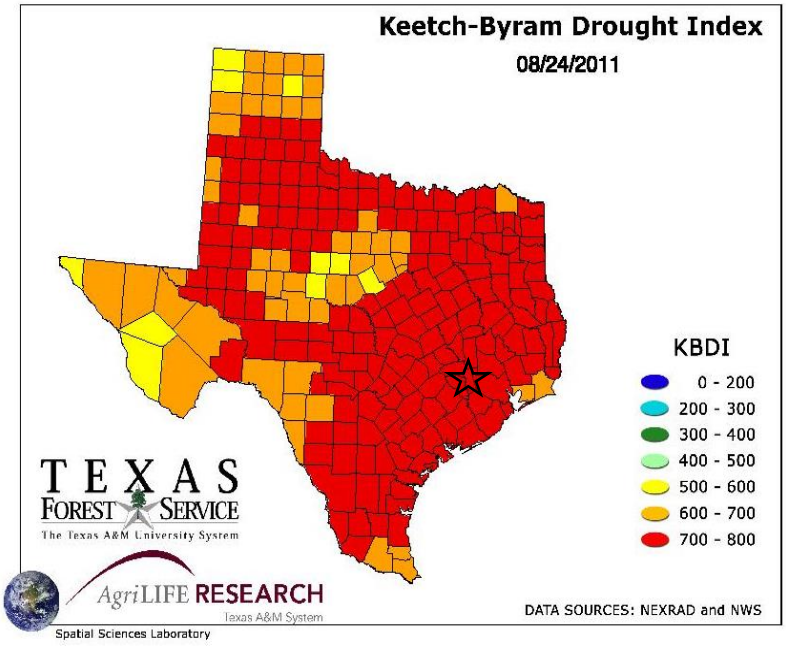
The Texas Wildfire Risk Assessment uses a variety of factors, such as fuels, vegetation, weather, and topography, to determine the fire potential of a specific land area. Particularly vulnerable are the Wildland Urban Interface (WUI) areas. These areas occur at the intersection of development and wildland. With continued population growth throughout the county, the WUI zones will become more abundant. Because most wildfires are caused by human activities, the intersection of WUI and drought are particularly dangerous.

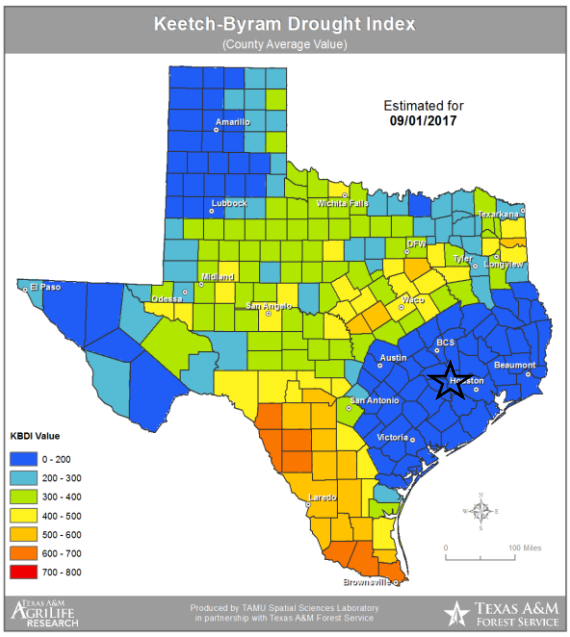
Wildland Fire Assessment System (WFAS) KBDI Value Scale:



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

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





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

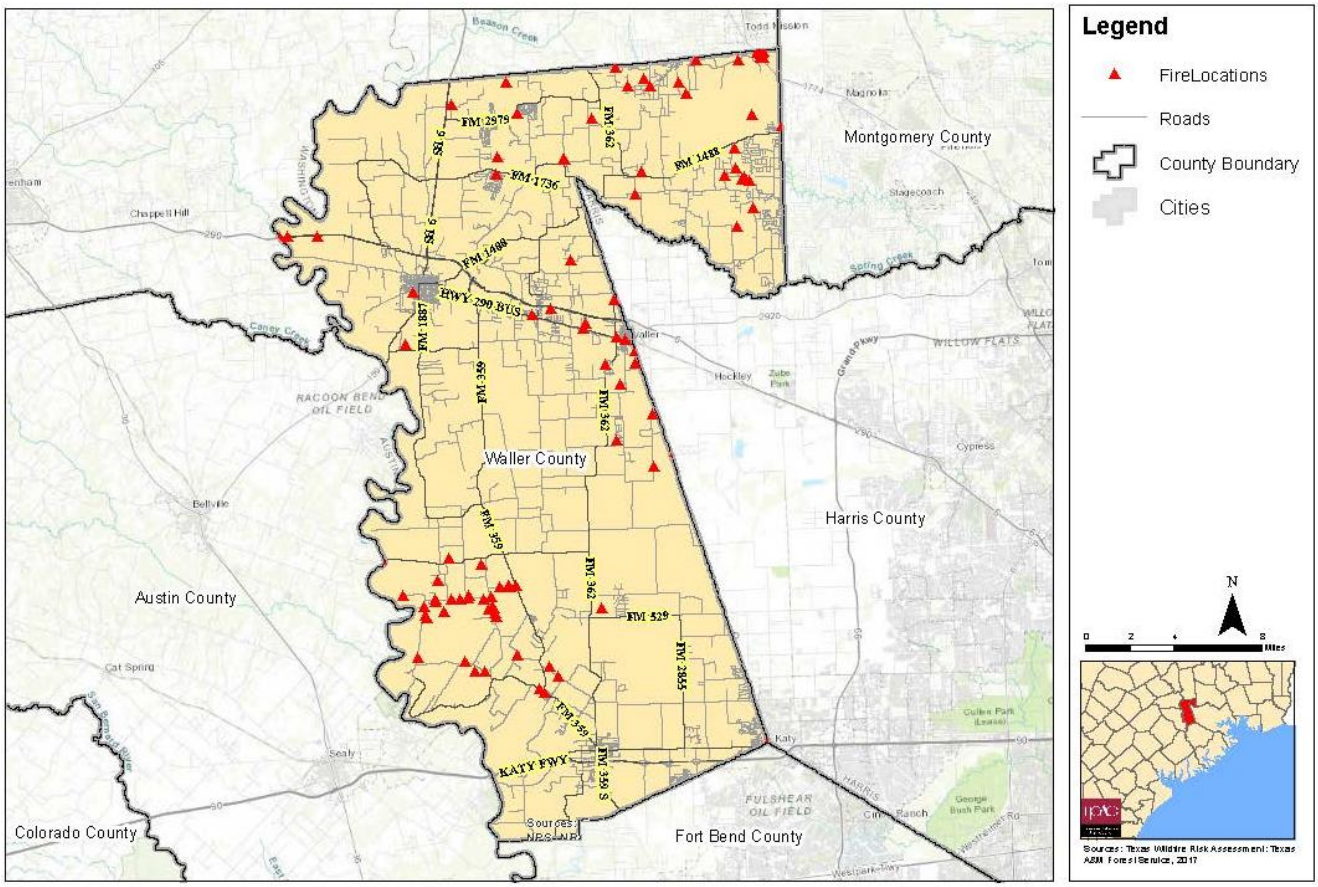
Historic Occurrence

The Texas A&M Forest Service tracks wildfire events, acres destroyed, and the initial ignition cause of the fire. Below is the historic data associated with any burns that caused recorded damage.

County Name	Cause Name	Damaged Acres	Year of Start Date
Waller	Campfire	250	2005
Waller	Debris burning	10	2006
Waller	Debris burning	10	2006
Waller	Debris burning	9	2006
Waller	Miscellaneous	3	2006
Waller	Smoking	25	2008
Waller	Debris burning	5	2009
Waller	Campfire	20	2009
Waller	Equipment use	12	2009
Waller	Debris burning	3	2010
Waller	Miscellaneous	10	2011
Waller	Miscellaneous	5	2011
Waller	Debris burning	20	2011
Waller	Incendiary	3	2011
Waller	Miscellaneous	15	2011
Waller	Power Lines	760	2011
Waller	Debris burning	10	2012
Waller	Debris burning	8	2012
Waller	Debris burning	3	2013
Waller	Equipment use	5	2013
Waller	Lightning	10	2013
Waller	Debris burning	5	2014
Waller	Debris burning	15.1	2015
Waller	Miscellaneous	23.1	2015
Waller	Debris burning	75	2015
Waller	Debris burning	10	2015
Waller	Incendiary	30	2015
Waller	Debris burning	5	2015
Waller	Incendiary	3	2015
Waller	Debris burning	6	2015
Waller	Smoking	14	2015
Waller	Miscellaneous	75	2015

Source: Texas Wildfire Risk Assessment Portal, Texas A&M Forest Service
https://www.texaswildfirerisk.com/

Fire Ignition Point (2000 – 2015)



Waller County Wildfire Disaster Declarations

Declaration Date	Title	Disaster Number
2/22/1996	Extreme Fire Hazard	3117
9/1/1999	Extreme Fire Hazards	3142
1/11/2006	Extreme Wildfire Threat	1624
3/13/2008	Wildfires	3284
9/5/2011	Riley Road Fire	2964
9/9/2011	Wildfires	4029

https://www.FEMA.gov/

Hazard Analysis & Vulnerability Identification

The hazard analysis uses historic hazard event data to determine the probability of an event occurring again within the next five years. The analysis calculates the average number of events in each jurisdiction annually and then multiplies by five.

The hazard analysis also provides hazard extent data for each participating jurisdiction. The greatest historic data is the most extreme data recorded during a storm or hazard event, and the extent data represents the worst damage a jurisdiction could experience. Information from stakeholders, Texas Forest Service, FEMA, and NOAA are the sources of data for the analysis. The analysis identified all structures, agricultural land, and gross acreage located within the 500 to 800 KBDI zones. Neither stakeholders or the GIS analysis identified any critical facilities located in the 500 to 800 KBDI zones.

To identify vulnerabilities for each jurisdiction, this plan used the following methods:

- GIS analysis of residential structures and critical facilities within 500 to 800 KBDI zones;
- GIS analysis of agricultural and gross acreage within 500 to 800 KBDI zones; and
- Stakeholder identified vulnerabilities.

Waller County (All Participating Jurisdictions)

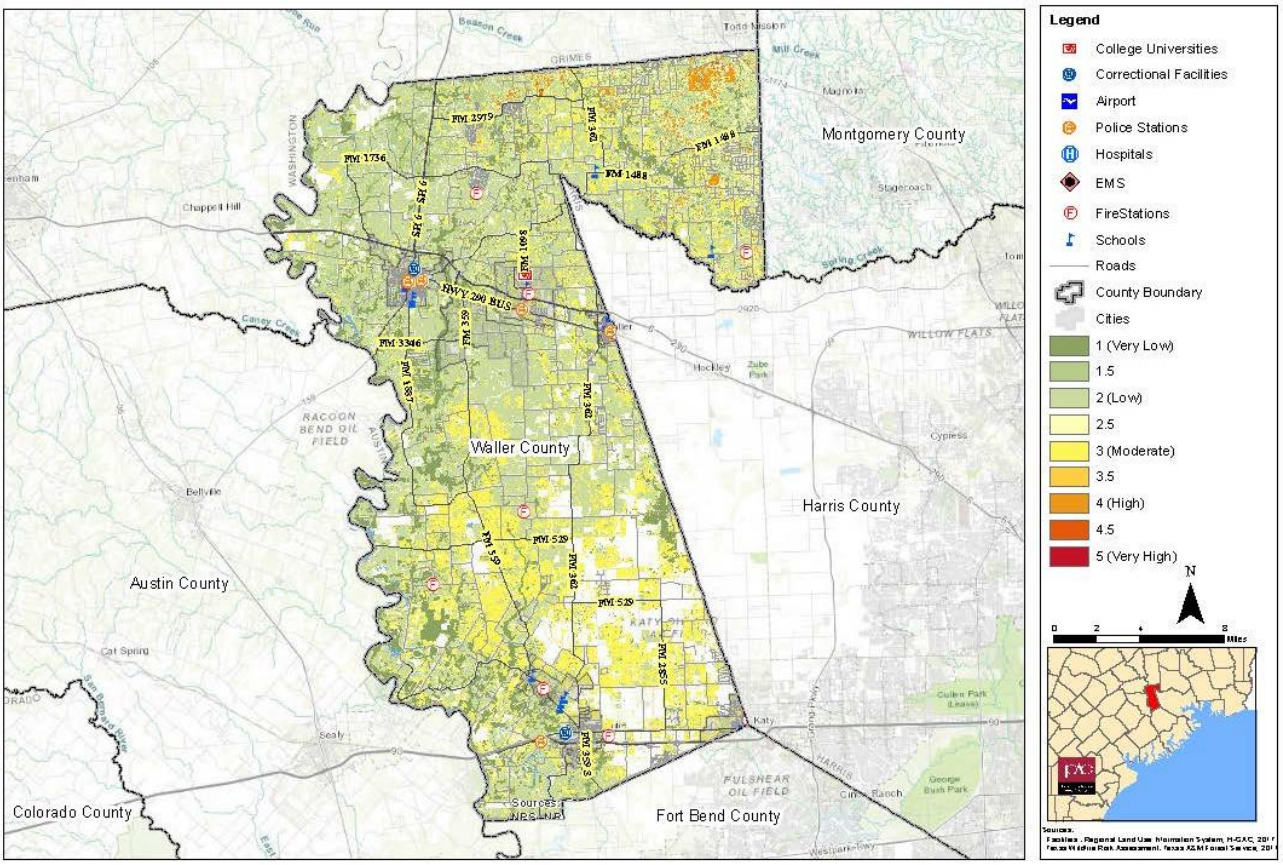
Identified Vulnerabilities:

- Residential structures throughout the county
- Vulnerable populations throughout the county (mapped and identified in Part 3)
- Agricultural areas and parklands throughout the county
- Industrial or commercial areas throughout the county

Identified Impacts:

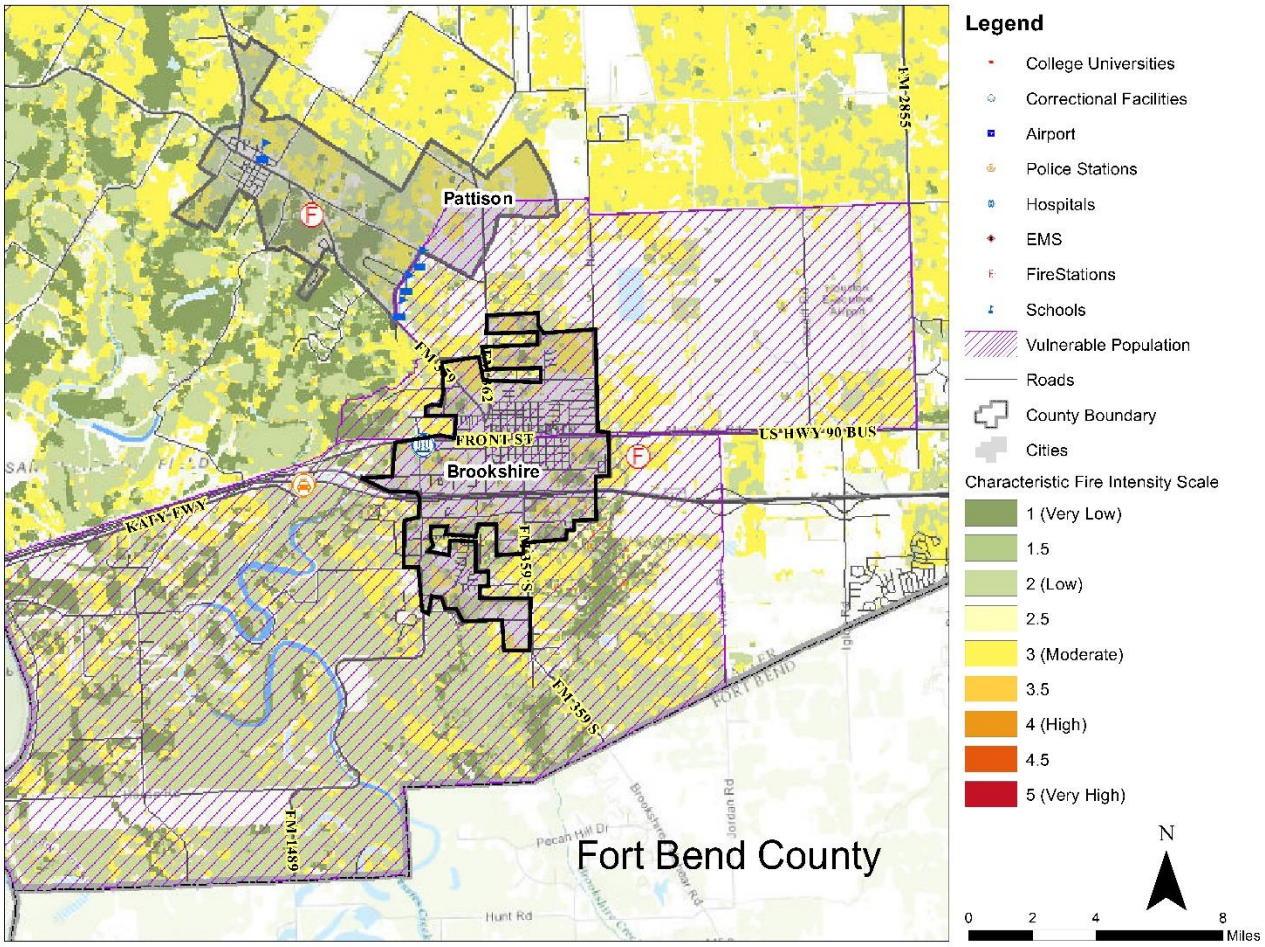
- Residential and commercial property loss throughout the county may lead to a financial loss for residents and jurisdictions
- Significant injury or loss of life particularly for children or older individuals due to potentially poor air quality
- Loss of agriculture land throughout the county may lead to an economic loss for the county and a loss for local farmers and business/ residents that rely on agriculture throughout the county as well
- If an industrial or chemical site catches fire this may lead to a technical hazard leading to an increase in property loss, serious injuries or loss of life

Unincorporated Waller County



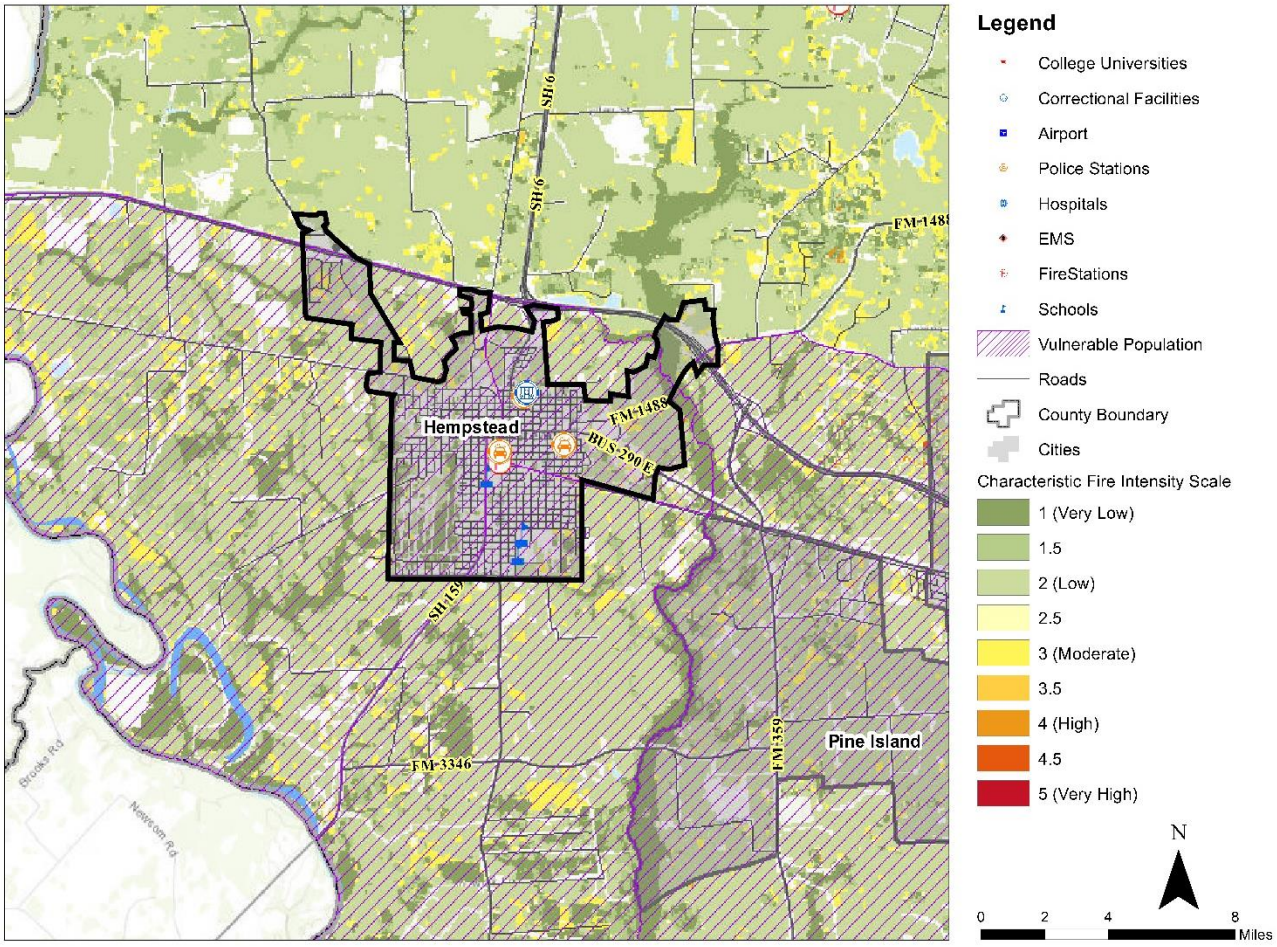
Unincorporated Waller County			
Planning Area (acres):	312,128	**Occurrences since 2005:**	24
Area Affected:	12.1%	**Annual Event Average:**	1.8 per year
Probability of Occurring in the next 5 years:	Very likely; 9.2 events estimated to occur within next 5 years.		
Greatest Occurrence:	Approximately 350 acres burn annually, and the largest wildfire experienced burned 250 acres.		
Extent:	Up to 500 acres burned in one event.		
Vulnerability		**Impact**	
37,767 aceres at high risk, and most of the at risk lands is agircultrual lands or immediately adjacent to agricultural lands.		Significant agricultural losses when large wildfires occur.	

Brookshire



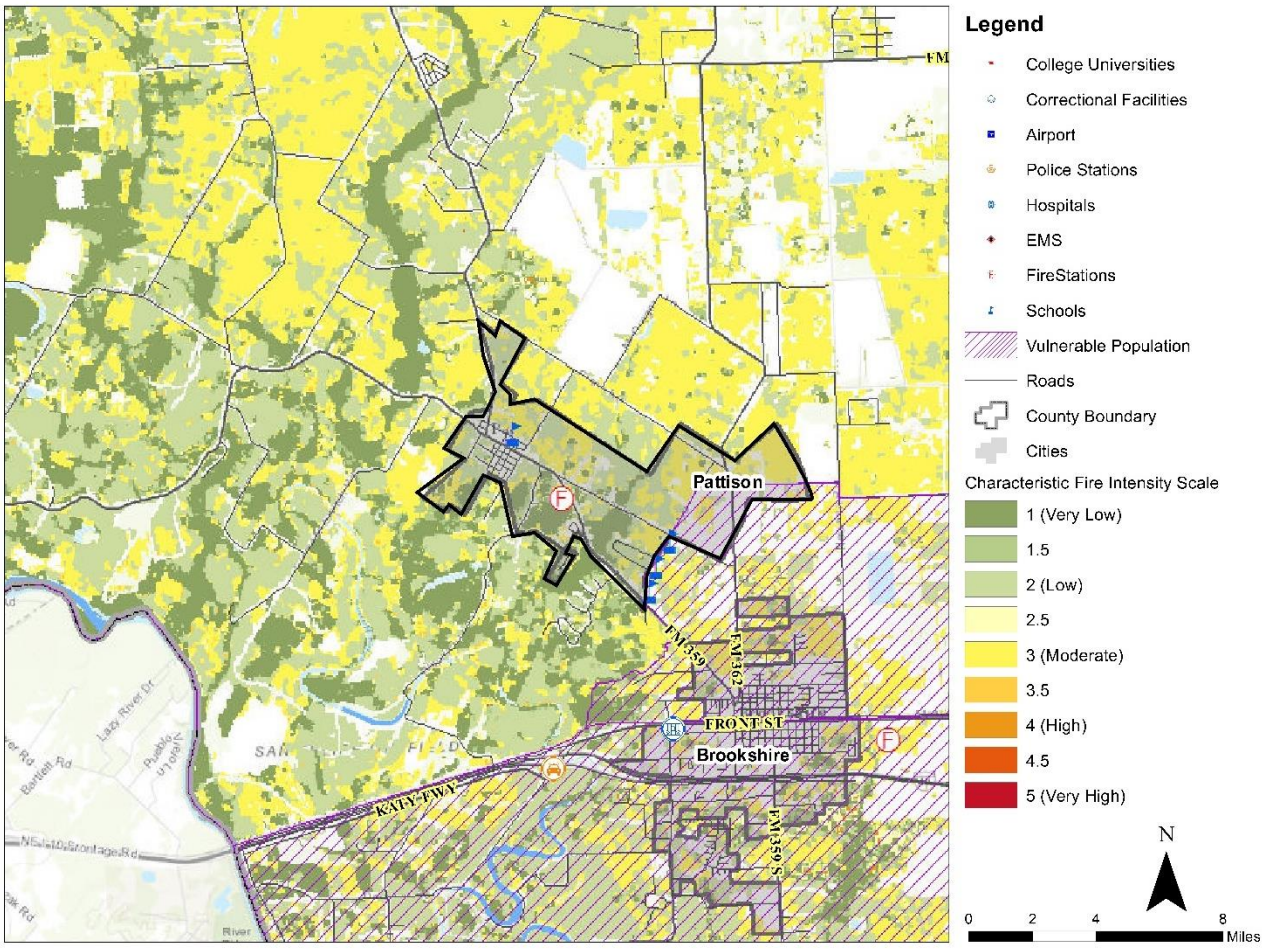
Brookshire			
Planning Area (acres):	2,240	**Occurrences since 2005:**	0
Area Affected:	11.5%	**Annual Event Average:**	0
Probability of Occurring in the next 5 years:	Not Likely, Less than 10% chance event will occur within the next 5 years.		
Greatest Occurrence:	N/A; Nearby jurisdiction Pattison has experienced wildfires, and Brookshire shares similar geographic conditions. Brookshire can expect some wildfire events in the future.		
Extent:	Up to 30 acres burn in one wildfire event		
Vulnerability		**Impact**	
257.6 aceres at high risk.		Potential loss of life and property.	

Hempstead



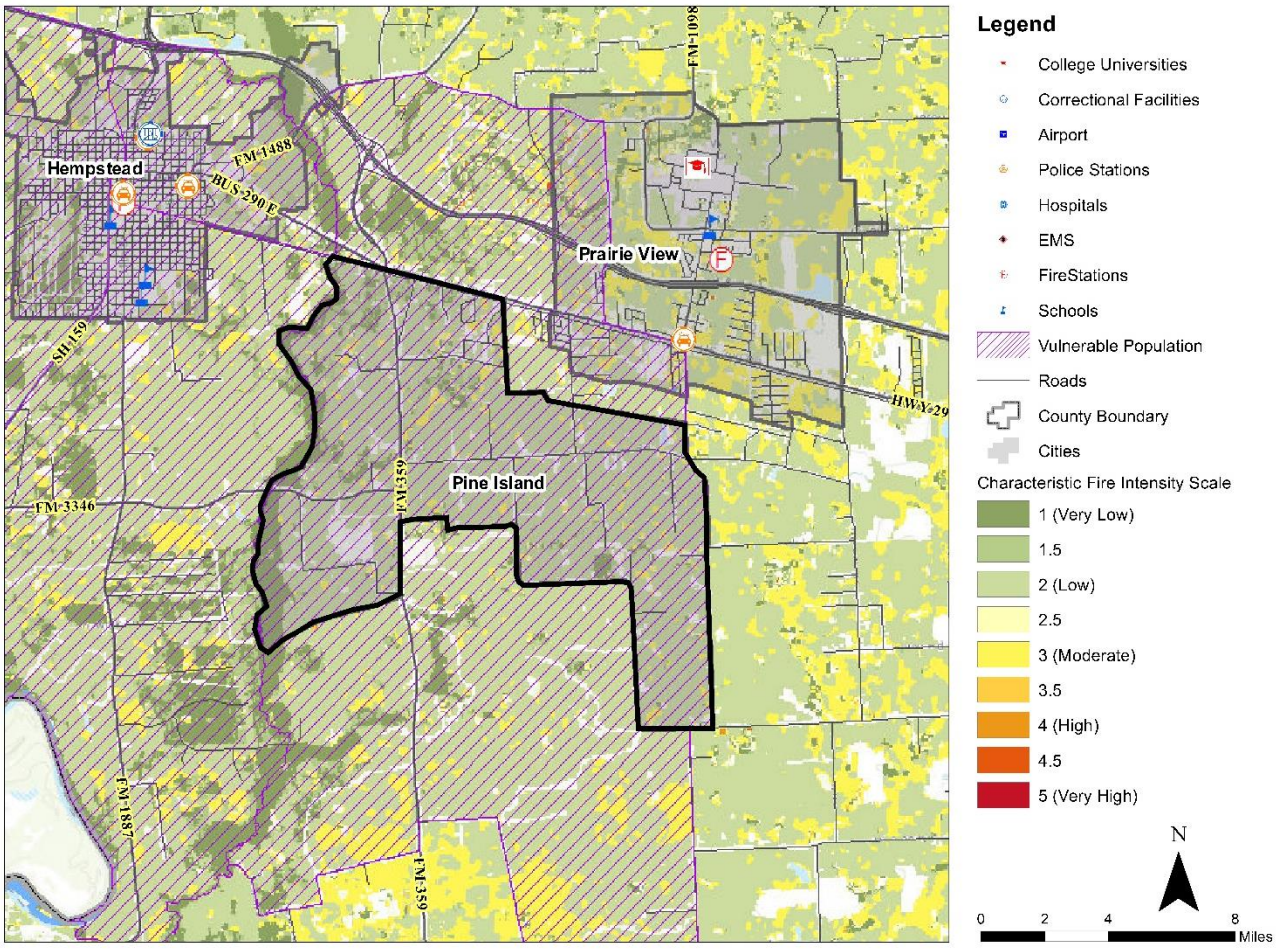
Hempstead			
Planning Area (acres):	3,200	**Occurrences since 2005:**	1
Area Affected:	6.1%	**Annual Event Average:**	0.07 per year
Probability of Occurring in the next 5 years:	Likely; 40% chance event will occur within next 5 years.		
Greatest Occurrence:	10 acres burned in one wildfire event		
Extent:	Up to 30 acres burn in one wildfire event		
Vulnerability		**Impact**	
195.2 aceres at high risk.		Potential loss of life and property.	

Pattison



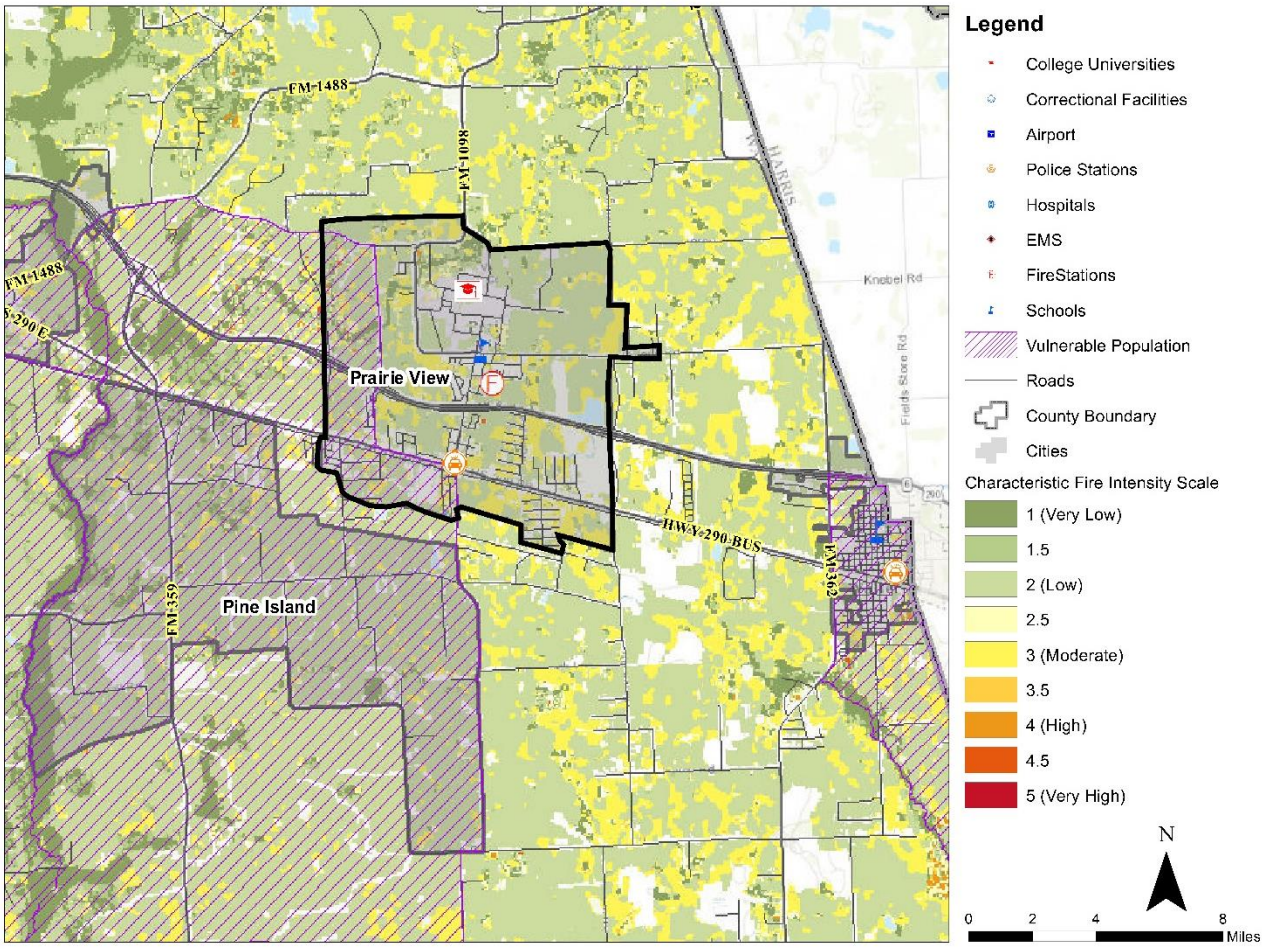
Pattison			
Planning Area (acres):	2,048	**Occurrences since 2005:**	2
Area Affected:	18.4%	**Annual Event Average:**	0.15 per year
Probability of Occurring in the next 5 years:	Likely; 80% chance event will occur within next 5 years.		
Greatest Occurrence:	10 acres burned in one wildfire event		
Extent:	Up to 30 acres burn in one wildfire event		
Vulnerability		**Impact**	
376.8 aceres at high risk.		Potential loss of life and property.	

Pine Island



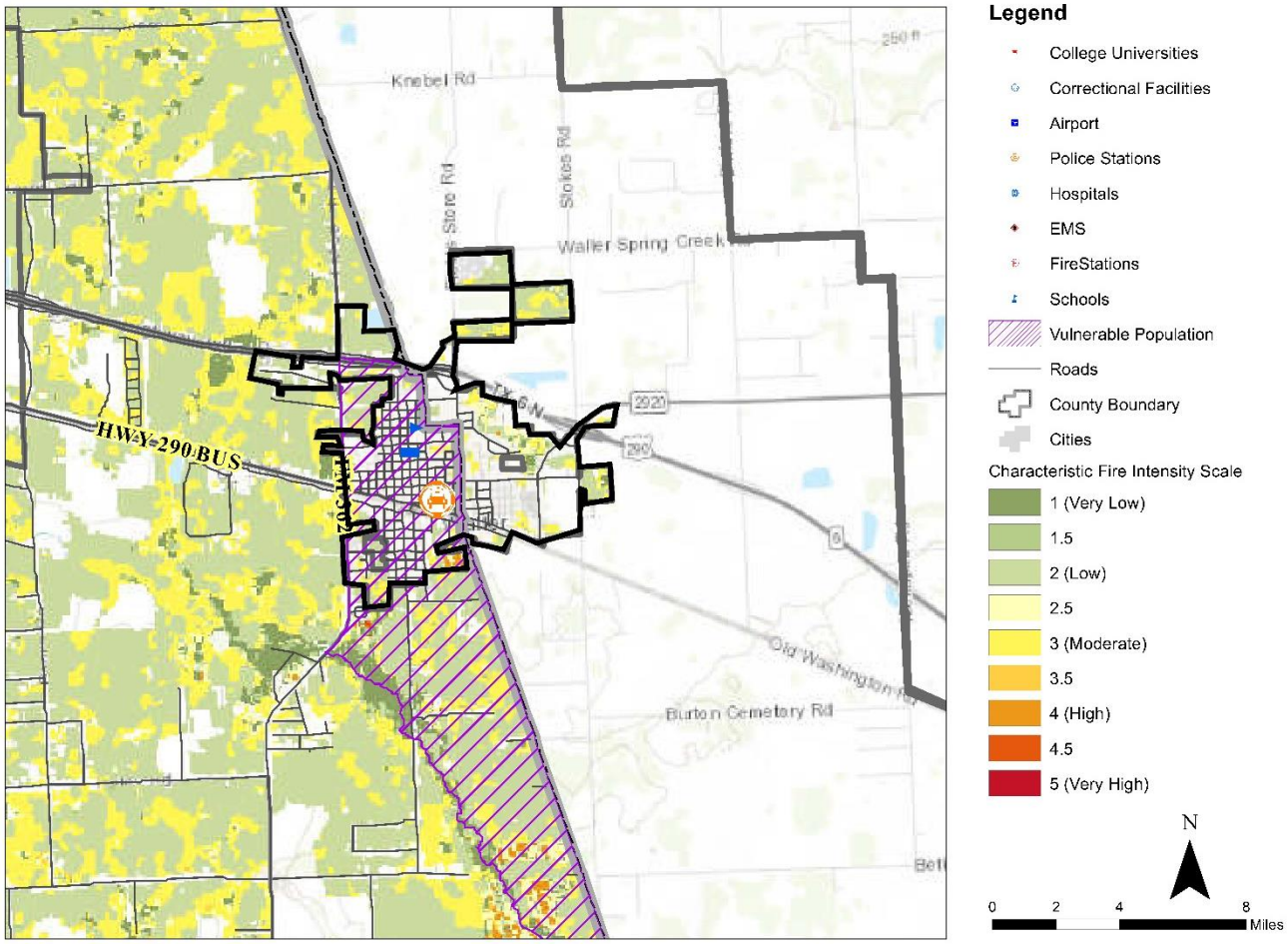
Pine Island			
Planning Area (acres):	5,952	**Occurrences since 2005:**	0
Area Affected:	3.3%	**Annual Event Average:**	0 per year
Probability of Occurring in the next 5 years:	Not Likely, Less than 10% chance event will occur within the next 5 years.		
Greatest Occurrence:	N/A; Nearby jurisdictions Prairie View and Hempstead have experienced wildfires, and Pine Island can expect some wildfire events to occur in the future.		
Extent:	Up to 30 acres burn in one wildfire event		
Vulnerability		**Impact**	
196.4 aceres at high risk.		Significant agricultural losses if a large wildfire were to occur, and potential loss of life.	

Prairie View



Prairie View			
Planning Area (acres):	4,608	**Occurrences since 2005:**	2
Area Affected:	15.4%	**Annual Event Average:**	0.15 per year
Probability of Occurring in the next 5 years:	Likely; 80% chance event will occur within next 5 years.		
Greatest Occurrence:	10 acres burned in one wildfire event		
Extent:	Up to 30 acres burn in one wildfire event		
Vulnerability		**Impact**	
709.63 aceres at high risk.		Significant agricultural losses if a large wildfire were to occur, and potential loss of life.	

Waller



Waller			
Planning Area (acres):	1,324	**Occurrences since 2005:**	3
Area Affected:	8.9%	**Annual Event Average:**	0.23 per year
Probability of Occurring in the next 5 years:	Very likely; 1.2 events estimated to occur within next 5 years.		
Greatest Occurrence:	30 acres burned in one wildfire event		
Extent:	Up to 60 acres burn in one wildfire event		
Vulnerability		**Impact**	
42 structures at risk of wildfire.		Potential loss of life and property.	

Part 6.3 Severe Thunderstorm

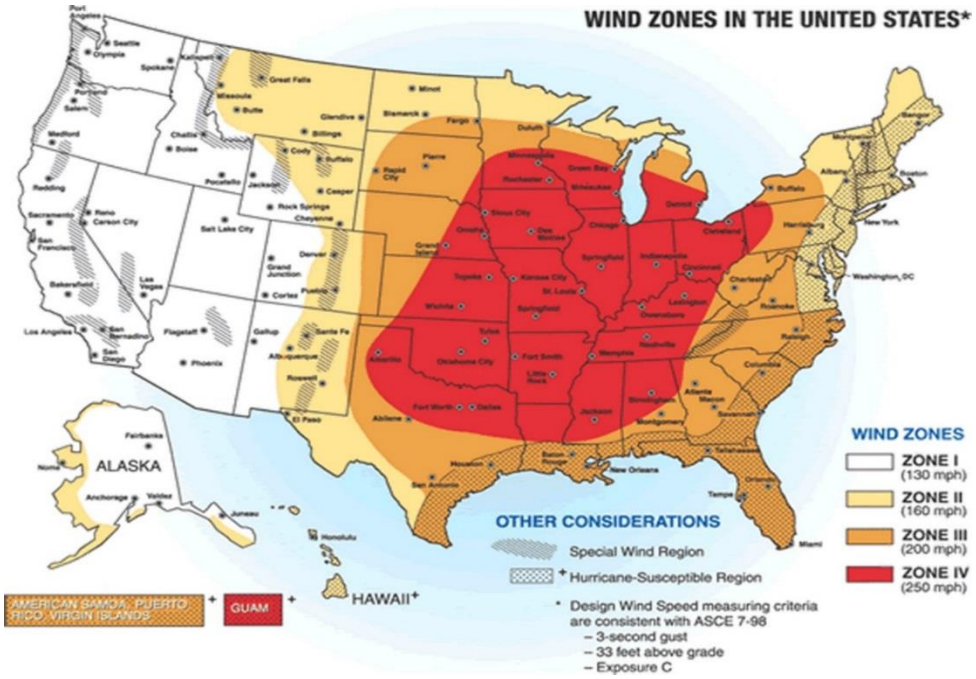
6.3 Severe Thunderstorm

A thunderstorm's magnitude is measured by the Beaufort Wind Scale. This scale considers visual and physical effects of wind to determine the force, displayed from 0 to 12. Severe gale to hurricane winds are typically considered more dangerous or damaging winds.

Force	Wind (Mph)	WMO Classification	Wind Effects
0	Less than 1	Calm	Calm, Smoke rises vertically
1	1 to 3	Light Air	Smoke drift indicates wind direction
2	4 to 8	Light Breese	Wind felt on face, leaves rustle, vanes begin to move
3	9 to 14	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
4	15-21	Moderate Breeze	Dust, leaves, and loose paper lifted, small tree branches move
5	22-28	Fresh Breeze	Small trees in leaf begin to sway
6	29-36	Strong Breeze	Larger tree branches moving, whistling in wires
7	37-44	Near Gale	Whole trees moving, resistance felt walking against wind
8	45-53	Gale	Whole trees in motion, resistance felt walking against wind
9	54-62	Strong Gale	Slight structural damage occurs, shingles blow off roofs
10	63-72	Storm	Trees broken or uprooted, considerable structural damage occurs
11	73-83	Violent Storm	Widespread damage
12	84 +	Hurricane	Violence and destruction

Source: http://www.ncdc.noaa.gov

A second tool to help measure the potential magnitude of a thunderstorm is the Wind Zone map. This map from FEMA shows the variety of wind speeds and depicts the frequency and strength of potential storms throughout the United States. Waller County is in Wind Zone III meaning that the county could experience winds up to 200 mph.



Map source: http://www.fema.gov

Historic Occurrences

Date	Jurisdiction	Property Damage (2015 Dollars)	Wind Speed (mph)
08/19/1996	Brookshire	$ 5,000	
11/7/1996	Hempstead	$ 5,000	
02/20/1997	Countywide	$ 2,000	
05/24/1997	Hempstead	$ 5,000	
12/23/1997	Brookshire	$ 3,000	
02/10/1998	Brookshire	$ 50,000	
08/3/1998	Brookshire	$ 30,000	
11/5/2000	Prairie View	$ 15,000	
11/12/2000	Hempstead	$ 15,000	
03/14/2001	Pattison	$ 60,000	
10/13/2001	Hempstead	$ 2,000	
06/16/2002	Waller	$ 3,000	
06/29/2002	Hempstead	$ 3,000	
12/12/2002	Hempstead	$ 15,000	
11/23/2004	Countywide	$ 25,000	69
11/23/2004	Countywide	$ 20,000	74
11/23/2004	Hempstead	$ -	57
04/25/2007	Hempstead	$ -	59
09/3/2009	Prairie View	$ 5,000	57
06/9/2010	Brookshire	$ 10,000	59
06/5/2011	Prairie View	$ -	64
08/24/2011	Brookshire	$ -	59
08/10/2012	Prairie View	$ -	57
04/27/2015	Hempstead	$ 6,000	58
05/25/2015	Waller	$ -	69
05/25/2015	Katy	$ -	69
04/27/2016	Waller	$ -	66
04/2/2017	Waller	$ -	59

Source: https://www.ncdc.noaa.gov/

Hazard Analysis & Vulnerability Identification

The hazard analysis uses historic hazard event data to determine the probability of an event occurring again within the next five years. The analysis calculates the average number of events in each jurisdiction annually and then multiplies by five.

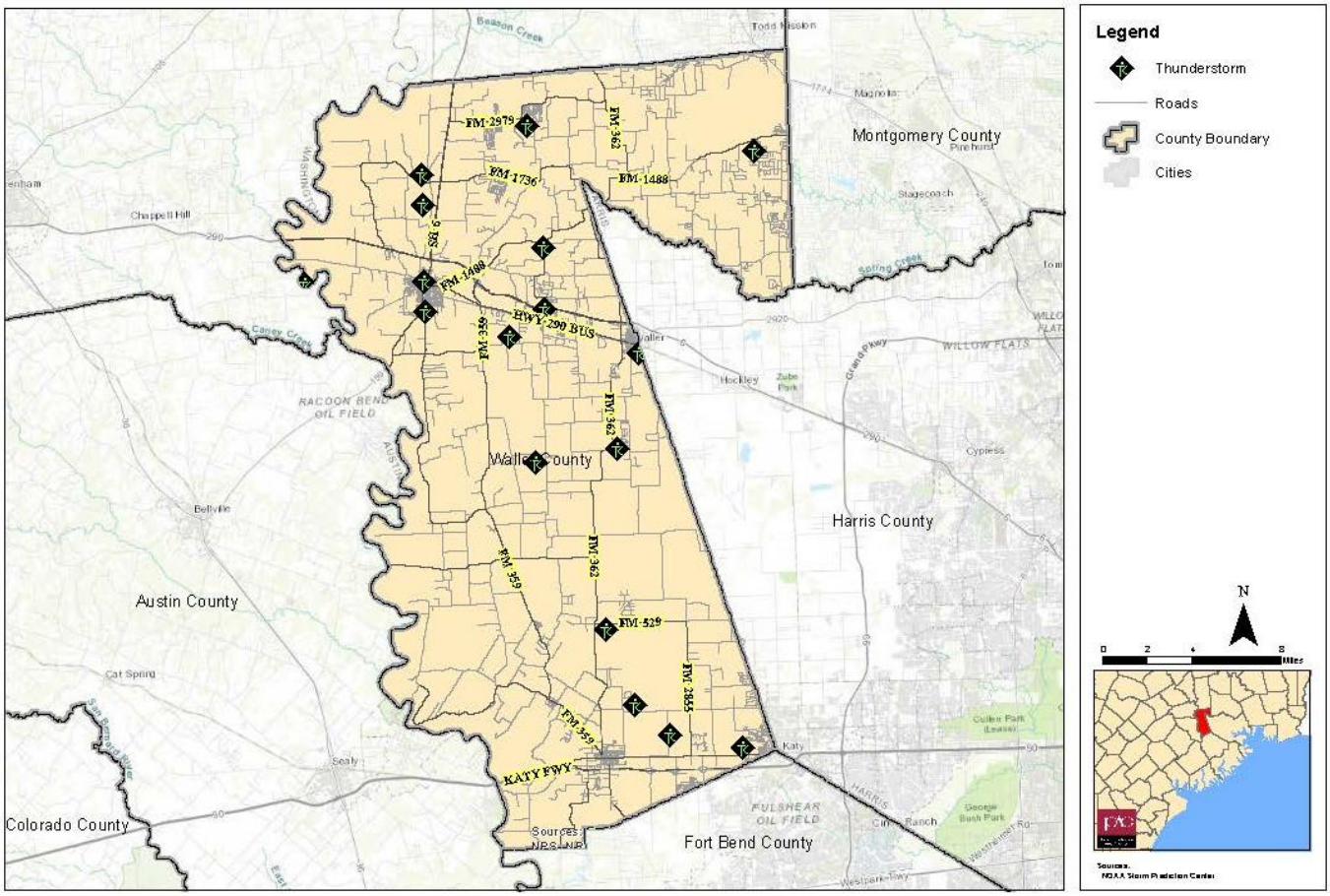
The hazard analysis also provides hazard extent data for each participating jurisdiction. The greatest historic occurrence data is the most extreme data recorded during a storm or hazard event and represents the worst damage a jurisdiction has experienced in recent history. The extent is the worst the jurisdiction could possibly experience. Information from stakeholders, FEMA, and NOAA are the sources of data for the analysis.

To identify vulnerabilities for each jurisdiction, this plan used three methods:

- GIS analysis to estimate structural damage costs in each jurisdiction; and
- Stakeholder identified vulnerabilities.

Due to its inland location, severe thunderstorms often produce stronger gusts of winds than hurricanes. These winds have caused damage to roofs, homes, agricultural structures, trees, and powerlines

Severe Thunderstorm Locations



Waller County (All participating jurisdictions)

Identified Vulnerabilities:

Similar to the hurricane section, this section identifies vulnerabilities from high winds. High winds can tear down powerlines, trees, barns, fences, and multitude of other debris can be blown into roadways and homes during the event.

Additionally, residences and commercial buildings could be damaged or destroyed due to wind events; older residential neighborhoods and structures without a permanent foundation were identified as one of the main vulnerabilities throughout the county. While current building codes address the vulnerability of wind damage to structures, older buildings (particularly residential buildings) were built when less stringent building codes were in place; therefore, older residential building and residences without a permanent foundation are a focus in this section.

- Older public and private structures throughout the county
- Vulnerable populations throughout the county (Identified in Part 3)

Identified Impacts:

- Downed powerlines could impact communication and daily active leading to a finical loss for the county, cities and individuals, and could impede first responders from reaching those in need or residents evacuating
- Strong winds could prevent first responders from traveling to assist individuals, because of unsafe driving conditions such as debris hitting emergency vehicles
- Critical facilities could sustain wind damage, potentially delaying first responders reaching those in need and city services during and after the event
- Economic and financial loss for cities and individuals including property loss

Unincorporated Waller County

Planning Area (sq. mi):	487.7	**Occurrences since 1996:**	28
Area Affected:	100%	**Annual Event Average:**	1.3
Probability of Occurring in the next 5 years:	Very likely; 6.7 events estimated to occur within next 5 years.		
Greatest Occurrence:	$25,000 in property damage from one event 65 mph wind speeds		
Extent:	Up to 70 mph winds.		

Vulnerability	Impact
14,520 structures and 331,520 acres in agricultural production are at risk of damage by severe thunderstorms. Critical faciltities at risk: 1 correctional facility, 4 EMS stations, 1 fire stations, 2 local emergency operations centers, 6 police stations, and 1 shelter.	$2,238 in annual losses to direct property damage and repairs. A disruption in emergency response services, shelters, and loss of secure inmate housing while repairs are made to critical facilities.

Brookshire			
Planning Area (sq. mi):	3.5	**Occurrences since 1996:**	6
Area Affected:	100%	**Annual Event Average:**	0.28
Probability of Occurring in the next 5 years:	Very likely; 1.4 events estimated to occur within next 5 years.		
Greatest Occurrence:	$50,000 in property damage from one event 52 mph wind speeds		
Extent:	Up to 70 mph winds.		

Vulnerability	Impact
1,722 structures are at risk of damage by severe thunderstorms. Critical faciltities at risk: 1 correctional facility, 1 EMS station, 2 fire stations, 6 schools, 2 local emergency operations centers, 2 police stations, and 4 shelters.	$4,667 in annual losses to direct property damage and repairs. A disruption in emergency response services, school services, and loss of secure inmate housing while repairs are made to critical facilities.

Hempstead			
Planning Area (sq. mi):	5.0	**Occurrences since 1996:**	9
Area Affected:	100%	**Annual Event Average:**	0.42
Probability of Occurring in the next 5 years:	Very likely; 2.1 events estimated to occur within next 5 years.		
Greatest Occurrence:	$15,000 in property damage from one event 52 mph wind speeds		
Extent:	Up to 70 mph winds.		

Vulnerability	Impact
5,770 structures are at risk of damage by severe thunderstorms. Critical faciltities at risk: 1 EMS station, 1 fire station, 3 schools, 1 local emergency operations center, 3 police stations, and 1 shelters.	$2,429 in annual losses to direct property damage and repairs. A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.

Pattison			
Planning Area (sq. mi):	3.2	**Occurrences since 1996:**	6
Area Affected:	100%	**Annual Event Average:**	0.28
Probability of Occurring in the next 5 years:	Very likely; 1.4 events estimated to occur within next 5 years.		
Greatest Occurrence:	$60,000 in property damage from one event		
Extent:	Up to 70 mph winds.		
Vulnerability		**Impact**	
472 structures are at risk of damage by severe thunderstorms. Critical faciltities at risk: 1 EMS station, 2 police stations, 1 school, and 2 shelters.		$2,857 in annual losses to direct property damage and repairs. A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.	

Pine Island			
Planning Area (sq. mi):	9.3	**Occurrences since 1996:**	9
Area Affected:	100%	**Annual Event Average:**	0.42
Probability of Occurring in the next 5 years:	Very likely; 2.1 events estimated to occur within next 5 years.		
Greatest Occurrence:	56 mph wind speeds		
Extent:	Up to 70 mph winds.		
Vulnerability		**Impact**	
484 structures are at risk of damage by severe thunderstorms. Critical faciltities at risk: 1 shelter and 1 school		Expensive repairs of damaged structures, and interruption of regular community services. A disruption in shelter services and educational activities while repairs are made to critical facilities.	

Prairie View			
Planning Area (sq. mi):	7.2	**Occurrences since 1996:**	4
Area Affected:	100%	**Annual Event Average:**	0.19
Probability of Occurring in the next 5 years:	Very likely; 1 events estimated to occur within next 5 years.		
Greatest Occurrence:	$5,000 in property damage from one event 56 mph wind speeds		
Extent:	Up to 70 mph winds.		
Vulnerability		**Impact**	
5,576 structures are at risk of damage by severe thunderstorms. Critical faciltities at risk: 2 fire stations, 3 police stations, 2 schools/unversities, and 1 electric substation.		$952 in annual losses to direct property damage and repairs. A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.	

Waller			
Planning Area (sq. mi):	2.07	**Occurrences since 1996:**	4
Area Affected:	100%	**Annual Event Average:**	0.19
Probability of Occurring in the next 5 years:	Very likely; 1 events estimated to occur within next 5 years.		
Greatest Occurrence:	$3,000 in property damage from one event 69 mph wind speeds		
Extent:	Up to 70 mph winds.		

Vulnerability	Impact
2,326 structures are at risk of damage by severe thunderstorms. Critical faciltities at risk: 1 EMS station, 1 fire station, 2 schools, 3 police stations, and 2 shelters.	$143 in annual losses to direct property damage and repairs. A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.

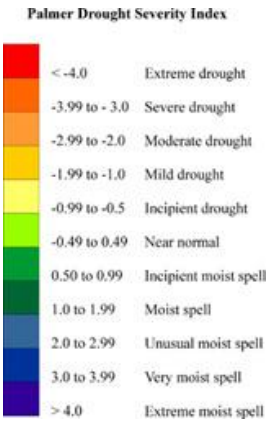
Part 6.4 Drought

6.5 Drought

The Palmers Hydrological Drought Severity Index (PHDI) is the typical way extent of drought is observed throughout the United States. This regional index considers dry and wet spells over an extended period of time to calculate the range in the Index. The greater the number the more extreme the drought in a specific area.

Drought has particularly adverse effects on agriculture which is major industry in Waller County. The most extreme conditions occurred in 2011. The county's PHDI rating was < -4.0 (Extreme Drought) from March 2011 through January 2012. There were periods of severe drought preceding and following this period from August 2010 through October 2014. The agricultural loses are estimated at $5.2 billion, though specific numbers by county are not available for this event.

Palmers Drought Severity Index	
< -4.0	Extreme Drought
-3.99 to -3.0	Severe Drought
-2.99 to -2.0	Moderate Drought
-1.99 to -1.0	Mild Drought
-0.99 to -0.5	Incipient Drought
-0.49 to 0.49	Near Normal
0.5 to 0.99	Incipient Moist Spell
1.0 to 1.99	Moist Spell
2.0 to 2.99	Unusual Moist Spell
3.0 to 3.99	Very Moist Spell
> 4.0	Extreme Moist Spell
Source: https://www.ncdc.noaa.gov/	



Historic Occurrence

In Waller County's recent history, there have been three notable droughts. Two of the droughts are known to have caused agricultural and financial losses that impacted Waller County. This information is listed below at the county level. The USDA estimates that there were agricultural losses totaling $7.6 billion across the state due to the 2010-2014 drought. For the 2011 – 2014 drought, there is no county-level data available. Members of the community did report economic losses due to the drought, but comprehensive data for the county is not available. The market values of agricultural products sold in 2012 was $91,677,000; of that 77% was crop sales and 23% is livestock sales. Cattle, rice, nursery crops, aquaculture, corn, hogs, poultry, hay, and watermelons are the chief agricultural products of Waller County.

Date	Description	Property Damage (2015 Dollars)	Crop Damage (2015 Dollars)
1996	Extreme Drought 4/1/1996 – 6/1/1996		
1998 - 2000	Declared Agricultural disaster by USDA	$1,000,000	$7,300,000
2010 - 2014	Declared Agricultural disaster by USDA	Information not available	Information not available

Source: https://www.ncdc.noaa.gov/

Hazard Analysis & Vulnerability Identification

The hazard analysis uses historic hazard event data to determine the probability of an event occurring again within the next five years. The analysis calculates the average number of events in each jurisdiction annually and then multiplies by five.

The hazard analysis also provides hazard extent data for each participating jurisdiction. The greatest historic occurrence data is the most extreme data recorded during a storm or hazard event and represents the worst damage a jurisdiction has experienced in recent history. The extent is the worst the jurisdiction could possibly experience. Information from stakeholders and NOAA are the sources of data for the analysis.

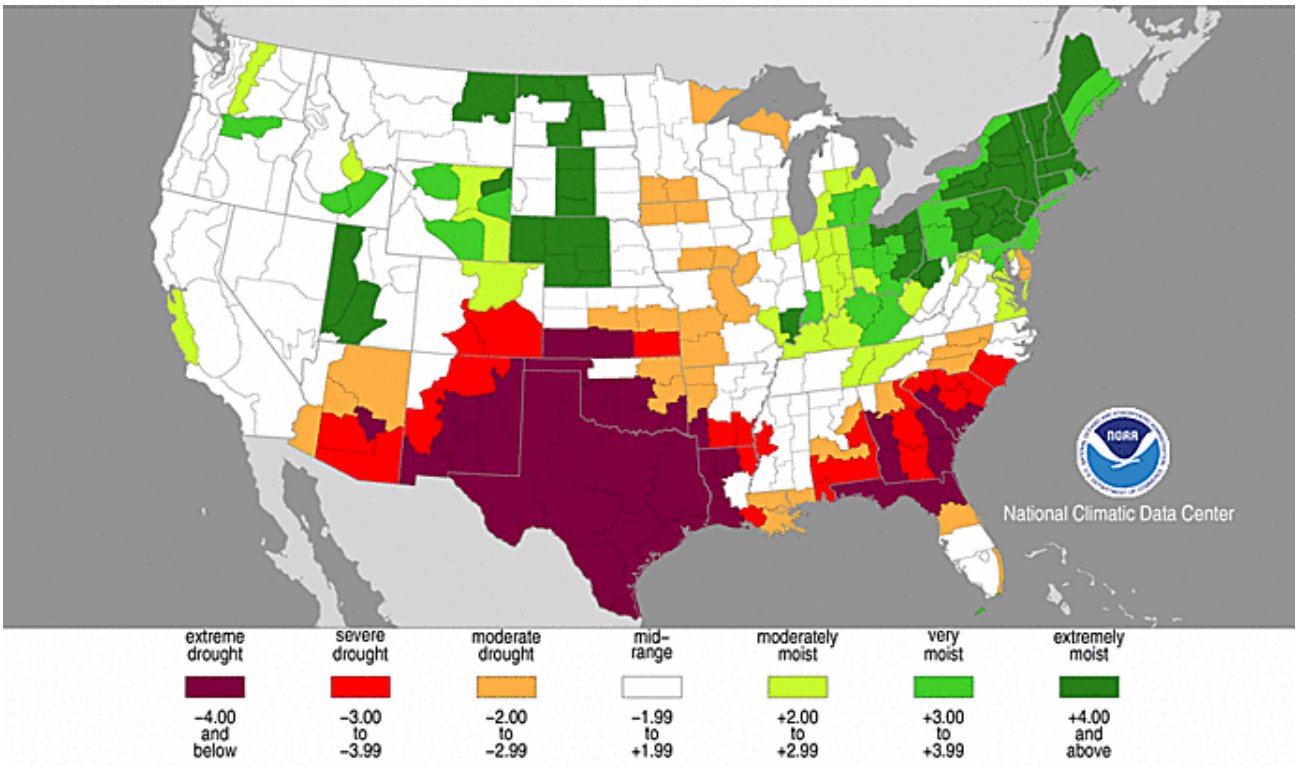
To identify vulnerabilities for each jurisdiction, this plan used the following methods:

- Analysis reported by the USDA and NCDC; and
- Stakeholder identified vulnerabilities.

Droughts often last multiple years and have an economic impact that last longer than the droughts themselves. Waller County's agricultural industry has been determined the most vulnerable asset to drought. Waller County has 331,520 acres in agricultural production. According to the United States Department of Agriculture (USDA) Census of Agriculture, the market value of agricultural production in the county is $91,677,000 annually; with 77% of revenues from crops, and 23% of revenue from livestock production.

Drought: Countywide

Palmers Drought Severity Index: October 2011



Map source: https://www.ncdc.noaa.gov/

All Participating Jurisdictions: Unincorporated Waller County, Brookshire, Hempstead, Pattison, Pine Island, Prairie View, and Waller			
Planning Area:	All Participating Jurisdictions: 331,520 acres	**Area Affected:**	100% - Entire planning area
Greatest historic occurrence:	1 year of extreme drought conditions; < -4.0 PHDI rating	**Occurrence:**	9 events in 27 years
		Event Average:	0.3 events per year
Extent:	2 years of extreme drought conditions; < -4.0 PHDI rating	**Probability:**	Very likely; 1.7 events estimated to occur within next 5 years.

Vulnerability	Impact
Livestock and Agricultural production; 331,520 acres of agricultural land.	An accumulative loss of an estimated $8.3 million in agricultural economic production in one year (catastrophic drought event).

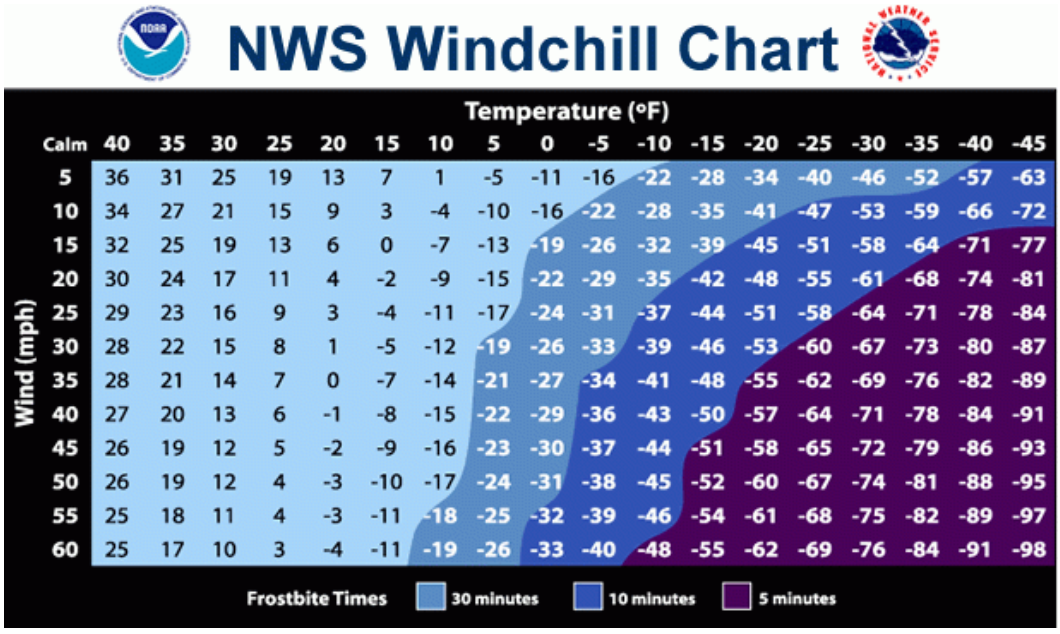
Part 6.5 Winter Weather

6.5 Winter Weather

The two main charts used to measure the magnitude of winter storms is the Sperry-Piltz Iace Accumulation (SPIA) Index Parameters and the National Weather Service's Windchill Chart. The SPIA chart measures the extent of ice in a region considering wind speed and the depth of ice on surfaces. The NWS Windchill Chart considers wind speed and temperatures to determine the amount of time frostbite may occur.

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

Source: http://www.spia-index.com/



Source: http://www.nws.noaa.gov/om/cold/wind_chill.shtml

The national weather service and NOAA also have a variety of watches and warnings for freeze, frost, wind, and ice events; these have been organized in a chart below.

Watch/ Warning/ Advisory	Description
Winter Storm Watch	Issued when there is the potential for significant and hazardous winter weather within 48 hours. It is possible hazardous weather may occur. Significant and hazardous winter weather is defined as: 5 inches or more of snow/sleet within a 12-hour period or 7 inches or more of snow/sleet within a 24-hour period. And/ or enough ice accumulation to cause damage to trees or powerlines and/or a life threatening or damaging combination of snow and/or ice accumulation with wind.
Winter Storm Warning	Issued when a significant combination of hazardous winter weather is occurring or imminent. Significant and hazardous winter weather is defined as above.
Ice Storm Warning	¼ inch or more of ice accumulation.
Winter Weather Advisory	Issued for any amount of freezing rain, or when 2 to 4 inches of snow (alone or in combination with sleet and freezing rain) is expected to cause a significant inconvenience, but not serious enough to warrant a warning.
Freeze Watch	Issued when there is a potential for significant, widespread freezing temperatures within the next 24-36 hours.
Freeze Warning	Issued when significant, widespread freezing temperatures are expected.
Frost Advisory	Issued when the minimum temperature is forecast to be 33 to 36 degrees on clear and calm nights during the growing season.
Wind Chill Advisory	Issued when wind chills of -5F to -19F are expected east of the Blue Ridge Mountains and when wind chills of -10 to -24F are expected along and west of the Blue Ridge Mountains and in Frederick and Carroll Counties in Maryland.
Wind Chill Warning	Issued when wind chills of -20F or lower are expected east of the Blue Ridge Mountains, and when wind chills of -25F or lower are expected along and west of the Blue Ridge Mountains and in Frederick and Carroll Counties in Maryland.

Source: www.weather.gov/lwx/WarningsDefined#Winter Storm Watch

Historic Occurrences

Date	Description	Death/Injury	Property Damage (2015 Dollars)	Crop Damage (2015 Dollars)
1/12/1997	Ice Storm	0	$0	$0
1/16/2007	Ice Storm	0	$2,000	$0
2/3/2011	Ice Storm	0	$0	$0
1/28/2014	Winter Storm	0	$0	$0
3/3/2014	Winter Storm	0	$0	$0
12/7/2017	Winter Storm	0	$0	$0
1/16/2018	Winter Storm	0	$0	$0

Source: https://www.ncdc.noaa.gov/stormevents/

Hazard Analysis & Vulnerability Identification

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To identify vulnerabilities for each jurisdiction, this plan used the following methods:

- GIS analysis of vulnerable populations;
- Stakeholder identified vulnerabilities

According to the CDC, adults over 65 years of age and children are the most vulnerable populations to winter weather related illnesses. The data available on these populations suggests that approximately 18.5% of the population in Waller County is vulnerable to winter weather.

Waller County experiences significant financial annual losses to winter weather. Most of these losses are attributed ice storms that cause dangerous driving conditions, falling trees, and power outages in homes. The most notable vulnerabilities throughout the county are the dangerous driving conditions and power outages.

Waller County (All Participating Jurisdictions)

Identified Vulnerabilities:

Icy roads are a main vulnerability throughout the planning area; icy road conditions create dangerous roadways that make people unable to drive to work school etc. at most a few days a year during the winter. Additionally, according to the CDC, adults over 65 years of age and children are the most vulnerable populations to winter weather related illnesses.

Identified Impacts:

- Power outages caused by frozen limbs that fall and damage powerlines has a far-reaching impact on the jurisdictions participating in this plan. It can cause loss of life, loss of wages for closed businesses, and can cause students to miss school.
- Frozen falling limbs can also cause harm to individuals and costly damage to homes, vehicles, and other property.
- Icy roadways may lead to accidents with severe injury or loss of life and monetary loss for residents
- Extreme and/or prolonged freezing temperatures can cause damage to levee and dam pumps throughout the county. This may result in expensive financial repairs.

Unincorporated Waller County			
Planning Area (sq. mi):	487.7	**Occurrences since 1996:**	7
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0.33
Probability of Occurring in the next 5 years:	Very likely; 1.7 events estimated to occur within next 5 years.		
Greatest Occurrence:	$2,000 in property damage from one event, and regional power outages.		
Extent:	Up to $100,000 in property damage from one event, and countywide power outages.		

Vulnerability	Impact
Power outages and icy roads put vulnerable populations at greater risk during winter weather events. 7,993 residents are considered vulnerable to winter weather.	Potential loss of life due to freezing weather, dangerous roadways, and power outages.
Critical faciltities at risk: 1 correctional facility, 4 EMS stations, 1 fire stations, 2 local emergency operations centers, 6 police stations, and 1 shelter.	A disruption in emergency response services, shelters, and loss of secure inmate housing while repairs are made to critical facilities.

Brookshire			
Planning Area (sq. mi):	3.5	**Occurrences since 1996:**	7
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0.33
Probability of Occurring in the next 5 years:	Very likely; 1.7 events estimated to occur within next 5 years.		
Greatest Occurrence:	1/10" of sleet and ice accumulation on roads and highways.		
Extent:	Up to 1" of sleet and ice accumulation on roads and highways.		

Vulnerability	Impact
870 residents are considered vulnerable to winter weather	Potential loss of life due to freezing weather, dangerous roadways, and power outages.
Critical faciltities at risk: 1 correctional facility, 1 EMS station, 2 fire stations, 6 schools, 2 local emergency operations centers, 2 police stations, and 4 shelters.	A disruption in emergency response services, school services, and loss of secure inmate housing while repairs are made to critical facilities.

Hempstead			
Planning Area (sq. mi):	5.0	**Occurrences since 1996:**	7
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0.33
Probability of Occurring in the next 5 years:	Very likely; 1.7 events estimated to occur within next 5 years.		
Greatest Occurrence:	1" of sleet and ice accumulation on roads and highways.		
Extent:	Up to 2" of sleet and ice accumulation on roads over a several days.		

Vulnerability	Impact
465 residents are considered vulnerable to winter weather. Power outages and icy roads put vulnerable populations at greater risk during winter weather events.	Potential loss of life due to freezing weather, dangerous roadways, and power outages.
Critical faciltities at risk: 1 EMS station, 1 fire station, 3 schools, 1 local emergency operations center, 3 police stations, and 1 shelters.	A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.

Pattison			
Planning Area (sq. mi):	3.2	**Occurrences since 1996:**	7
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0.33
Probability of Occurring in the next 5 years:	Very likely; 1.7 events estimated to occur within next 5 years.		
Greatest Occurrence:	1/10" of sleet and ice accumulation on roads and highways.		
Extent:	Up to 1" of sleet and ice accumulation on roads and highways.		

Vulnerability	Impact
Power outages and icy roads put vulnerable populations at greater risk during winter weather events. 44 residents are considered vulnerable to winter weather	Icy conditions on roadways resulted in numerous accidents; Potential loss of life.
Critical faciltities at risk: 1 EMS station, 2 police stations, 1 school, and 2 shelters.	A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.

Pine Island			
Planning Area (sq. mi):	9.3	**Occurrences since 1996:**	7
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0.33
Probability of Occurring in the next 5 years:	Very likely; 1.7 events estimated to occur within next 5 years.		
Greatest Occurrence:	1" of sleet and ice accumulation on roads and highways.		
Extent:	Up to 2" of sleet and ice accumulation on roads over a several days.		

Vulnerability	Impact
Trees, powerlines and roadways were all effected. The weight of the ice caused trees and powerlines to snap/fall. Power outages and icy roads put vulnerable populations at greater risk during winter weather events. 183 residents are considered vulnerable to winter weather.	Potential loss of life.
Icy conditions on roadways resulted in numerous accidents.	Glazed roadways posed hazardous driving conditions.
Critical faciltities at risk: 1 shelter and 1 school	A disruption in shelter services and educational activities while repairs are made to critical facilities.

Prairie View			
Planning Area (sq. mi):	7.2	**Occurrences since 1996:**	7
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0.33
Probability of Occurring in the next 5 years:	Very likely; 1.7 events estimated to occur within next 5 years.		
Greatest Occurrence:	1" of sleet and ice accumulation on roads and highways.		
Extent:	Up to 2" of sleet and ice accumulation on roads over a several days.		

Vulnerability	Impact
137 residents are considered vulnerable to winter weather	Potential loss of life.
Critical faciltities at risk: 2 fire stations, 3 police stations, 2 schools/unversities, and 1 electric substation.	A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.

Waller			
Planning Area (sq. mi):	2.07	**Occurrences since 1996:**	7
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0.33
Probability of Occurring in the next 5 years:	Very likely; 1.7 events estimated to occur within next 5 years.		
Greatest Occurrence:	1" of sleet and ice accumulation on roads and highways.		
Extent:	Up to 2" of sleet and ice accumulation on roads over a several days.		

Vulnerability	Impact
Icy conditions on roadways resulted in numerous accidents.	Icy roads create difficult and dangerous conditions for emergency responders.
178 residents are considered vulnerable to winter weather	Potential loss of life.
Critical faciltities at risk: 1 EMS station, 1 fire station, 2 schools, 3 police stations, and 2 shelters.	A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.

Part 6.6 Tornado

6.6 Tornado

Before 2007, tornadoes were ranked through the Fujita Scale. The Enhanced Fujita Scale replaced the Fujita Scale in 2007 and is a set of wind estimates (not measurements) based on damage. The higher the number the more intense the tornado. Both the Fujita Scale and the Enhanced Fujita Scale are below.

Fujita Scale			Enhanced Fujita Scale		
Scale	**Fastest 1/4 mile (mph)**	**3 second gust (mph)**	**EF Number**	**3 Second Gust (mph)**	**Typical Damage**
F0	40-72	45-78	0	65-85	Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
F1	73-112	79-117	1	86-109	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
F2	113-157	118-161	2	110-137	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-207	162-209	3	138-167	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.
F4	208-260	210-261	4	168-199	Devastating damage. Whole frame houses Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
F5	261-318	262-317	5	200-234	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 109 yards; high-rise buildings have significant structural deformation; incredible phenomena will occur.

Source: http://www.spc.noaa.gov/

Historic Occurrence

Waller County has reported three tornados in the last 20 years.

Date	Rating	Location	Property Damage (2015 Dollars)	Crop Damage (2015 Dollars)	Deaths
10/18/1998	F2	Brookshire	$2,500	$0	0
05/21/2017	EF0	Brookshire	$250,000	$0	0
08/26/2017	EF1	Unincorporated Waller County	$250,000	$0	1

Hazard Analysis & Vulnerability Identification

The hazard analysis uses historic hazard event data to determine the probability of an event occurring again within the next five years. The analysis calculates the average number of events in each jurisdiction annually and multiplies by five.

The hazard analysis also provides hazard extent data for each participating jurisdiction. The greatest historic occurrence data is the most extreme data recorded during a storm or hazard event and represents the worst damage a jurisdiction has experienced in recent history. The extent is the worst the jurisdiction could possibly experience. Information from stakeholders and NOAA are the sources of data for the analysis.

To identify vulnerabilities for each jurisdiction, this plan used the following methods:

- GIS analysis of structures exposed to tornado damage; and
- Stakeholder identified vulnerabilities.

Waller County (All participating jurisdictions)

Identified Vulnerabilities:

Similar to the hurricane and severe thunderstorm section, this section identifies vulnerabilities from high winds. High winds can tear down powerlines, trees, barns, fences, and multitude of other debris can be blown into roadways and homes during the event.

Additionally, residences and commercial buildings could be damaged or destroyed due to wind events; older residential neighborhoods and structures without a permanent foundation were identified as one of the main vulnerabilities throughout the county. While current building codes address the vulnerability of wind damage to structures, older buildings (particularly residential buildings) were built when less stringent building codes were in place; therefore, older residential building and residences without a permanent foundation are a focus in this section.

- Public and residential structures throughout the county
- Vulnerable populations throughout the county (Identified in Part 3)

Identified Impacts:

- Downed powerlines could impact communication and daily active leading to a finical loss for the county, cities and individuals, and could impede first responders from reaching those in need or residents evacuating
- Strong winds could prevent first responders from traveling to assist individuals, because of unsafe driving conditions such as debris hitting emergency vehicles
- Critical facilities could sustain wind damage, potentially delaying first responders reaching those in need and city services during and after the event
- Economic and financial loss for cities and individuals including property loss

Unincorporated Waller County			
Planning Area (sq. mi):	487.7	**Occurrences since 1996:**	3
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0.14
Probability of Occurring in the next 5 years:	Likely; 70% chance event will occur within next 5 years.		
Greatest Occurrence:	EF1 tornado; Tornado appeared to touch down at an RV and boat storage facility then cross Interstate 10. It then damaged Pepperl Fuchs facility on north side of Interstate 10. $200,000 in property damage occurred.		
Extent:	Up to an F5 tornado		

Vulnerability	Impact
14,520 structures and 331,520 acres in agricultural production are at risk of damage by a tornado. Critical faciltities at risk: 1 correctional facility, 4 EMS stations, 1 fire stations, 2 local emergency operations centers, 6 police stations, and 1 shelter.	$9,524 in annual losses to direct property damage and repairs, and potential loss of life. A disruption in emergency response services, shelters, and loss of secure inmate housing while repairs are made to critical facilities.

Brookshire			
Planning Area (sq. mi):	3.5	**Occurrences since 1996:**	2
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	9.52
Probability of Occurring in the next 5 years:	Likely; 50% chance event will occur within next 5 years.		
Greatest Occurrence:	F2 tornado; Tornado destroyed mobile home. One person killed and another injured in the home. Nine other homes damaged and 2 barns destroyed. There was $75,000 in property damages.		
Extent:	Up to an F5 tornado		

Vulnerability	Impact
1,722 structures are at risk of damage by tornados. Critical faciltities at risk: 1 correctional facility, 1 EMS station, 2 fire stations, 6 schools, 2 local emergency operations centers, 2 police stations, and 4 shelters.	$3,810 in annual losses to direct property damage and repairs, and potential loss of life. A disruption in emergency response services, school services, and loss of secure inmate housing while repairs are made to critical facilities.

Hempstead			
Planning Area (sq. mi):	5.0	**Occurrences since 1996:**	0
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0
Probability of Occurring in the next 5 years:	Not Likely, Less than 10% chance event will occur within the next 5 years		
Greatest Occurrence:	N/A; Nearby jurisdictions have experienced tornados and Hempstead can assume they are at risk.		
Extent:	Up to an F5 tornado		

Vulnerability	Impact
5,770 structures are at risk of damage by tornado. Critical faciltities at risk: 1 EMS station, 1 fire station, 3 schools, 1 local emergency operations center, 3 police stations, and 1 shelters.	Costly repairs, interruption of city services, and potential loss of life. A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.

Pattison			
Planning Area (sq. mi):	3.2	**Occurrences since 1996:**	0
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0
Probability of Occurring in the next 5 years:	Not Likely, Less than 10% chance event will occur within the next 5 years.		
Greatest Occurrence:	N/A; Neighboring jurisdiction, Brookshire, has experienced tornados and Pattison should mitigate and plan for a tornado to occur.		
Extent:	Up to an F5 tornado		

Vulnerability	Impact
472 structures are at risk of damage by tornado. Critical faciltities at risk: 1 EMS station, 2 police stations, 1 school, and 2 shelters.	Costly repairs, interruption of city services, and potential loss of life. A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.

Pine Island

Planning Area (sq. mi):	9.3	**Occurrences since 1996:**	0
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0
Probability of Occurring in the next 5 years:	Not Likely, Less than 10% chance event will occur within the next 5 years		
Greatest Occurrence:	N/A; Nearby jurisdictions have experienced tornados and Pine Island can assume they are at risk.		
Extent:	Up to an F5 tornado		

Vulnerability	Impact
484 structures are at risk of damage by tornado.	Costly repairs, interruption of city services, and potential loss of life.
Critical faciltities at risk: 1 shelter and 1 school	A disruption in shelter services and educational activities while repairs are made to critical facilities.

Prairie View			
Planning Area (sq. mi):	7.2	**Occurrences since 1996:**	0
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0
Probability of Occurring in the next 5 years:	Not Likely, Less than 10% chance event will occur within the next 5 years		
Greatest Occurrence:	N/A; Nearby jurisdictions have experienced tornados and Prairie View can assume they are at risk.		
Extent:	Up to an F5 tornado		

Vulnerability	Impact
5,576 structures are at risk of damage by tornado.	Costly repairs, interruption of city services, and potential loss of life.
Critical faciltities at risk: 2 fire stations, 3 police stations, 2 schools/unversities, and 1 electric substation.	A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.

Waller			
Planning Area (sq. mi):	2.07	**Occurrences since 1996:**	0
Area Affected:	100%, Entire Planning Area	**Annual Event Average:**	0
Probability of Occurring in the next 5 years:	Not Likely, Less than 10% chance event will occur within the next 5 years		
Greatest Occurrence:	N/A; Nearby jurisdictions have experienced tornados and Waller can assume they are at risk.		
Extent:	Up to an F5 tornado		

Vulnerability	Impact
2,326 structures are at risk of damage by tornado. Critical faciltities at risk: 1 EMS station, 1 fire station, 2 schools, 3 police stations, and 2 shelters.	Costly repairs, interruption of city services, and potential loss of life. A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.

Part 6.7 Hail

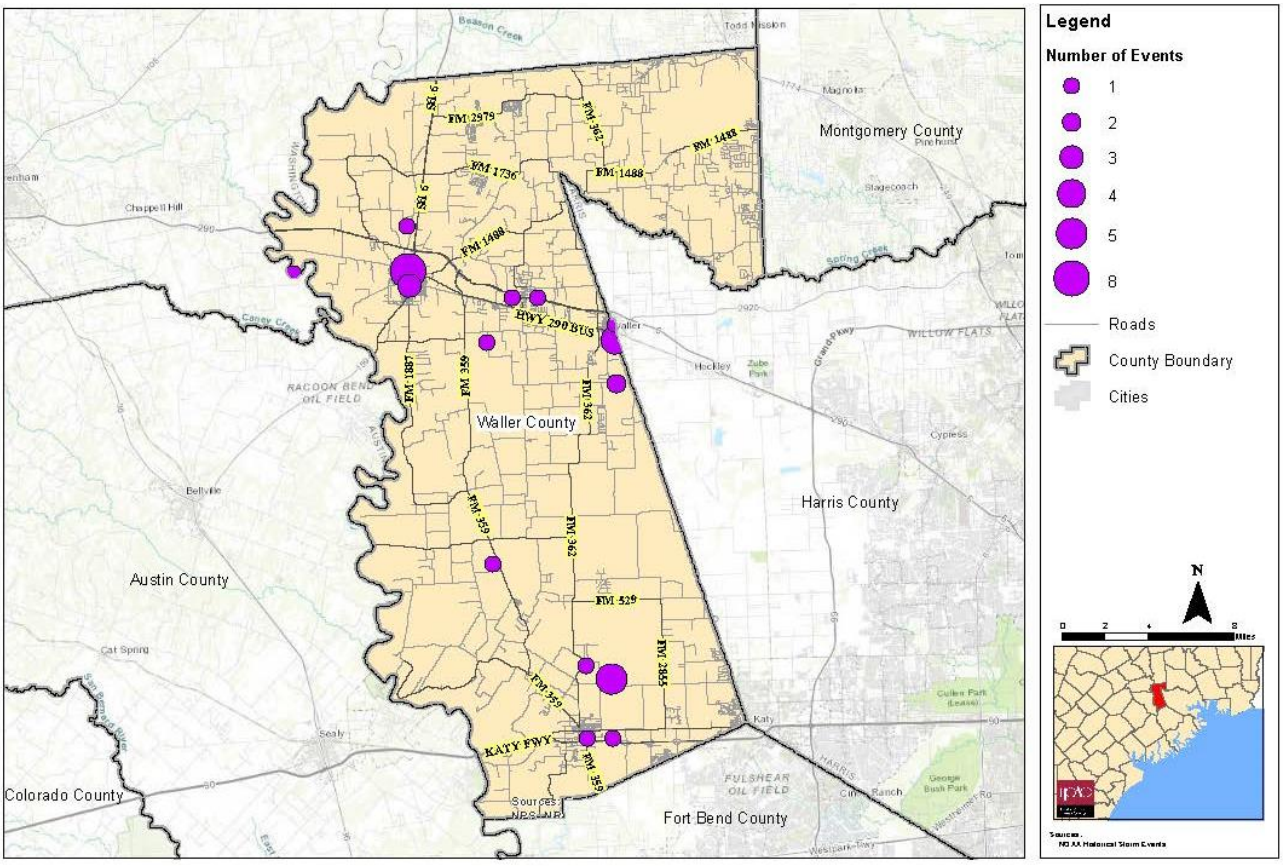
6.7 Hail

NOAA's National Centers for Environmental Information (NCEI) intensity scale for hail is the typical way to measure the extent for hail storms. This scale considers the size of an individual piece of hail. A hail storm is considered severe if hail reaches one inch in diameter or roughly the size of a quarter.

Size	Hail Diameter (Inches)	Description
H0	1/4	Pea Size
H1	1/2	Small Marble Size
H2	¾	Penny or Large Marble Size
H3	7/8	Nickel Size
H4	1	Quarter Size
H5	1 ¼	Half Dollar Size
H6	1 ½	Walnut or Ping Pong Ball Size
H7	1 ¾	Golfball Size
H8	2	Hen Egg Size
H9	2 ½	Tennis Ball Size
H10	2 ¾	Baseball Size
H11	3	Teacup Size
H12	4	Grapefruit Size
H13	4 ½	Softball Size

Source: https://www.ncei.noaa.gov/

Location of Hail Events



Historic Occurrences

Since 1996, Waller County experienced 33 hail events and 19 were considered severe (quarter sized and above). Golf ball sized hail or size H10 is the largest size hail the County experienced.

Event Date	Jurisdiction	Size	Total Damage (2015 Dollars)
4/5/1996	Pattison	1.75	$ 10,000
4/25/1997	Waller	1.75	$ 10,000
4/25/1997	Waller	3	$ 15,000
4/25/1997	Waller	1.75	$ 7,000
5/28/1997	Brookshire	0.75	$ 5,000
10/25/1997	Waller	0.75	$ 5,000
10/25/1997	Prairie View	0.75	$ 5,000
2/16/1998	Brookshire	1.75	$ 15,000
6/5/1998	Hempstead	2	$ 15,000
6/5/1998	Waller	1.5	$ 5,000
2/27/1999	Hempstead	0.88	$ 4,000
5/12/1999	Hempstead	1.75	$ 40,000
3/10/2000	Hempstead	1	$ 15,000
4/2/2000	Pattison	0.75	$ 10,000
5/2/2000	Hempstead	0.75	$ 10,000
5/4/2000	Hempstead	1.75	$ 25,000
11/12/2000	Hempstead	0.75	$ 10,000
3/14/2001	Hempstead	0.75	$ 5,000
4/16/2001	Brookshire	0.88	$ 20,000
3/30/2002	Brookshire	0.75	$ 5,000
2/25/2003	Pattison	0.75	$ 5,000
3/13/2003	Brookshire	0.75	$ 5,000
4/22/2003	Hempstead	2	$ 15,000
6/4/2004	Brookshire	1	$ 15,000
2/23/2005	Pattison	1.75	$ 15,000
2/23/2005	Pattison	2.75	$ 30,000
6/14/2005	Prairie View	0.75	$ 3,000
10/31/2005	Pattison	1	$ 10,000
3/14/2007	Hempstead	0.88	$ 3,000
3/20/2013	Brookshire	1.75	$ 8,000
4/19/2015	Hempstead	1	$ -
4/19/2015	Hempstead	1.75	$ 2,000
4/19/2015	Waller	2	$ 7,000

Source: https://www.ncdc.noaa.gov/stormevents/

Hazard Analysis & Vulnerability Identification

The hazard analysis uses historic hazard event data to determine the probability of an event occurring again within the next five years. The analysis calculates the average number of events in each jurisdiction annually and then multiplies by five.

The hazard analysis also provides hazard extent data for each participating jurisdiction. The greatest historic occurrence data is the most extreme data recorded during a storm or hazard event and represents the worst damage a jurisdiction has experienced in recent history. The extent is the worst the jurisdiction could possibly experience. Information from stakeholders and NOAA are the sources of data for the analysis.

To identify vulnerabilities for each jurisdiction, this plan used the following methods:

- NOAA historic event data; and
- Stakeholder identified vulnerabilities.

Waller County (All participating jurisdictions)

Identified Vulnerabilities:

- Critical facilities including emergency response vehicles (fire trucks, ambulances etc.) throughout the county:
    - Uncovered parking lots may lead to damaged vehicles
    - Facility's generators located outside may be damaged.
    - Damage to critical facilities, including roof damage or window damage, may occur as well.

- Identified vulnerable populations throughout the county, identified in the county profile, may be more vulnerable financially if they sustain damage to a personal vehicle, property

Identified Impacts:

- Strong winds or hail could prevent first responders from traveling to assist individuals, because of unsafe driving conditions such as debris hitting emergency vehicles
- Critical facilities could sustain hail damage- windows of response vehicles broken, potentially delaying first responders reaching those in need and city services during and after the event
- Financial loss for individuals whose vehicles or homes are damaged by hail-including cost to repair hail damage and potential financial loss from potential loss of a job because of the lack of transportation to and from their job
- Financial loss for jurisdictions that need to replace damaged buildings or infrastructure, including damaged roofs or equipment

Unincorporated Waller County			
Planning Area (sq. mi):	487.7	**Occurrences since 1996:**	33
Area Affected:	100%	**Annual Event Average:**	1.6
Probability of Occurring in the next 5 years:	Very likely; 1.6 events estimated to occur within next 5 years.		
Greatest Occurrence:	H10 size hail stones (2.75 inch)		
Extent:	Up to H13 size hail stones (4.5 inch)		
Vulnerability		**Impact**	
14,520 structures and 331,520 acres in agricultural production are at risk of damage by a major hail event.		Costly repairs to structures, interruption of city services, damage to vehicles, and potential loss of life.	
Critical faciltities at risk: 1 correctional facility, 4 EMS stations, 1 fire stations, 2 local emergency operations centers, 6 police stations, and 1 shelter.		A disruption in emergency response services, shelters, and loss of secure inmate housing while repairs are made to critical facilities.	

Brookshire			
Planning Area (sq. mi):	3.5	**Occurrences since 1996:**	12
Area Affected:	100%	**Annual Event Average:**	0.6
Probability of Occurring in the next 5 years:	Very likely; 2.9 events estimated to occur within next 5 years.		
Greatest Occurrence:	H7 size hail stones (1.75 inch) $20,000 in damage from single hail event		
Extent:	Up to H13 size hail stones (4.5 inch)		
Vulnerability		**Impact**	
1,722 structures are at risk of damage by a major hail event.		$3,476 in annual losses to direct property damage and repairs, and potential loss of life.	
Critical faciltities at risk: 1 correctional facility, 1 EMS station, 2 fire stations, 6 schools, 2 local emergency operations centers, 2 police stations, and 4 shelters.		A disruption in emergency response services, school services, and loss of secure inmate housing while repairs are made to critical facilities.	

Hempstead			
Planning Area (sq. mi):	5.0	**Occurrences since 1996:**	7
Area Affected:	100%	**Annual Event Average:**	0.33
Probability of Occurring in the next 5 years:	Very likely; 1.7 events estimated to occur within next 5 years.		
Greatest Occurrence:	H7 size hail stones (1.75 inch) $40,000 in damage from single hail event		
Extent:	Up to H13 size hail stones (4.5 inch)		
Vulnerability		**Impact**	
5,770 structures are at risk of damage by a major hail event.		$6,857 in annual losses to direct property damage and repairs, and potential loss of life.	
Critical faciltities at risk: 1 EMS station, 1 fire station, 3 schools, 1 local emergency operations center, 3 police stations, and 1 shelters.		A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.	

Pattison			
Planning Area (sq. mi):	3.2	**Occurrences since 1996:**	5
Area Affected:	100%	**Annual Event Average:**	0.2
Probability of Occurring in the next 5 years:	Very likely; 1.2 events estimated to occur within next 5 years.		
Greatest Occurrence:	H10 size hail stones (2.75 inch) $30,000 in damage from single hail event		
Extent:	Up to H13 size hail stones (4.5 inch)		
Vulnerability		**Impact**	
472 structures are at risk of damage by a major hail event.		$3,810 in annual losses to direct property damage and repairs, and potential loss of life.	
Critical faciltities at risk: 1 EMS station, 2 police stations, 1 school, and 2 shelters.		A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.	

Pine Island			
Planning Area (sq. mi):	9.3	**Occurrences since 1996:**	2
Area Affected:	100%	**Annual Event Average:**	0.1
Probability of Occurring in the next 5 years:	Likely; 50% chance event will occur within next 5 years.		
Greatest Occurrence:	H2 size hail stones (0.75 inch)		
Extent:	Up to H13 size hail stones (4.5 inch)		
Vulnerability		**Impact**	
484 structures are at risk of damage bya major hail event.		Costly repairs, interruption of city services, and potential loss of life.	
Critical faciltities at risk: 1 shelter and 1 school		A disruption in shelter services and educational activities while repairs are made to critical facilities.	

Prairie View			
Planning Area (sq. mi):	7.2	**Occurrences since 1996:**	2
Area Affected:	100%	**Annual Event Average:**	0.1
Probability of Occurring in the next 5 years:	Likely; 50% chance event will occur within next 5 years.		
Greatest Occurrence:	H2 size hail stones (0.75 inch) $5,000 in damage from single hail event		
Extent:	Up to H13 size hail stones (4.5 inch)		
Vulnerability		**Impact**	
5,576 structures are at risk of damage by a major hail event.		Costly repairs, interruption of city services, and potential loss of life.	
Critical faciltities at risk: 2 fire stations, 3 police stations, 2 schools/unversities, and 1 electric substation.		A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.	

Waller			
Planning Area (sq. mi):	2.07	**Occurrences since 1996:**	6
Area Affected:	100%	**Annual Event Average:**	0.3
Probability of Occurring in the next 5 years:	Very likely; 1.4 events estimated to occur within next 5 years.		
Greatest Occurrence:	H7 size hail stones (1.75 inch) $15,000 in damage from single hail event		
Extent:	Up to H13 size hail stones (4.5 inch)		
Vulnerability		**Impact**	
2,326 structures are at risk of damage by a major hail event.		$2,333 in annual losses to direct property damage and repairs, and potential loss of life.	
Critical faciltities at risk: 1 EMS station, 1 fire station, 2 schools, 3 police stations, and 2 shelters.		A disruption in emergency response services, shelters, and educational services while repairs are made to critical facilities.	

Part 7: Mitigation Strategy

Part 7: MITIGATION STRATEGY

The planning process, hazard analysis, and vulnerability assessment serve as a foundation for a meaningful hazard mitigation strategy. The mitigation strategy provides an outline for how the county and the local jurisdictions aim to address and reduce the risks associated with the natural hazards identified in the HMAP and reduce the potential impact on residents and structures identified through the Vulnerability Analysis. The mitigation strategy is divided into three sections the mission statement, goals and objectives, and the mitigation action plan. The mission statement provides the overall purpose of the mitigation strategy and the HMAP. The goals and objectives provide milestones for how the county aims to meet this purpose. The mitigation action plan details specific mitigation actions, or projects, programs, and polices the county aims to meet these goals and objectives.

Mission Statement

The HMAP aims to implement new policies, programs, and projects to reduce the risks and impacts associated with natural hazards, including public education and partnerships between local officials and residents.

Goal
Improve existing local plans, codes, and regulations to reduce the impacts of natural hazards

> ***Objective***
> Hold workshops and educational events throughout the county to provide an opportunity for local and regional partners to collaborate on local and regional planning initiatives

Goal
Reduce the loss of life and property in the 25, 50, and 100-year floodplain

> ***Objective***
> Update and create county programs, and local ordinances to eliminate or retrofit repetitive loss properties throughout the county

> ***Objective***
> Through collaborative efforts with county partners and cities, develop incentives to encourage flood mitigation and design throughout the county

> ***Objective***
> Move county roads away from the Brazos river, enlarge culverts and install flood gauges and signs throughout identified areas of the county

Goal
Improve communication systems and local communications among departments and residents throughout the county

> ***Objective:*** Improve and increase use of social media platforms in order to educate residents about the impacts of natural hazards

Mitigation Action Plan

The mitigation action plan explains the specific programs, policies, and projects that the county and the local jurisdictions aim to implement for the county to reach its HMAP objectives and goals. The mitigation action plan provides the details of each mitigation action including which local department will be in charge of implementing the actions, how the county or local jurisdiction plan to pay for these actions, and the estimated time for implementing these actions.

Each jurisdiction and the county prioritized their mitigation actions based on their greatest vulnerabilities and needs. Actions were rated 1, 2, or 3 with 1 being the highest priority. Within each of the priority categories, a sub-category for feasibility was created. Each action was evaluated for feasibility using FEMA's mitigation action evaluation worksheet (Appendix A). After evaluating the mitigation actions based on priorities and feasibility, the actions were ranked. The actions are separated by jurisdiction and then ranked as described. The subsequent charts demonstrate the final ranking of mitigation actions based on their scoring.

All Participating Jurisdictions:

Waller County, Brookshire, Hempstead, Pattison, Pine Island, Prairie View, & Waller

Jurisdiction:	All Participating Jurisdictions	**Action Number:**	A1
Hazard(s) Addressed:	Floods		
Project Title:	Voluntary Buy-Out Program		
Project Description:	The county and partnering jurisdictions will begin a voluntary buyout program for insured repetitive loss properties that are in the floodplain.		
Responsible Entity:	Waller County OEM		
Partner(s):	Cities of Waller, Prairie View, Hempstead, Pine Island, Pattison, and Brookshire		
Losses avoided:	Prevent homes that have been flooded multiple times in the past 10 years from continuing to flood. A reduction NFIP insurance claims reduces long-term costs, and the removal of structures from the floodplain will reduce flooding. Reduce loss of life and injuries during flood events by helping residents relocate to less flood prone areas.		
Cost Estimate:	3,000,000	**Timeframe:**	3 years
Priority:	1 = Highest Priority Rating	**Feasibility Score:**	7
Potential Funding Sources:	HMGP, Local budget	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	All Participating Jurisdictions	**Action Number:**	A2
Hazard(s) Addressed:	Floods Severe Thunderstorms		
Project Title:	Stream and River Flood Program		
Project Description:	Conduct a flood mitigation outreach program using information from a river and stream flood study. Property owners, local governments, and county staff will be made aware of specific stream and river flooding problems in their communities, and will be provided guidance on how to mitigate flooding in their jurisdiction.		
Responsible Entity:	Waller County OEM		
Partner(s):	All participating jurisdictions		
Losses avoided:	Loss of property will be reduced.		
Cost Estimate:	$250,000	**Timeframe:**	48 months
Priority:	1 = Highest Priority Rating	**Feasibility Score:**	7
Potential Funding Sources:	HMGP, PDM	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	All Participating Jurisdictions	**Action Number:**	A3
Hazard(s) Addressed:	Floods		
Project Title:	Infrastructure Improvements		
Project Description:	Project will clear obstacles, widen and reshape ditches, and upgrade culverts to restore adequate drainage to mitigate flooding in all participating jurisdictions.		
Responsible Entity:	County Judge, Mayors, and County/City Engineers		
Partner(s):			
Losses avoided:	Reduction in flooding of homes and commercial structures throughout the county.		
Cost Estimate:	$2,500,000	**Timeframe:**	60 months
Priority:	1 = Highest Priority Rating	**Feasibility Score:**	5
Potential Funding Sources:	HMGP, PDM	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	All Participating Jurisdictions	**Action Number:**	A4
Hazard(s) Addressed:	Floods Wildfire Severe Thunderstorms Tornado Drought Hail Winter Storms		
Project Title:	Education and Mitigation Techniques		
Project Description:	Implement an outreach and education campaign to educate the public on mitigation techniques for all hazards to reduce loss of life and property.		
Responsible Entity:	County OEM and City Managers office or Mayor for each participating jurisdiction.		
Partner(s):			
Losses avoided:	Preservation of property, decreased financial losses due to natural hazards, and mitigating the loss of human life and injuries.		
Cost Estimate:	$7,000	**Timeframe:**	12-24 months
Priority:	2 = Mid-Level Priority Rating	**Feasibility Score:**	8
Potential Funding Sources:	Local budget and salary, HMPG, Fire Prevention and Safety Grants	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	All Participating Jurisdictions	**Action Number:**	A5
Hazard(s) Addressed:	Floods Wildfire Severe Thunderstorms Tornado Drought Hail Winter Storms		
Project Title:	Install Back-Up Generators		
Project Description:	Purchase and install generators for all critical facilities, and elevate the generators in order to prevent malfunctions during flood events.		
Responsible Entity:	County OEM and City EMCs		
Partner(s):			
Losses avoided:	Continued communication and power during catastrophic events, and ultimately preventing the loss of life and property.		
Cost Estimate:	$500,000	**Timeframe:**	48 months
Priority:	2 = Mid-Level Priority Rating	**Feasibility Score:**	5
Potential Funding Sources:	HMGP, PDM	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	All Participating Jurisdictions	**Action Number:**	A6
Hazard(s) Addressed:	Wildfire		
Project Title:	Technical Support		
Project Description:	The county and partnering cities will provide incentives and technical support for property owners to reduce underbrush throughout the county to properly cut back trees, upgrade fences, and replace landscape materials with nonflammable materials		
Responsible Entity:	County OEM		
Partner(s):			
Losses avoided:	Homes within the wild-urban interface and residents living within these areas.		
Cost Estimate:	$50,000	**Timeframe:**	6 months
Priority:	2 = Mid-Level Priority Rating	**Feasibility Score:**	4
Potential Funding Sources:	HMPG, Current county and city budget/ staff time	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	All Participating Jurisdictions	**Action Number:**	A7
Hazard(s) Addressed:	Severe Thunderstorms Tornado Hail		
Project Title:	Retrofitting Structures for Hail and Wind Protection		
Project Description:	All participating jurisdictions will retrofit city and county owned structures with roofs and window panes that can withstand hail and high wind damage.		
Responsible Entity:	County OEM office, and Building Department or Mayors office of each participating jurisdiction.		
Partner(s):			
Losses avoided:	Buildings damage decreased considerably, and injury prevention of city/county employees during major hail and wind events.		
Cost Estimate:	$150,000	**Timeframe:**	36 months
Priority:	2 = Mid-Level Priority Rating	**Feasibility Score:**	3
Potential Funding Sources:	HMGP, PDM, Local budgets	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	All Participating Jurisdictions	**Action Number:**	A8
Hazard(s) Addressed:	Winter Storms		
Project Title:	Warning System for Winter Weather		
Project Description:	All participating jurisdictions will install signage and sensors to alert drivers during winter weather on major roadways, curved roads, and steep roads.		
Responsible Entity:	County Emergency Coordinator		
Partner(s):			
Losses avoided:	Prevent injury and/or death of residents, emergency responders, and visitors traveling throughout the county.		
Cost Estimate:	$150,000	**Timeframe:**	18 months
Priority:	2 = Mid-Level Priority Rating	**Feasibility Score:**	2
Potential Funding Sources:	HMGP, FPS Grants	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			No
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	All Participating Jurisdictions	**Action Number:**	A9
Hazard(s) Addressed:	Winter Storms		
Project Title:	Infrastructure Improvements		
Project Description:	All participating jurisdictions will burying power-lines to prevent power outages from falling limbs during winter storms.		
Responsible Entity:	County OEM and Mayor's office for each participating jurisdiction		
Partner(s):			
Losses avoided:	Preventing the loss of life of vulnerable residents that lose power during winter storms.		
Cost Estimate:	$1,500,000	**Timeframe:**	60 months
Priority:	3 = Lowest Priority Rating	**Feasibility Score:**	1
Potential Funding Sources:	HMGP	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	All Participating Jurisdictions	**Action Number:**	A10
Hazard(s) Addressed:	Drought		
Project Title:	Ordinance Adoption		
Project Description:	All participating jurisdictions will develop an ordinance to require incorporating drought tolerant landscape design into all new county and city owned properties.		
Responsible Entity:	County Commissioners Court and City Council of each participating jurisdiction		
Partner(s):			
Losses avoided:	Reduction in water needs during drought, and preserving much needed ground water for agricultural purposes throughout the county.		
Cost Estimate:	$1000	**Timeframe:**	3 months
Priority:	3 = Lowest Priority Rating	**Feasibility Score:**	0
Potential Funding Sources:	Staff time and wages	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Waller County

Jurisdiction:	Waller County	**Action Number:**	C1
Hazard(s) Addressed:	Floods		
Project Title:	Court Order - Floodplain Dev		
Project Description:	The County may increase its freeboard requirement to 24-in from 18-in above the base flood elevation. The County may require that all new lots within a platted subdivision be located fully outside of the floodplain. Applicable to all floodplain development.		
Responsible Entity:	Waller County FPA		
Partner(s):	Consultant(s)		
Losses avoided:	Homes, businesses and residents within the floodplain.		
Cost Estimate:	10,000	**Timeframe:**	12-24 months
Priority:	1 = Highest Priority Rating	**Feasibility Score:**	9
Potential Funding Sources:	HMGP, PDM	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Waller County	**Action Number:**	C2
Hazard(s) Addressed:	Floods		
Project Title:	Prevention-Planning		
Project Description:	Establish watershed-based planning and studies to address flood hazards with neighboring and constituent communities.		
Responsible Entity:	Waller County		
Partner(s):			
Losses avoided:	TWDB, HMGP, HMA		
Cost Estimate:	Three Mile Creek $151,000 Brushy Creek $115,000 Walnut Creek $106,000 Bessies Creek $205,000 Irons Creek $203,000 Clear Creek $188,000 Total $968,000 With a 20% contingency, this would run about $1.16 million	**Timeframe:**	12-24 months
Priority:	1 = Highest Priority Rating	**Feasibility Score:**	6
Potential Funding Sources:	HMGP, PDM	**Benefit-Cost Ratio**	Approximately a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Waller County	**Action Number:**	C3
Hazard(s) Addressed:	Floods Wildfire Severe Thunderstorms Drought		
Project Title:	Public Information		
Project Description:	Posting of signage at high profile locations and use of social media to communicate threats/concerns. Flood gauges for common flooded road crossings. Burn ban signs.		
Responsible Entity:	Waller County		
Partner(s):	VFDs		
Losses avoided:	Driving into flooded creeks.		
Cost Estimate:	$50,000	**Timeframe:**	12-24months
Priority:	2 = Mid-Level Priority Rating	**Feasibility Score:**	7
Potential Funding Sources:	HMGP, County Budget	**Benefit-Cost Ratio**	Approximately a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			No
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Waller County	**Action Number:**	C4
Hazard(s) Addressed:	Floods Severe Thunderstorms Tornado		
Project Title:	Road/Creek Debris Removal		
Project Description:	Removal of debris, silt and vegetation obstacles at road/creek crossings following significant rain events throughout the County.		
Responsible Entity:	Waller County		
Losses avoided:	Damage to public infrastructure and homes.		
Cost Estimate:	County Force Account Labor and Equipment	**Timeframe:**	6 months
Priority:	2 = Mid-Level Priority Rating	**Feasibility Score:**	6
Potential Funding Sources:	County M&O budget	**Benefit-Cost Ratio**	Approximately a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Waller County	**Action Number:**	C5
Hazard(s) Addressed:	Floods		
Project Title:	Prevention		
Project Description:	Require and maintain FEMA elevation certificates for all new/improved buildings in the SFHA. Finished construction ECs must be submitted prior to OSSF permitting.		
Responsible Entity:	Waller County FPA		
Partner(s):			
Losses avoided:			
Cost Estimate:	None	**Timeframe:**	12 months
Priority:	2 = Mid-Level Priority Rating	**Feasibility Score:**	5
Potential Funding Sources:	HMGP, PDM	**Benefit-Cost Ratio**	Approximately a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Waller County	**Action Number:**	C6
Hazard(s) Addressed:	Floods		
Project Title:	Cane Island Branch-Alt 2		
Project Description:	Alternative 2 consisted of upstream detention that would reduce flows downstream of Clay Road along with improvements to the existing channel and culvert crossings to further reduce the floodplain. The existing channel was widened to raise the capacity limit to a 50-year while the detention pond reduced flows for the 100-year storm downstream of Pitts to a 50-year storm. The existing channel has a top width of 100-feet. Approximately 150 feet to 240 feet of Rightof-Way would be required to accommodate the channel. The proposed channel includes 3:1 side slopes and 30 feet on either side for maintenance. This alternative significantly reduced the floodplain from Clay Road to Franz Road, removing all structures in these locations from the floodplain.		
Responsible Entity:	Waller County/Brookshire-Katy Drainage District		
Partner(s):	Developers, Harris County, City of Katy		
Losses avoided:	Removes 174 habitable structures and 1,177 acres from the 100-year floodplain.		
Cost Estimate:	$65.3M	**Timeframe:**	24-36 months
Priority:	2 = Mid-Level Priority Rating	**Feasibility Score:**	3
Potential Funding Sources:	HMA, HMGP	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Waller County	**Action Number:**	C7
Hazard(s) Addressed:	Floods		
Project Title:	Cane Island Branch-Alt 1		
Project Description:	The first alternative included placing detention upstream of Pitts Road in order to reduce the existing 100-year flows at Morton Road to that of a 25-year event. There are 99 habitable structures upstream of Morton Road subject to inundation since the floodplain is fairly at its widest in the City. The amount of detention required upstream of Pitts Road is approximately 2,800 ac-ft. This alternative potentially removes 147 habitable structures and 476 acres from the floodplain upstream and downstream of Morton Road. Though the amount of detention needed to reduce the flow to a 25-year storm was large, several sites upstream of Pitts Road may allow the detention to be distributed throughout the upper basin, i.e. upstream of Pitts Road. By detaining the flow to a 25-year storm, the flooding area is significantly reduced in both Waller County and the City of Katy.		
Responsible Entity:	Waller County/Brookshire-Katy Drainage District		
Partner(s):	Developers, City of Katy, Harris County		
Losses avoided:	This alternative potentially removes a total of 147 habitable structures and 476 acres from the floodplain.		
Cost Estimate:	$72.8M	**Timeframe:**	60 months
Priority:	2 = Mid-Level Priority Rating	**Feasibility Score:**	3
Potential Funding Sources:	HMA, HMGP	**Benefit-Cost Ratio**	More than a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			Yes
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

City of Waller

Jurisdiction:	City of Waller	**Action Number:**	B1
Hazard(s) Addressed:	Floods Severe Thunderstorms		
Project Title:	Diemer Road		
Project Description:	Re-Routing of County Road near Brazos River		
Responsible Entity:	Waller County Road and Bridge		
Partner(s):	Waller County Road and Bridge, Office of Emergency Management		
Losses avoided:	County Road shut down due to erosion of the Brazos River		
Cost Estimate:	300,000	**Timeframe:**	8 Months
Priority:	2 = Mid-Level Priority Rating	**Feasibility Score:**	1
Potential Funding Sources:	HMGP and 25% County Match	**Benefit-Cost Ratio**	Approximately a 1:4 cost-benefit ratio
Does this action reduce effects of hazards on existing buildings?			No
Does this action reduce effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Part 8: Plan Maintenance

Part 8: PLAN MAINTENANCE

To remain an effective tool, the HMAP will undergo continuous review and updates. This practice is known as plan maintenance and requires monitoring, evaluating, updating, and implementing the plan the entirety of the written plan and planning process. To accomplish this, a Plan Maintenance Team (PMT) has been determined and is comprised of representatives from each of the County's participating jurisdictions.

Plan Maintenance Team	
Plan Maintenance Team Leader	Waller County Emergency Management Coordinator
Jurisdiction	**Responsible Entity**
Waller County	Waller County OEM and County Judge
City of Brookshire	Mayor, City Manager
City of Hempstead	City Engineer, City Secretary
City of Pattison	Mayor
Town of Pine Island	Mayor
City of Prairie View	Mayor, Chief of Police
City of Waller	Superintendent of Public Works
Brookshire/Katy Drainage District	President
Members of the Public	Public

Public Involvement

Continued stakeholder and public involvement will remain a vital component of the HMAP. The HMAP will be hosted on the County and H-GAC websites, and public input can be submitted at any time. The PMT is responsible for documenting public feedback and presenting the comments for discussion at each annual Plan Maintenance Meeting.

The PMT Leader will also conduct outreach and invite the public to annual Plan Maintenance meetings. The PMT Leader will notify the public of all annual meetings through by posting online and printed copies of the meeting agenda and posting fliers at city and county buildings 30 days prior to the meetings.

In addition, each participating jurisdiction will seek input from the public on the status of existing hazards, emerging vulnerabilities, and evaluate the entire written plan and planning process including improving public participation throughout future planning process. During each meeting, the PMT will provide an open comment forum for interactive discussion with the public. The development of a list of improvements for the entire plan and process-including new goals and strategies will be a joint effort between the PMT and public participants.

Procedures & Schedule

Procedures to monitor and evaluate the HMAP were determined during the December 18th meeting. This ensures that the goals, objectives, and the mitigation strategy are regularly examined for feasibility, and that the HMAP remains a relevant and adaptive tool. The PMT will meet annually and hold its first meeting within one year after the plan's approval date. An additional mid-year meeting will be held 18 months prior to the plan's expiration to develop a timeline and strategy to update the HMAP.

Any new mitigation actions, strategies, or required studies, suggestions for improvements or changes to the entire written plan or planning process will be submitted to the County's representative. The representative will evaluate

the items for compliance with TDEM and FEMA regulations before leading the process to adopt or approve the new items or suggestions. Recommended changes, updates, and revisions will be implemented based on available funding to support revisions, and updates and will be assigned to appropriate officials with pre-determined timelines for completion. Updates to the HMAP will then be adopted by the appropriate governing body.

Plan Maintenance: Evaluation & Monitoring Procedures

Method and Procedures	Schedule	Responsible Entity
The PMT Leader will advertise all annual meetings in local newspapers, post invitations on the County social media pages, and post fliers at city and county buildings 30 days prior to the meetings.	30 days prior to annual meetings	Plan Maintenance Team Leader
The PMT Leader is responsible for evaluating the entire plan prior to the meeting. Each PMT member will be asked to identify and discuss any deficiencies in the plan as it relates to their jurisdiction. Each PMT member will discuss their findings followed by public input and comments.	Annually	PMT Leader, PMT member for each participating jurisdiction, and Public
Emerging hazards, risks, and vulnerabilities will be identified and discussed. 1) PMT members are responsible for monitoring each natural hazard in their jurisdiction, and providing a written and/or verbal update on any new occurrences and emerging risks. 2) The PMT Leader will seek input from participants and the public at the annual meetings by opening the meeting for public comment. 3) Newly identified hazards, risks, and vulnerabilities will be assigned to a PMT member to research and monitor.	Annually	Public and all participating jurisdictions
The PMT will evaluate the mitigation goals and objectives to ensure the HMAP remains relevant and the strategy continues to be effective. 1) PMT members will identify new projects and/or re-prioritize existing strategies based on changes in their jurisdiction, emerging hazards, and shifting priorities. 2) Funding sources and multijurisdictional cooperation for new initiatives will be determined. 3) PMT members will review public participation outreach strategies in order to identify new or different methods of outreach in order to reach more community members. 4) The Plan Maintenance Team Leader will report on any suggestions for changing the whole written plan, planning, maintenance, or implementation process for the plan received by PMT members throughout the year. The PMT members will discuss which revisions/ suggestions they would like to implement.	Annually	PMT member for each participating jurisdiction

Each participating jurisdiction will evaluate their progress implementing the HMAP, and suggest improvements for the entire plan, public participation, and overall planning process. 1) Representatives will publicly discuss progress and submit written progress reports to the team leader. 2) Completed and ongoing mitigation actions will be discussed by responsible entity. 3) Unaddressed mitigation actions will be evaluated for relevancy and/or amended to increase feasibility. 4) Feasibility of the mitigation strategy will be evaluated, and any necessary revisions will be proposed. 5) The team leader will seek comment from the public after each participating jurisdiction's presentation. 6) The team leader and each representative will report on all suggestions received throughout the passed year on the planning process and the entire written plan and discuss how to incorporate these suggestions into current and future planning efforts.	Annually	PMT, the responsible department identified in the mitigation action up for discussion, and the public.
The PMT will develop a timeline and strategy to update the plan 18 months before it expires. The update strategy will include: 1) Establish entities responsible for drafting and submitting the update to TDEM 2) Send appropriate representatives to G-318 training. 3) Determine funding needs and funding sources for plan update. 4) Review the entirety of the plan; discuss hazards, vulnerabilities and impacts identified in the plan and what to include/ revise in the update	Every 5 years	PMT

Plan Integration

Integrating the HMAP into county and local planning mechanisms is key to its success. Effective integration allows communities to benefit from existing plans and procedures to further reduce their vulnerability and risk. Upon approval of the plan and approval of updates or revisions as proposed by the Plan Maintenance team, each participating jurisdiction will follow the pre-determined actions:

Chart 1: Adoption and Integration Procedures	
Waller County	HMAP and plan amendments will be presented to the Commissioner's Court by the Waller County Emergency Management Office. An agenda for the meeting will be posted 30 days in advance, and a 30-day period of public comment will be provided. Upon approval by Commissioner's Court, the approved HMAP will be integrated into existing planning mechanisms described in Chart 2.
City of Brookshire	The Brookshire PMT representative will draft a proposal for incorporating the HMAP's mitigation recommendations into their existing planning mechanisms. The proposal will be presented to the City Council for consideration. Brookshire will advertise the amendment no less than 14 days before the meeting where it will be discussed.

City of Hempstead	The Hempstead PMT member representative will draft a proposal for incorporating the HMAP's mitigation recommendations into their existing planning mechanisms. The proposal will be presented to the City Council. The Council will also consider Resolutions that may not require fiscal or staff resources. Agendas are posted 14 days in advance.
City of Pattison	The Mayor of Pattison will draft a proposal for incorporating the HMAP's mitigation recommendations into their existing planning mechanisms. The proposal will be presented to the City Council, and must be approved with 3 or more votes. Agendas are posted 14 days in advance of meetings.
Town of Pine Island	Pine Island's Mayor will review and propose any changes made the HMAP to the local commissioners. Upon approval by the mayor and commissioners, the updates and plan will be officially adopted.
City of Prairie View	Prairie View's PMT representative will select mitigation actions to be budgeted into the City's annual budget to be implemented the following year. The proposal will be presented before City Council. An agenda will be published 30 days in advance.
City of Waller	The Waller PMT representative will draft a proposal for incorporating the HMAP's mitigation recommendations into their existing planning mechanisms. The proposal will be presented to the City Council and/or Planning and Zoning Commission for consideration. Brookshire will post an agenda no less than 14 days before the meeting where it will be discussed.

To update and revise existing planning mechanisms to further integrate the HMAP, each participating jurisdiction will follow a basic process(es) described in this section.

1.) Propose a policy, strategy, or regulatory amendment to the proper governing body.
2.) Advertise the amendment 15 days prior to meeting where it will be discussed. Advertising procedures for the public meeting(s) is outlined in the public involvement measures described in Section 8 of this plan.
3.) Provide the public, elected officials, and governing bodies the opportunity to discuss and comment upon proposed change(s).
4.) If the proposal is accepted, the change is implemented by the appropriate governing authority.

Several existing plans and programs that require integration of the HMAP have been identified by the participating jurisdictions. The PMT will initiate the process described above. As each participating jurisdiction develops or approves new planning mechanisms, the mechanism's name and the integration method will be added to the HMAP

Chart 2: Integration of HMAP and Planning Mechanisms

Planning Mechanism	Integration Method
Disaster Recovery Plan	Both plans should be updated and maintained in accordance with the other plan's goals and strategies. The HMAP will be consulted before any revisions or update to the disaster recovery plans are made.
Floodplain Management Plan	Waller County's floodplain regulations provide preventative measures to prevent future development in the floodplains, and it also provides corrective guidance on development in the floodplain. When the regulations are updated, it will be reflected the mitigation action strategy for flooding in Section 6.1 of this plan.

Emergency Operations Plan	Both plans will be continuously evaluated and monitored. Any Emergency Operations Plan updates will refer to, incorporate, and/or complement the HMAP.
Subdivision/Zoning Ordinance	All participating jurisdictions will review their codes, and propose the adoption of codes that support mitigation activities defined in the HMAP when appropriate.
Planning & Development Regulations	Each participating jurisdiction has reviewed the vulnerabilities defined in the HMAP and will adopt codes that support mitigation strategy and mitigation activities. PMT members will propose code amendments to the appropriate governing body, following to process to amend codes in the jurisdiction, and document any regulation amendments to be included in the HMAP update.
Annual Budget	Waller County and each participating jurisdiction will review their annual budget each September for opportunities to fund their highest priority mitigation actions.
Flood Damage Prevention Ordinance	When the plan is updated or revised, the PMT will propose the adoption of codes that support mitigation strategy and mitigation activities.
Capital Improvements Plan	Waller County and the City of Waller will review their capital improvements plan for projects that can also serve as natural hazard mitigation infrastructure. The CIP will be updated with project schedules and policies that support the implementation of each jurisdiction's highest priority projects.

2017

Appendix A: Planning Process

APPENDIX A: Planning Process Documentation

Public Meeting Attendees: October 18, 2017

Representative Name & Position/Title	Agency/Office
Ester A Chalmers, Risk Management and Safety Department	Prairie View A&M University
Greg Henry, IT Director	Waller County
Brian Cantrell, Emergency Management Coordinator	Waller County Office of Emergency Management
Holly Avery, Administrative Assistant	Waller County
Trey Duhon, County Judge	Waller County
Jeremy Royster, Paramedic Supervisor	Waller County EMS
Joe Garcia	Pattison Mayor
Lorena Reyes, Hazard Mitigation Planner	Texas Department of Emergency management
Alexis Hall, Community Planner (Reserves)	Federal Emergency Management Agency
Jamie Leigh Price, Community Planner	Federal Emergency Management Agency
Clint McManus, Regional Planner	Houston- Galveston Area Council
Joey Kaspar, Senior Regional Planner	Houston- Galveston Area Council
Amy Combs, Regional Planner	Houston- Galveston Area Council

Multi-jurisdictional Meeting Attendees: December 18, 2017

Name		Organization
Brian Cantrell	Emergency Management Coordinator	Waller County Office of Emergency Management
Glenn LaMont	Deputy Emergency Management Coordinator	Brazoria County Office of Emergency Management
Ray Chislett	Emergency Management Coordinator	Austin County Office of Emergency Management
Butch Davis	Emergency Management Coordinator	Walker County Office of Emergency Management
Sherri Pegoda	Deputy Emergency Management Coordinator	Walker County Office of Emergency Management
Morgan Lumbley	Hazard and Community Planner	Montgomery County Office of Emergency Management
Darren Hess	Emergency Management Coordinator	Montgomery County Office of Emergency Management
Tom Branch	Emergency Management Coordinator	Liberty County Office of Emergency Management
Yancy Scott	Waller County Engineer	Waller County Office of Emergency Management
Joey Kaspar	Senior Regional Planer	Houston - Galveston Area Council
Amy Combs	Regional Planner	Houston - Galveston Area Council
Cheryl Mergo	Project Manager	Houston - Galveston Area Council
Jeff Taebel	Director of C&E	Houston - Galveston Area Council

Public Meeting Press Release & Advertisements

HOUSTON-GALVESTON AREA COUNCIL

PO Box 22777 • Houston, Texas 77227-2777• 713-627-3200

NEWS RELEASE

FOR IMMEDIATE RELEASE
September 29, 2017

Contact: Joey Kaspar: (713) 993-4547 or Joey.Kaspar@h-gac.com
Becki Begley: (713) 993-2410 or Becki.Begley@h-gac.com (Media Inquiries Only)

WALLER COUNTY HAZARD MITIGATION PLAN KICK-OFF MEETING

The Houston-Galveston Area Council (H-GAC), in partnership with Waller County, City of Brookshire, City of Hempstead, City of Pattison, Town of Pine Island, City of Praire View, City of Waller, is hosting the first public meeting to develop Waller County's Hazard Mitigation Plan. The meeting will be held from 2 p.m. to 5 p.m., October 18, at the Waller County Commissioners Courtroom, 836 Austin St., Hempstead, TX, 77445.

A Hazard Mitigation Plan is a strategic plan that proposes actions to reduce or eliminate long-term risk to people and property from future natural disasters. Public input and involvement is important for developing a comprehensive approach to reduce the effects of natural disasters on communities.

All Waller County residents are invited to participate and contribute their local expertise during the planning process. Mitigation actions developed by participants will be considered for inclusion in the County's Hazard Mitigation Plan to be submitted to the Federal Emergency Management Agency (FEMA).

The meeting agenda is available on H-GAC's website at http://www.h-gac.com/community/community/hazard/documents/10-18-17-Waller-County-Meeting-Agenda.pdf

More information on hazard mitigation plans is available on FEMA's website at https://www.fema.gov/hazard-mitigation-planning.

For more information about the meeting, contact Joey Kaspar at (713) 993-4547 or at Joey.Kaspar@h-gac.com, or Amy Combs, (713) 993-4544 or at Amy.Combs@h-gac.com.

Public Meeting Press Release & Advertisement

Press releases and advertisements were submitted to the city secretaries of participating jurisdictions, and to three local news outlets.

Contact	Title	Organization
Courtney Burleson	Editor	Times Tribune
Lori Ann Lilley	Managing Editor	Times Tribune
Pat Chernosky	Owner and Publisher	Hotline Press
Barbara Haffelfinger	City Secretary	City of Hempstead
Claudia J. Harrison	City Secretary	City of Brookshire
Cynthia Ward	City Secretary	City of Waller
Linda M. Cole	City Secretary	Town of Pine Island
Lynda L. Fairchild	City Secretary	City of Pattison
Shannon Smith	Interim City Secretary/Treasurer	City of Prairie View

Waller County
Hazard Mitigation Plan Kick-Off Meeting

October 18, 2017
2:00 pm – 5:00 pm
Waller County Commissioners Courtroom
836 Austin St.
Hempstead, TX 77445

Agenda

1:30-2:00 pm **Registration**

2:00 pm **Welcome & Overview of Hazard Mitigation Plans & Procedures**
H-GAC Staff will provide an overview of meeting objectives, activities, and H-GAC's planning process. The presentation will also include project timelines, partner roles and responsibilities, in-kind match requirements, and exemptions.

2:15 pm **Review 2017 Risk Assessment**
H-GAC staff will present the County's draft risk assessment. Attendees will participate in a breakout session to review the draft risk assessment maps, charts, and provide feedback.

3:10 pm **Local Risk Assessment & Capability Form**
Meeting attendees will fill out a form describing the frequency of a hazard, and rate their mitigation capabilities in their jurisdiction.

3:15 pm **15-minute Break**

3:30 pm **Mitigation Actions Presentation & Activity**
H-GAC staff will give a presentation on creating mitigation actions and facilitate a practice exercise in writing a mitigation action.

4:00 pm **Update 2011 Mitigation Actions & Write New Actions**
Review 2011 mitigation actions for viability, and update actions to meet new FEMA standards. With remaining time, draft new mitigations for 2017.

5:00 pm **Adjourn**

Multi-jurisdictional Meeting Agenda: December 18, 2017

Hazard Mitigation Plan Meeting

December 18, 2017
1:30 pm – 3:30 pm
Conference Room D
Houston-Galveston Area Council
3555 Timmons Lane, 2nd Floor
Houston, TX 77027

Agenda

1:15pm **Registration**

1:30pm **Welcome by Jeff Taebel, Director of Community & Environmental Planning**

1:35pm **Progress Update& Meeting Objectives**

1:40pm **Mitigation Strategy &Goals Presentation**
A brief presentation over mitigation strategy goals, and the importance of multi-jurisdictional coordination.

1:50pm – 2:15pm **Goal Development Activity**
H-GAC staff will guide an activity that demonstrates how to draft goals for a Mitigation Strategy. Participants will then draft their County specific goals to be included in their plan's Mitigation Strategy.

2:15pm **15Minute Break**

2:30pm **Plan Maintenance Presentation**
Maintenance Plans are a required component of every Hazard Mitigation Plan. H-GAC staff will give a presentation on the required components and provide example maintenance plans.

2:40pm – 3:00pm **Plan Maintenance Activity**
Participants will develop and draft their 5-year Hazard Mitigation Maintenance Plans.

3:00pm **Project Checklist Review**
A review of the required components for the Hazard Mitigation Plan will be provided for each county. This checklist will provide guidance on completed and remaining tasks. H-GAC staff will field questions and comments regarding the checklist.

3:30pm **Adjourn**

2017

Appendix B: Critical Facilities

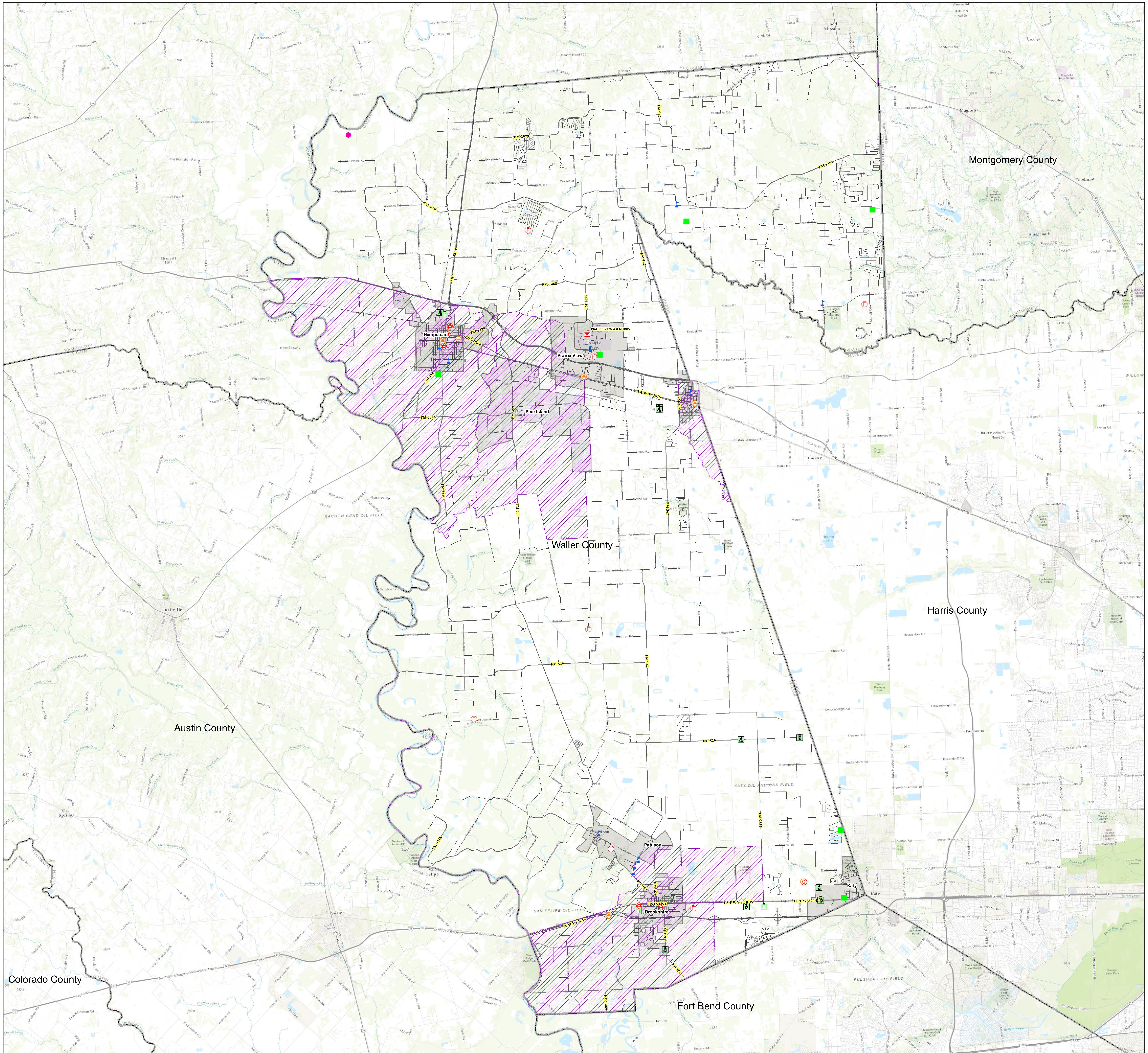
APPENDIX B: Critical Facilities

Facility Type	Name (if applicable)	Jurisdiction
CERCLA (Superfund) National Priorities List	Sheridan Disposal Service Inc	Hempstead
Colleges & Universities	Prairie View A & M Univ	Prairie View
Correctional Facilities	Waller County Jail	Hempstead
Correctional Facilities	Brookshire Police Department	Brookshire
Dam		Waller County
Dam		Hempstead
Dam		Waller County
Dam		Waller County
Dam		Waller County
Dam		Waller County
Dam		Waller County
Dam		Waller County
Dam		Waller County
Dam		Waller County
Electric Substation		Hempstead
Electric Substation		Waller County
Electric Substation		Prairie View
Electric Substation		Waller County
Electric Substation		Katy
Electric Substation		Waller County
EMS	Phoenix Emergency Medical Services West Incorporated	Katy
EMS	Waller County Emergency Medical Services	Pattison
EMS	Waller County Emergency Medical Services	Hempstead
EMS	Frontier Emergency Medical Serv. Limited Liability Company	Hempstead
EMS	Waller County Emergency Medical Services	Hempstead
EMS	Waller County Emergency Medical Services	Hempstead
EMS	Brookshire-Pattison Area Emergency Medical Services	Brookshire
EMS	Waller County Emergency Medical Services	Waller
Fire Station	Pattison Area VFD	Brookshire
Fire Station	Prairie View Volunteer Fire Department	Prairie View
Fire Station	Hempstead VFD	Hempstead
Fire Station	Prairie View VFD	Prairie View
Fire Station	Mt. Zion Community Volunteer Fire Fighting Assoc.	Hempstead
Fire Station	Brookshire VFD	Brookshire
Fire Station	Monaville Fire Dept.	Waller
Fire Station	Tri-County VFD	Hockley
High Schools	Hempstead H S	Hempstead
High Schools	Royal H S	Brookshire
High Schools	Royal Early College H S	Brookshire
Local Emergency Operation Center	Waller County Emergency Operations Center	Hempstead
Local Emergency Operation Center	Waller County Emergency Operations Center-Alternate	Hempstead

Local Emergency Operation Center	City of Hempstead Emergency Operations Center	Hempstead
Local Emergency Operation Center	City of Brookshire Emergency Operations Center	Brookshire
Local Emergency Operation Center	City of Brookshire Emergency Operations Center-Alternate	Brookshire
Police Station	Waller County Constable - Precinct 4	Pattison
Police Station	Waller County Sheriffs of fice / Waller County Jail	Hempstead
Police Station	Waller County Constable - Precinct 1	Hempstead
Police Station	Hempstead Independent School District Police Department	Hempstead
Police Station	Hempstead Police Department	Hempstead
Police Station	Texas Department of Public Safety - Highway Patrol Region 2 District C Sergeant 0 Area 4	Hempstead
Police Station	Waller County Constable - Precinct 3	Hempstead
Police Station	Hempstead Police Dept	Hempstead
Police Station	Waller County Highway Patrol	Hempstead
Police Station	Waller County Sheriff	Hempstead
Police Station	Brookshire Police Department	Brookshire
Police Station	Royal Independent School District Police Department	Pattison
Police Station	Brookshire Crime Stoppers	Brookshire
Police Station	Waller Police Department	Waller
Police Station	Waller County Constable - Precinct 2	Waller
Police Station	Waller Police Dept	Waller
Police Station	Prairie View A&M University Police Department	Prairie View
Police Station	Prairie View Police Department	Prairie View
Police Station	Prairie View Police Dept	Prairie View
School	Royal Early Childhood Center	Brookshire
School	Hempstead Middle	Hempstead
School	Hempstead El	Hempstead
School	Royal El	Brookshire
School	Royal Academic Academy	Brookshire
School	Royal J H	Brookshire
School	Waller J H	Waller
School	Fields Store El	Waller
School	H T Jones El	Prairie View
School	Evelyn Turlington El	Hockley
Shelter	Pattison United Methodist Church	Pattison
Shelter	First Baptist Church Hempstead	Hempstead
Shelter	Kc Hall Hempstead	Hempstead
Shelter	Pine Island Baptist Church	Hempstead
Shelter	Waller County Fairgrounds	Hempstead
Shelter	Curry's Chapel Baptist Church	Brookshire
Shelter	First United Methodist Church	Brookshire
Shelter	Brookshire Civic Center	Brookshire
Shelter	Royal High School	Pattison
Shelter	Bible Fellowship Baptist Church	Brookshire
Shelter	Pine Island Baptist Church	Hempstead
Shelter	St. John's Lutheran Church	Waller

Shelter	Waller Baptist Church	Waller
Toxic Release Inventory Facility	Texas Liquid Fertilizer Company Limited	Hempstead
Toxic Release Inventory Facility	Parish International Inc	Hempstead
Toxic Release Inventory Facility	State Chemical Mfg. Co.	Katy
Toxic Release Inventory Facility	Igloo Products Corp	Katy
Toxic Release Inventory Facility	Monierlifetile Llc // Katy (Us34)	Brookshire
Toxic Release Inventory Facility	Mh-Pryamid Inc.	Katy
Toxic Release Inventory Facility	Sulzer Pumps Houston Inc	Brookshire
Toxic Release Inventory Facility	Oldcastle Precast	Brookshire
Toxic Release Inventory Facility	Ppg Architectural Finishes Waller	Waller
Toxic Release Inventory Facility	Copper Energy Services Compression Group	Waller
Toxic Release Inventory Facility	Century Asphalt Ltd Katy Plant	Katy
Toxic Release Inventory Facility	Cemex Construction Materials South Llc - Katy	Katy

Critical Facilities Map : Waller County



Legend

- College Universities
- Correctional Facilities
- Airport
- Police Stations
- Hospitals
- EMS
- FireStations
- Vulnerable Population
- Roads
- County Boundary
- Cities
- Schools

Utilities

- Electric Substation
- Natural Gas Receipt Delivery
- Power Plant
- Wastewater Treatments Plant

Industrial

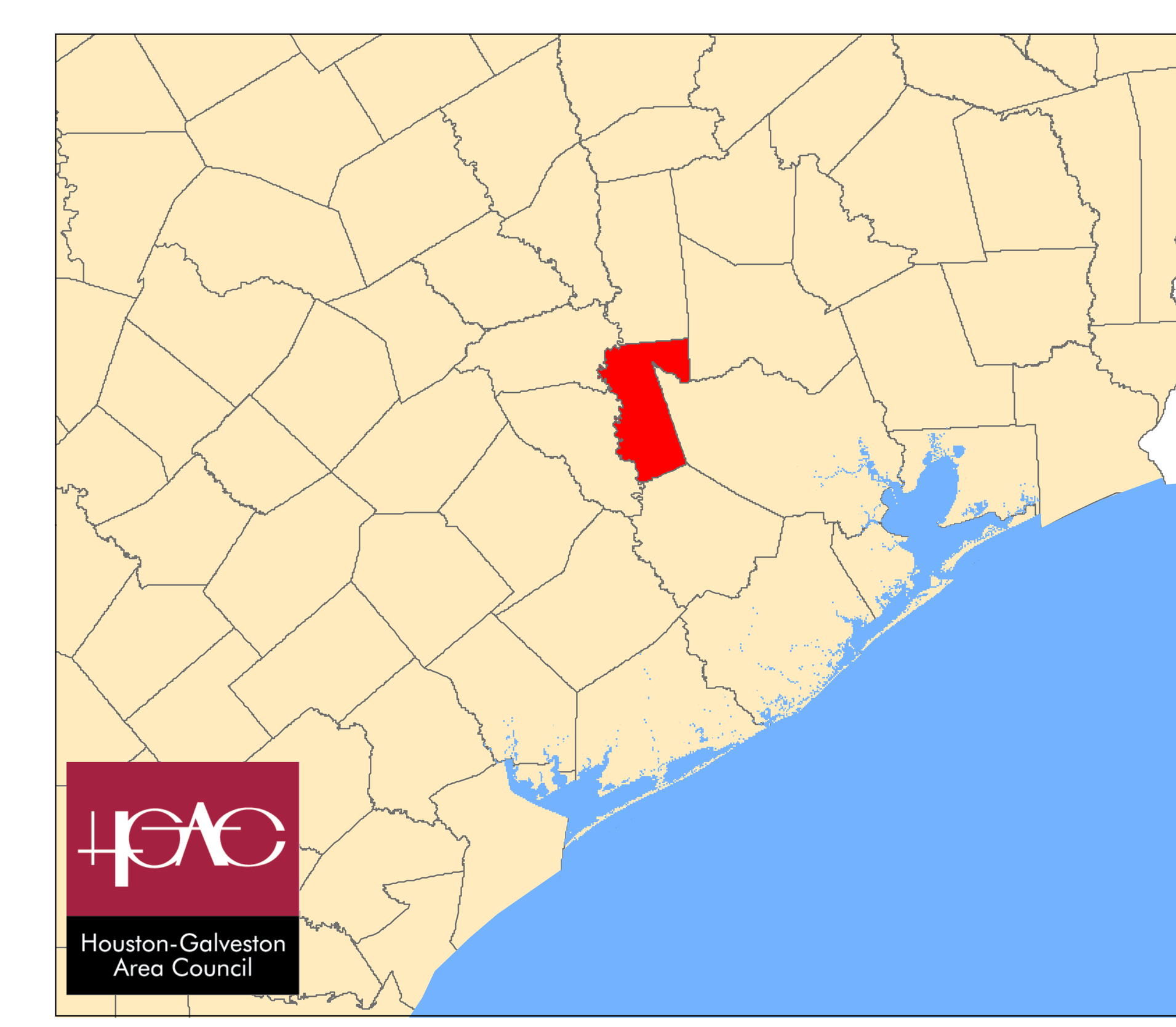
- Brownfields
- CERCLA(Superfund) National Priorities List
- Hazardous Waste Teratment Facility
- Solid Waste Landfill
- Toxic Release Inventory Facility

Public Safety and Security

- Disaster Recovery Center
- Local Emergency Operation Center

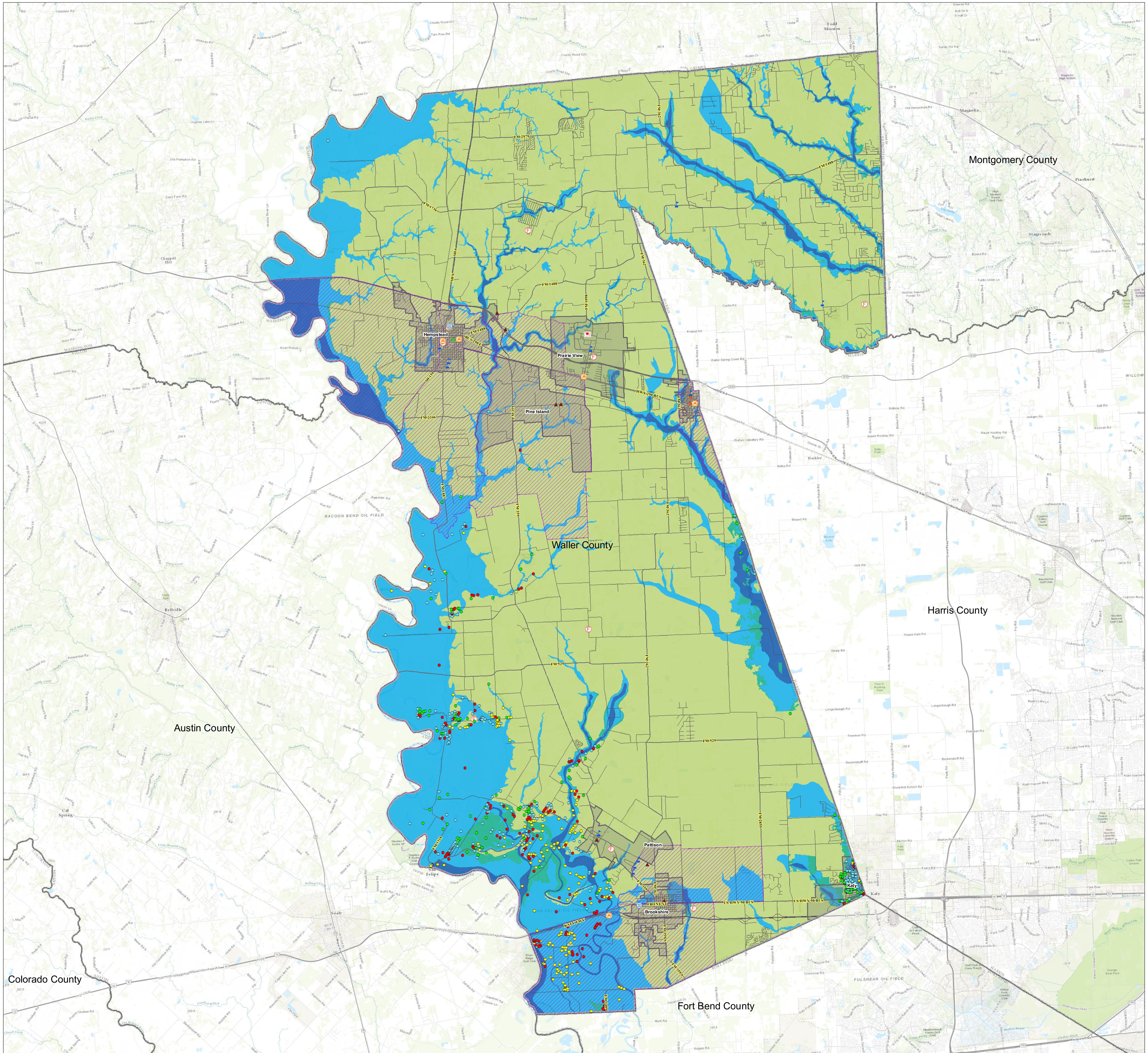
N

0 2.5 5 10 Miles



Sources:
Facilities : Regional Land Use Information System, H-GAC, 2017
Electric Substation : Electric Substations, Homeland Infrastructure Foundation-Level Data (HIFLD), DHS, 2017
Natural Gas Receipt Delivery: Homeland Infrastructure Foundation-Level Data (HIFLD), DHS, 2017
Power Plant : Homeland Infrastructure Foundation-Level Data (HIFLD), DHS, 2017
Wastewater Treatment Plant: EPA Facility Registry Service(FRS) Wastewater Treatment Plants, 2015
Hazardous Waste Treatment Facility: EPA Resource Conservation and Recovery Act Treatment Storage and Disposal Facilities, 2017
Brownfields: EPA The Assessment, Cleanup and Redevelopment Exchange System (ACRES), EPA, 2017
Superfunds : CERCLA (Superfund) National Priorities List, EPA, 2017
Solid Waste Landfill : Homeland Infrastructure Foundation-Leve Data (HIFLD), DHS, 2017
Toxic Release Inventory Facility : EPA Emergency Response (ER) Toxic Release (TRI) Facilities, 2017
Local Emergency Operation Center : Homeland Infrastructure Foundation-Level Data (HIFLD), DHS, 2009
Disaster Recovery Center : Disaster Recovery Center, FEMA, 2017

Harvey Map : Waller County



Legend

- College Universities
- Correctional Facilities
- Airport
- Police Stations
- Hospitals
- EMS
- FireStations
- Schools
- Roads
- County Boundary
- Vulnerable Population
- Cities

FEMA National Shelter System

- Both
- Evacuation
- Post Event

FEMA Damage Level

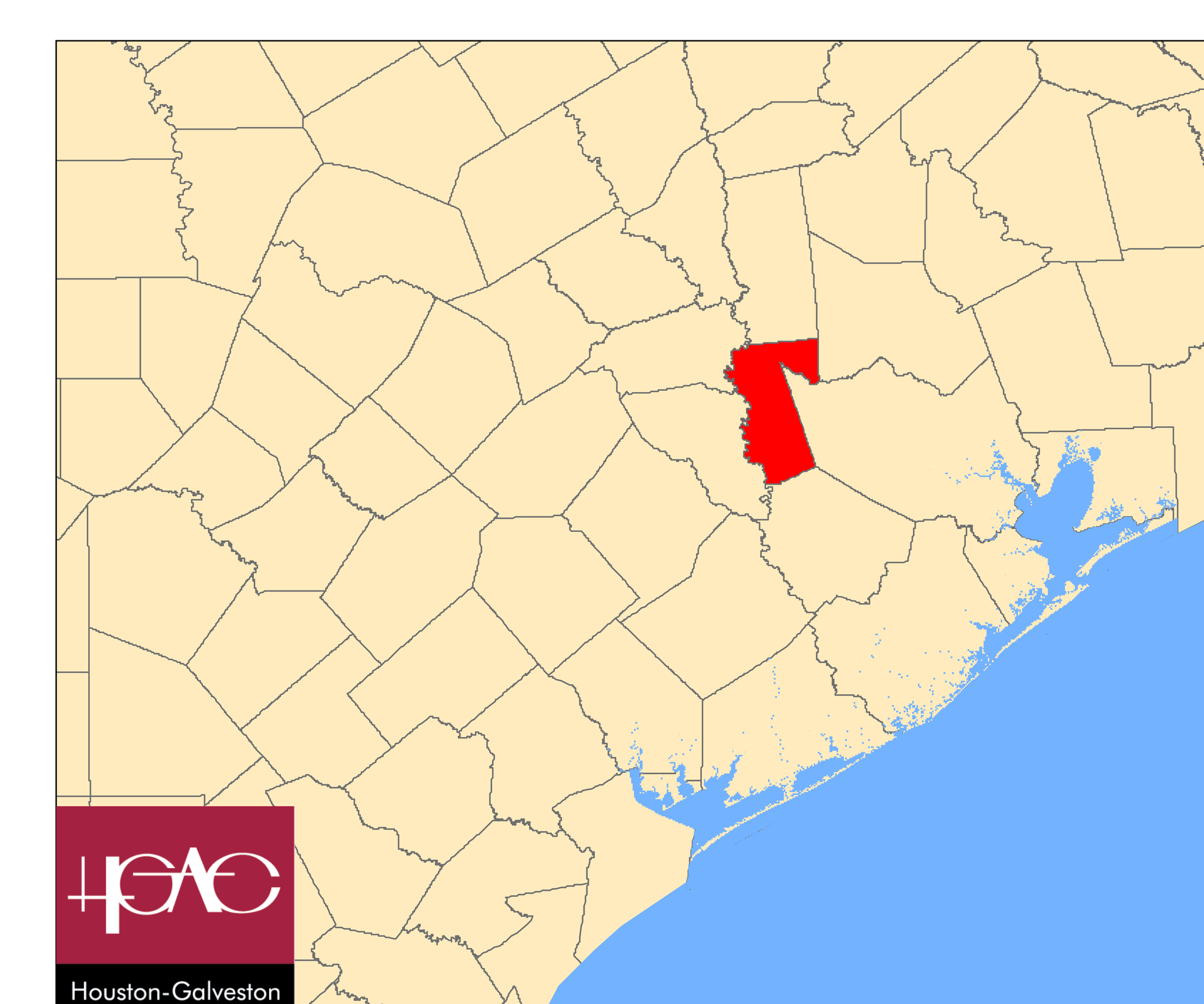
- Affected
- Minor
- Major
- Destroyed

FEMA Floodplains NFHL 2015

- Floodway
- 100YR
- 500YR
- Minimal
- Levee Zone

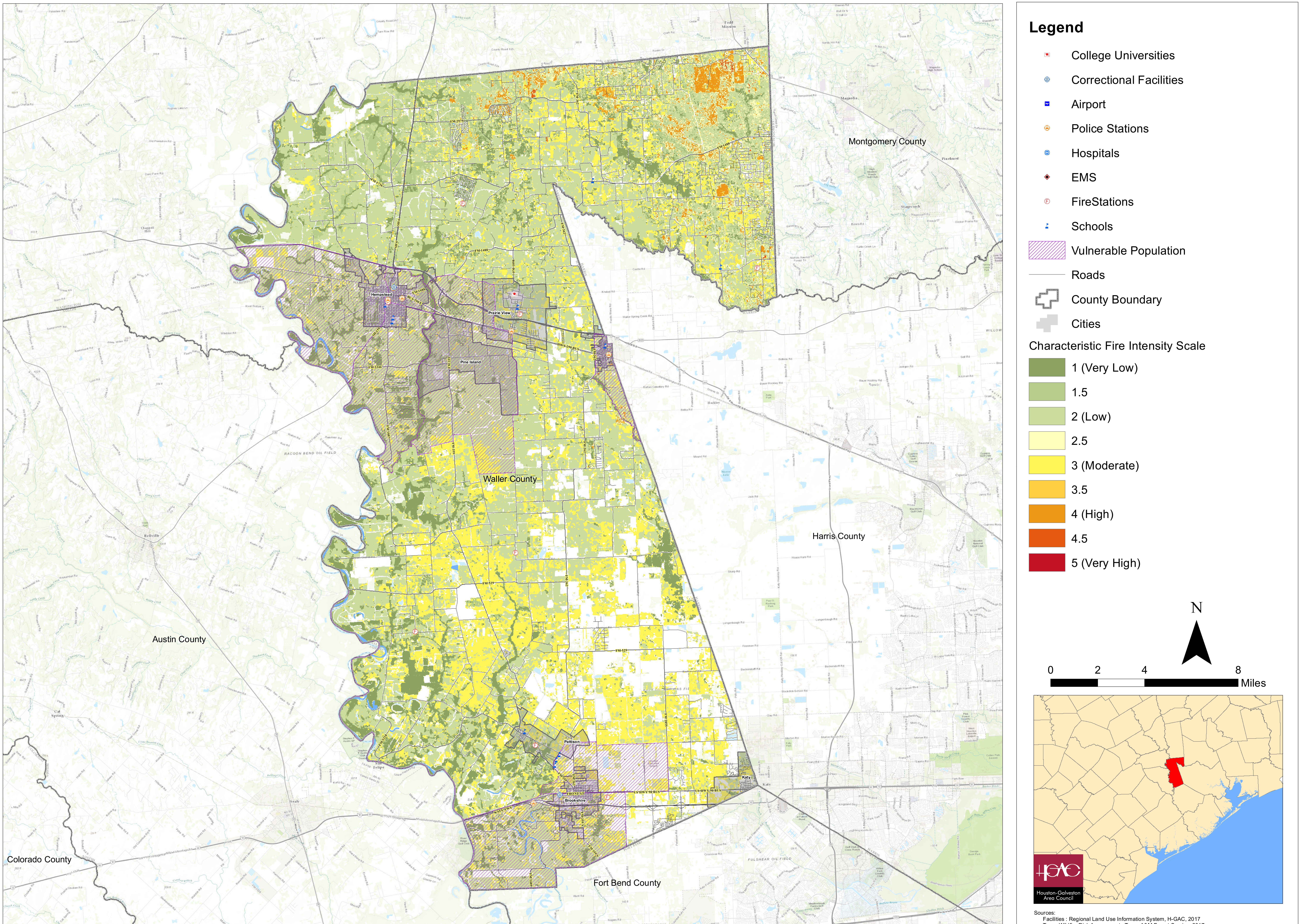
N

0 2 4 8 Miles

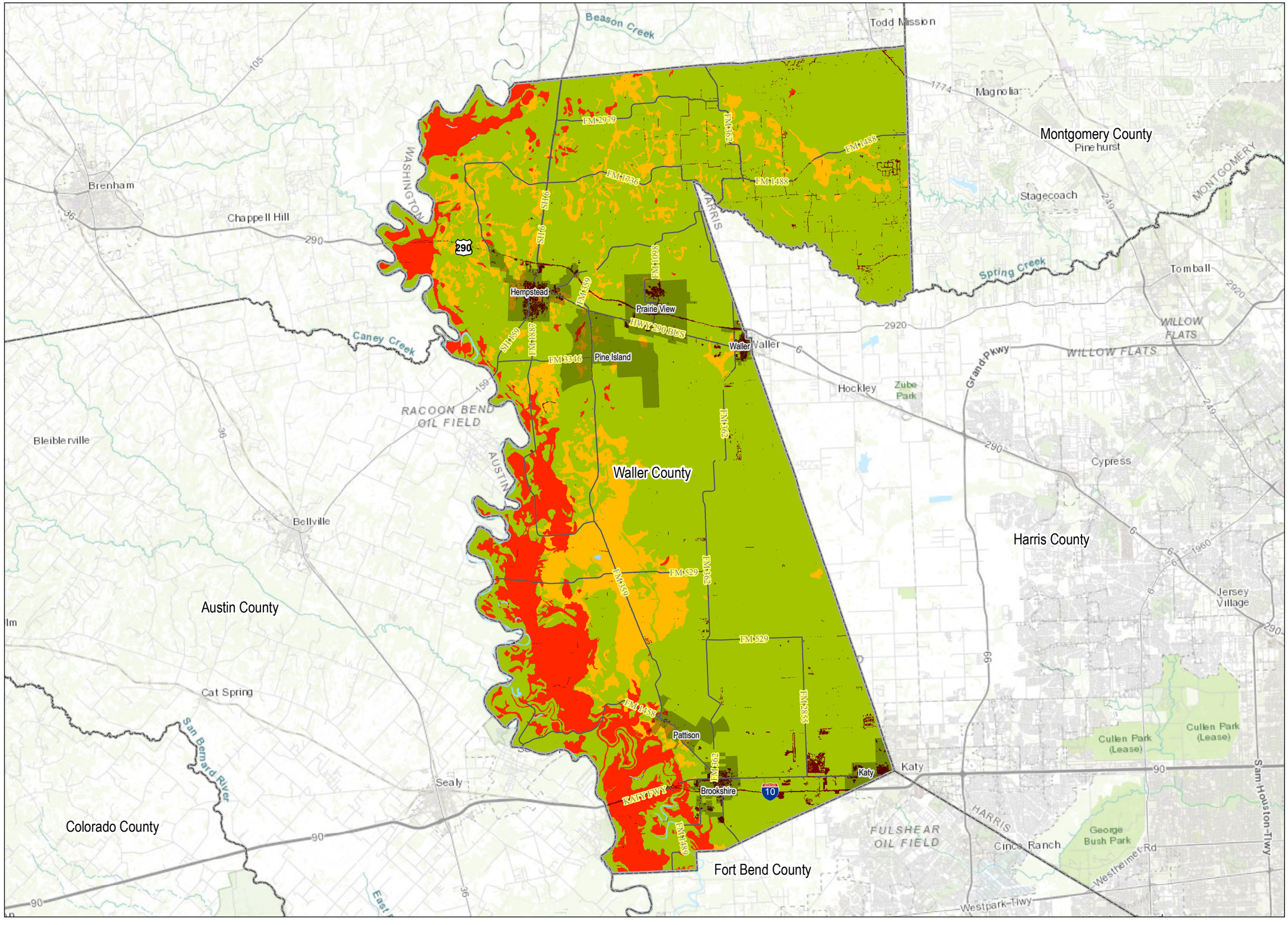


Sources:
Facilities : Regional Land Use Information System, H-GAC, 2017
National Flood Hazard Layer (NFHL) : Federal Emergency Management Agency (FEMA), 2015
National Shelter System : Federal Emergency Management Agency (FEMA), 2017
FEMA Preliminary Damage Assessment : Federal Emergency Management Agency (FEMA), 2017

Wildfire : Waller County



Expansive Soil Map : Waller County



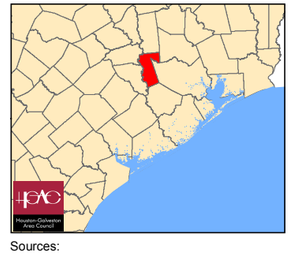
Legend

Expansive Soils Type

- Water
- Moderate swelling potential
- Low swelling potential
- High swelling potential
- Developed
- Cities
- County Boundary

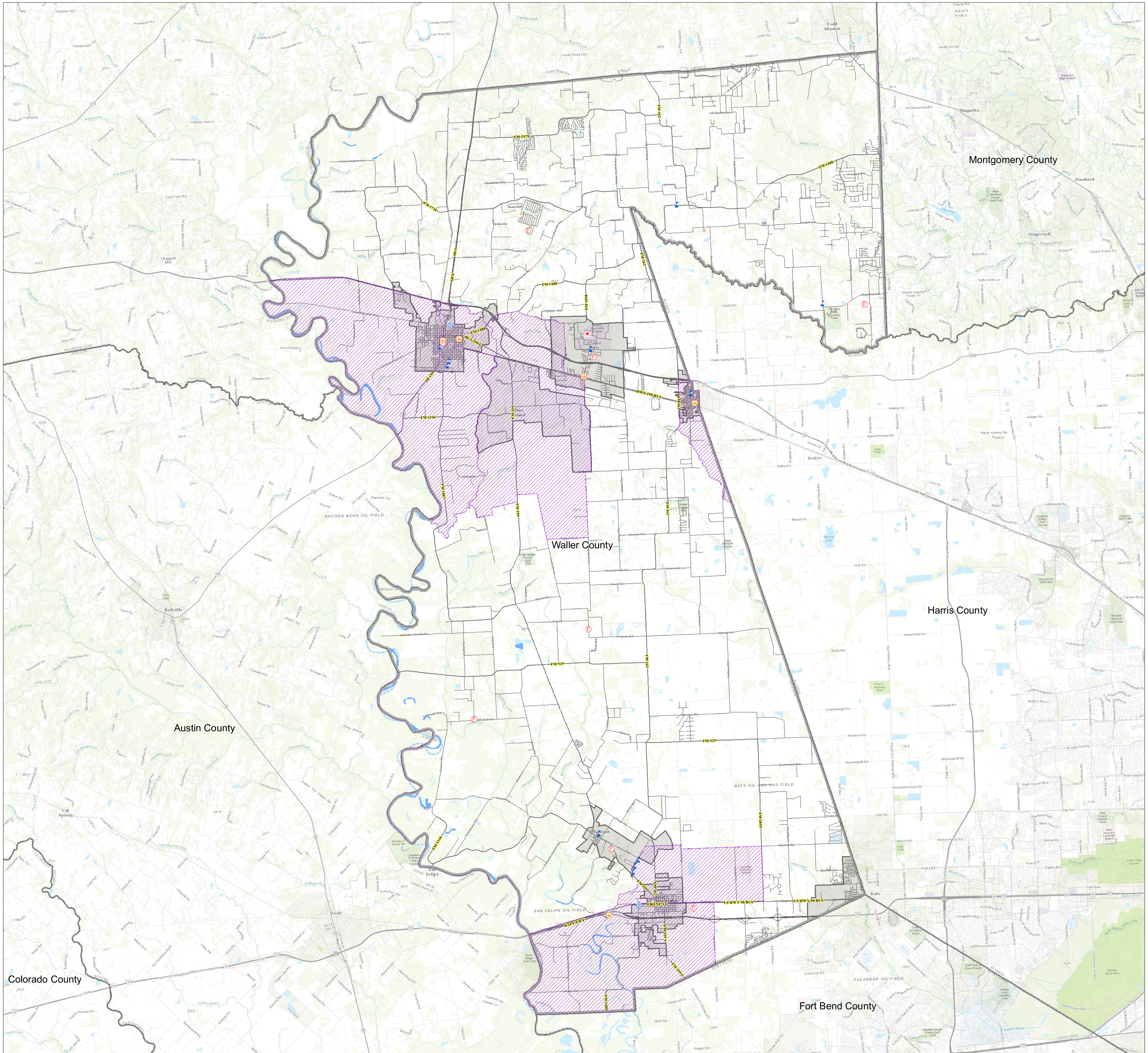
N

0 1.5 3 6 Miles



Sources:
HGAC Natural Resource Conservation Service

Dam & Levee Map : Waller County



Legend

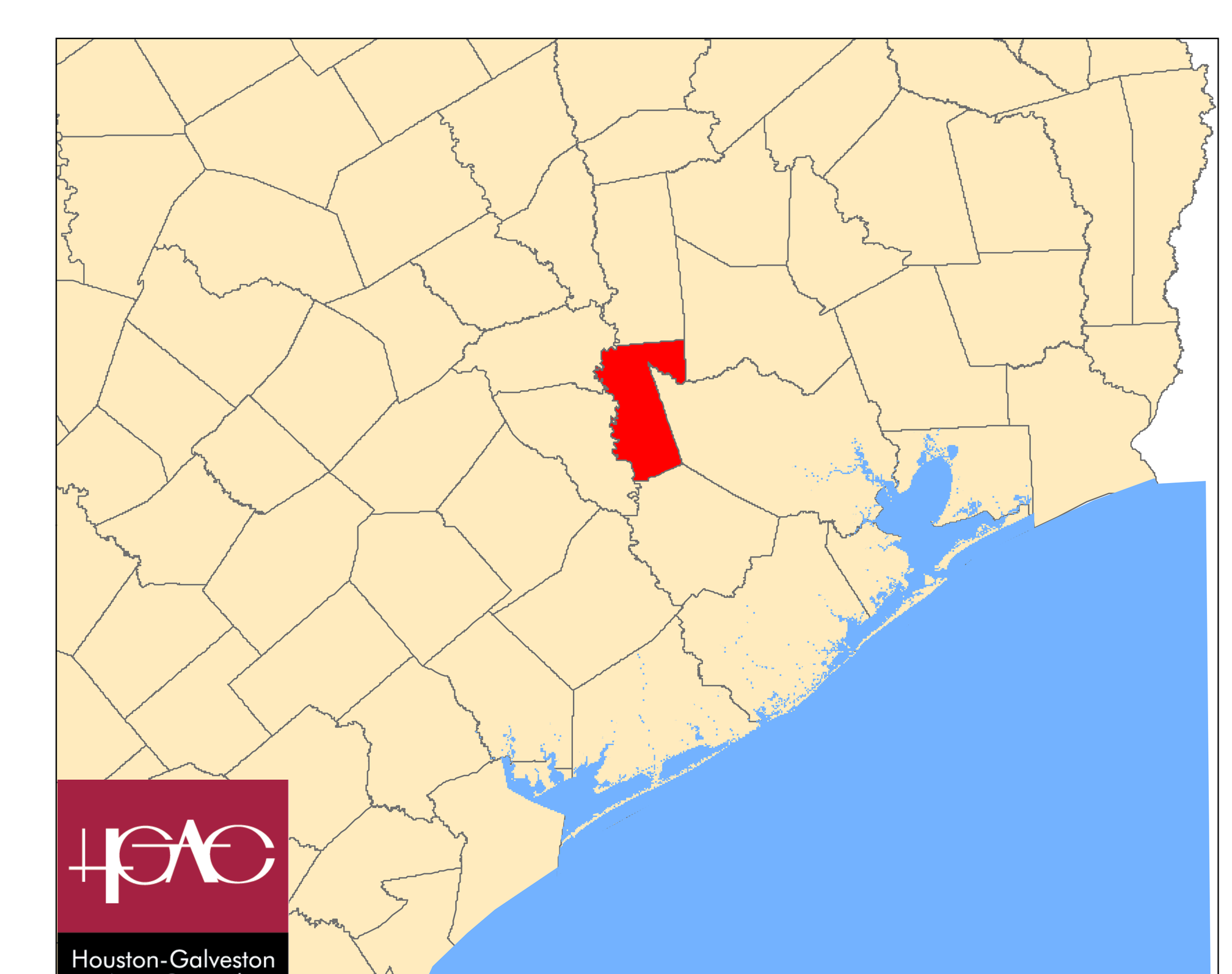
- College Universities
- Correctional Facilities
- Airport
- Police Stations
- Hospitals
- EMS
- FireStations
- Schools

Dams

- Federal
- State
- Local Government
- Private
- Dam Lines
- Vulnerable Population
- Levee Line
- Roads
- County Boundary
- Cities

N

0 2 4 8 Miles



Sources:
Facilities : Regional Land Use Information System, H-GAC, 2017
National Inventory of Dams : US Army Corps of Engineers, 2016
National Levee Database : US Army Corps of Engineers, 2017

2017

Appendix C: Hazus Analysis

Quick Assessment Report

November 8, 2017

Study Region : WL
Scenario : Waller_all
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	518
Number of Census Blocks	1,925
Number of Buildings	
Residential	14,520
Total	15,593
Number of People in the Region (x 1000)	43
Building Exposure ($ Millions)	
Residential	2,868
Total	3,553

Scenario Results

Shelter Requirements

Displaced Population (# Households)	236
Short Term Shelter (# People)	227

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	13
Total Property (Capital Stock) Losses ($ Millions)	18
Business Interruption (Income) Losses ($ Millions)	0

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific flood. These results can be improved by using enhanced inventory data and flood hazard information.

Hazus-MH: Flood Global Risk Report

Region Name: Waller County

Flood Scenario: 100-Year

Print Date: Wednesday, November 08, 2017

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

FEMA

RiskMAP
Increasing Resilience Together

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Texas

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 518 square miles and contains 1,925 census blocks. The region contains over 14 thousand households and has a total population of 43,205 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 15,593 buildings in the region with a total building replacement value (excluding contents) of 3,553 million dollars (2010 dollars). Approximately 93.12% of the buildings (and 80.74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 15,593 buildings in the region which have an aggregate total replacement value of 3,553 million (2014 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,868,290	80.7%
Commercial	256,565	7.2%
Industrial	264,333	7.4%
Agricultural	27,731	0.8%
Religion	44,161	1.2%
Government	14,018	0.4%
Education	77,621	2.2%
Total	**3,552,719**	**100.0%**

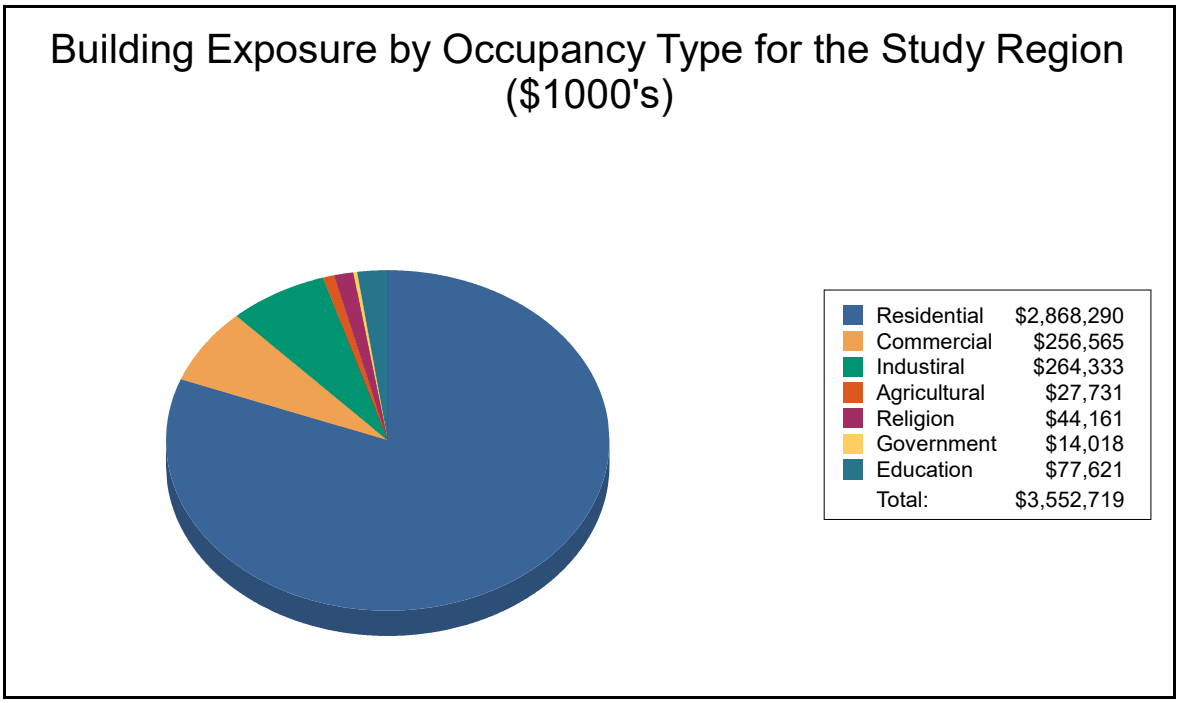
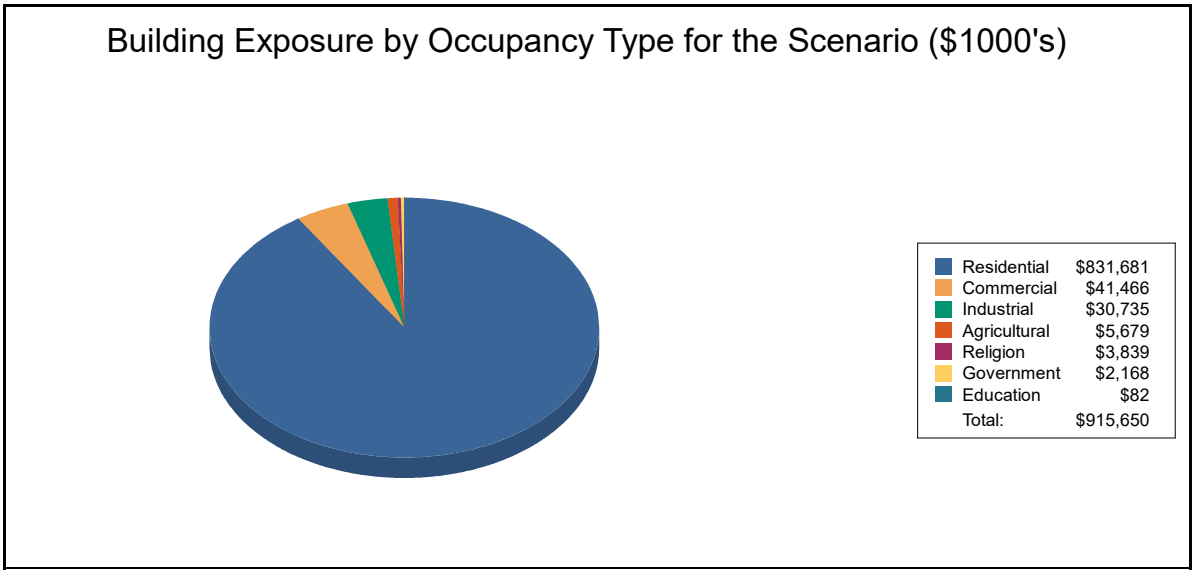


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	831,681	90.8%
Commercial	41,466	4.5%
Industrial	30,735	3.4%
Agricultural	5,679	0.6%
Religion	3,839	0.4%
Government	2,168	0.2%
Education	82	0.0%
Total	**915,650**	**100.0%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 6 fire stations, 6 police stations and no emergency operation centers.

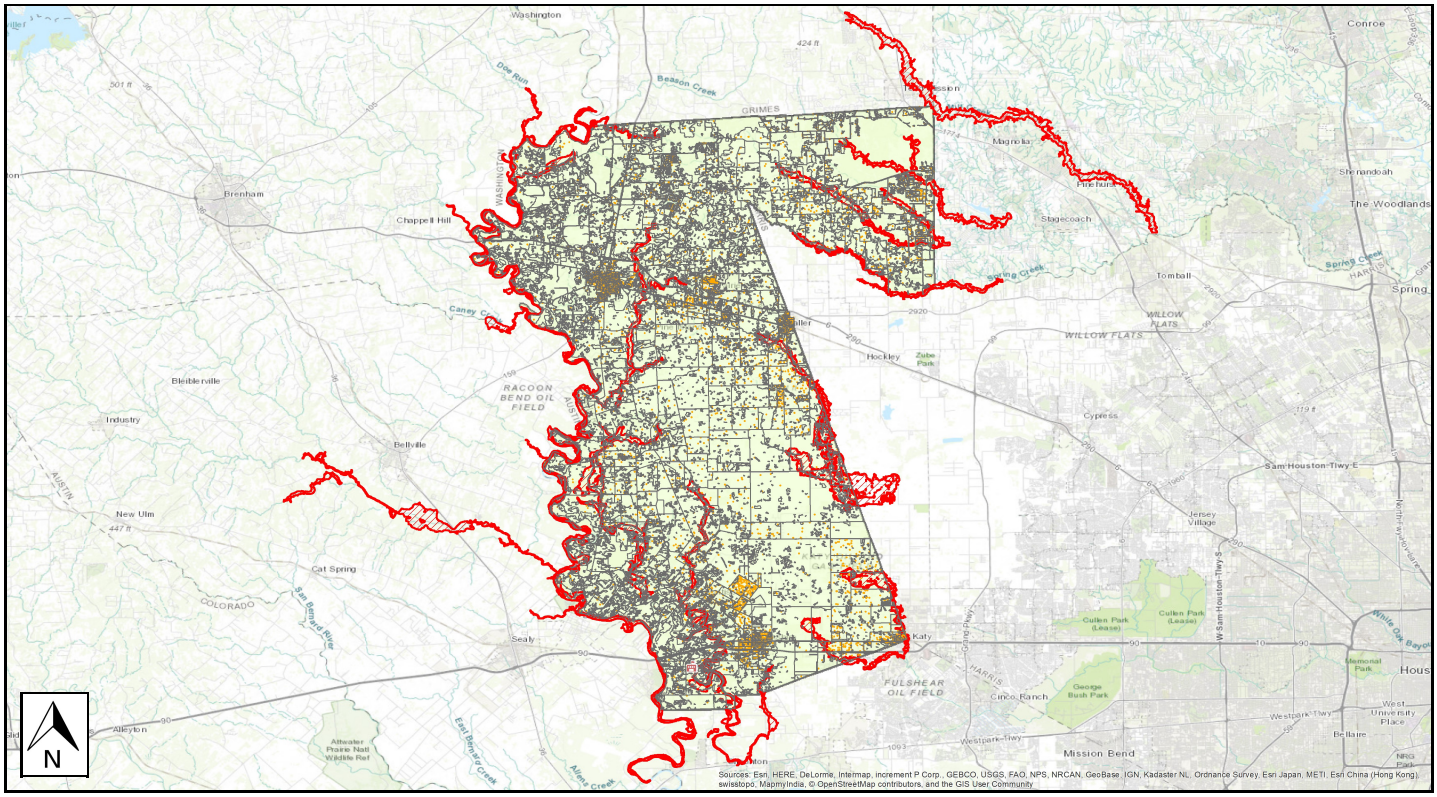
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Waller County
Scenario Name:	100-Year
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 29 buildings will be at least moderately damaged. This is over 68% of the total number of buildings in the scenario. There are an estimated 1 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

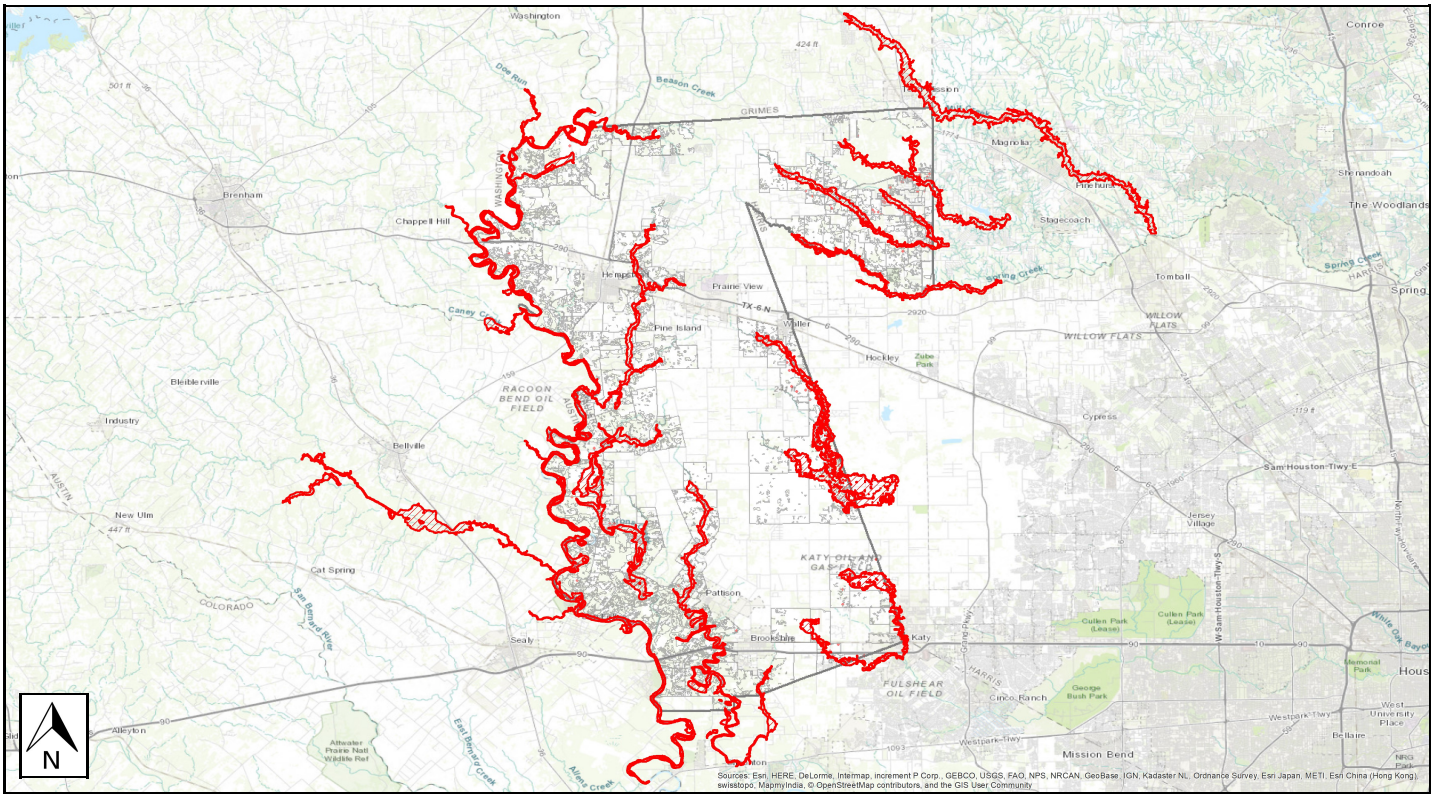


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	1	100.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	16	36.36	21	47.73	4	9.09	2	4.55	0	0.00	1	2.27
Total	**16**		**21**		**4**		**2**		**1**		**1**	

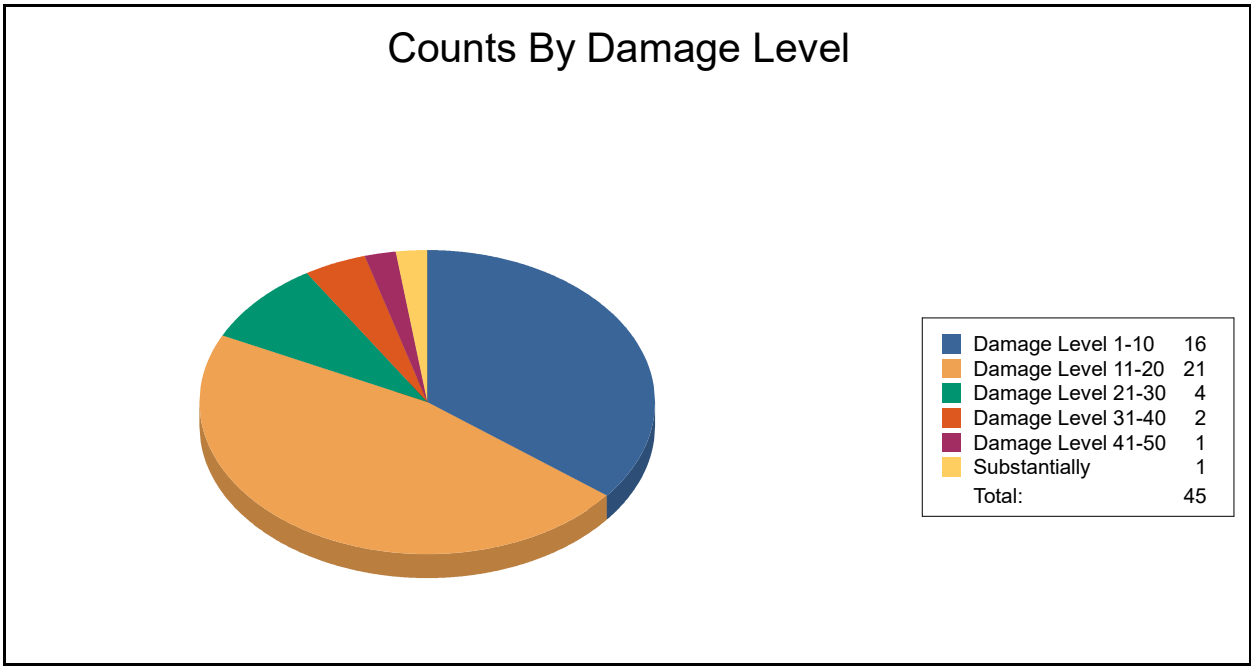


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	1	100
Masonry	1	50	1	50	0	0	0	0	0	0	0	0
Steel	0	0	0	0	0	0	0	0	1	100	0	0
Wood	15	37	20	49	4	10	2	5	0	0	0	0

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	6	0	0	0
Hospitals	0	0	0	0
Police Stations	6	0	0	0
Schools	15	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

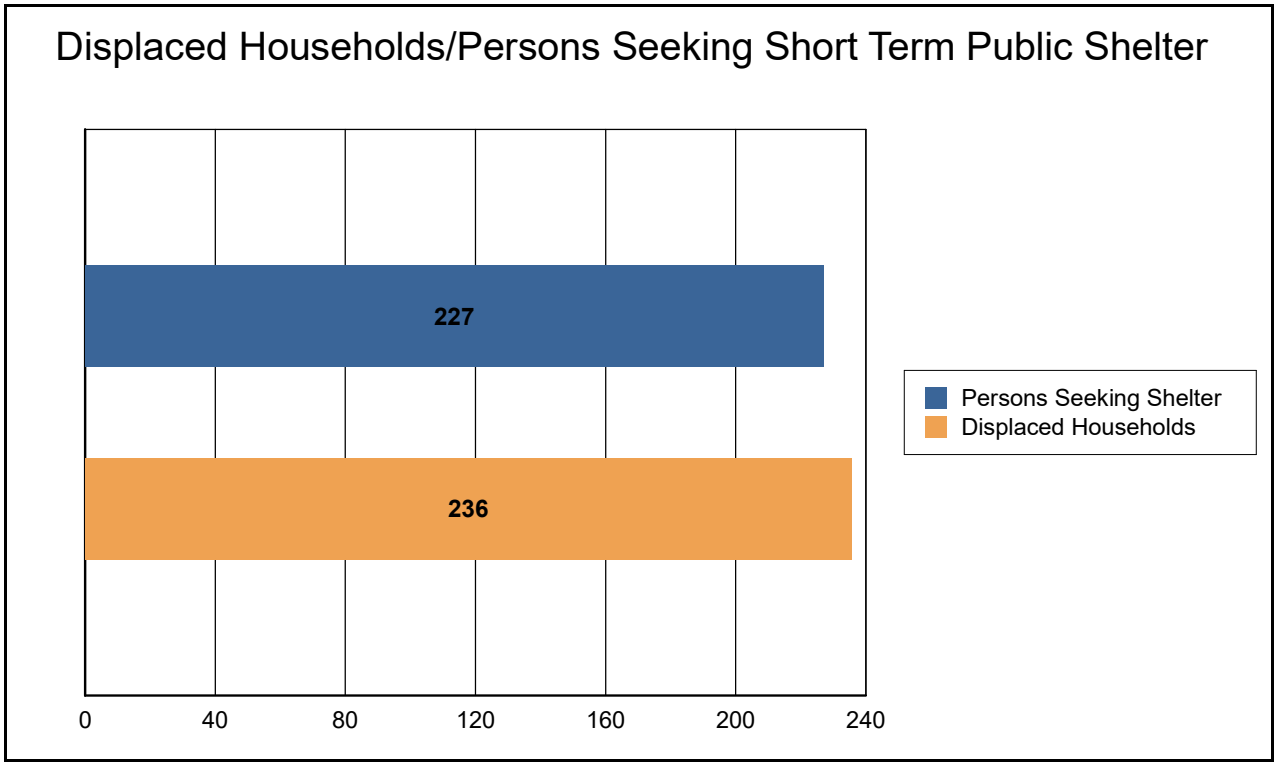
Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

Analysis has not been performed for this Scenario.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 236 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 227 people (out of a total population of 43,205) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 18.27 million dollars, which represents 2.00 % of the total replacement value of the scenario buildings.

Building-Related Losses

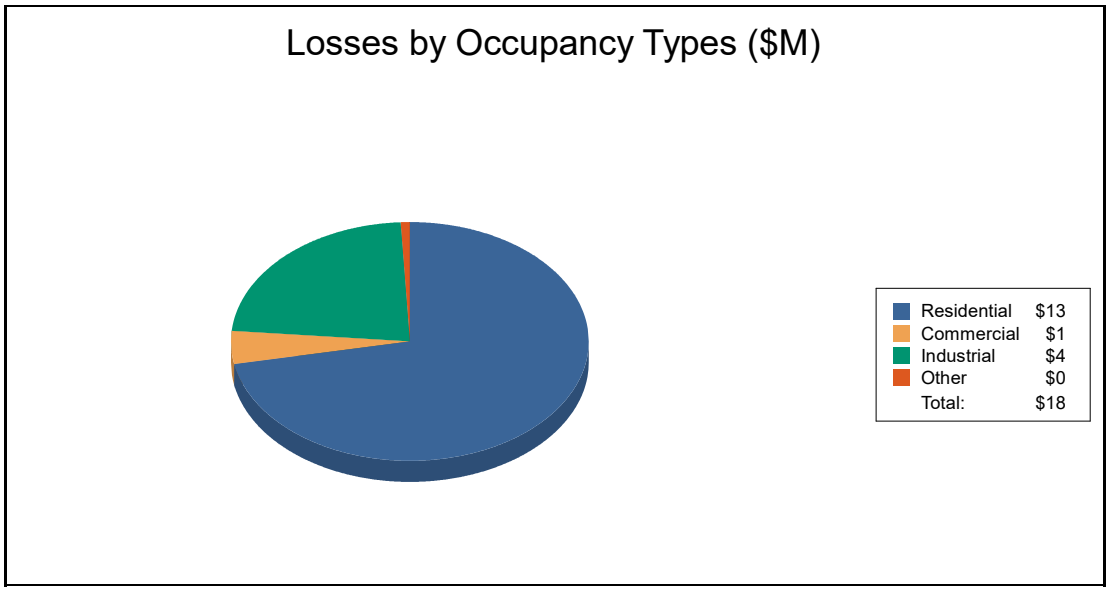
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 18.25 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 71.92% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	8.44	0.19	1.33	0.02	9.98
	Content	4.69	0.60	2.54	0.15	7.98
	Inventory	0.00	0.02	0.27	0.00	0.29
	Subtotal	**13.13**	**0.80**	**4.15**	**0.17**	**18.25**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.01	0.00	0.00	0.00	0.01
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.01	0.01
	Subtotal	**0.01**	**0.00**	**0.00**	**0.01**	**0.02**
ALL	**Total**	**13.14**	**0.81**	**4.15**	**0.17**	**18.27**



Appendix A: County Listing for the Region

Texas

- Waller

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Texas				
Waller	43,205	2,868,290	684,429	3,552,719
Total	**43,205**	**2,868,290**	**684,429**	**3,552,719**
Total Study Region	**43,205**	**2,868,290**	**684,429**	**3,552,719**

Hazus-MH: Flood Global Risk Report

Region Name: Waller County

Flood Scenario: 500-Year

Print Date: Wednesday, November 08, 2017

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

FEMA

RiskMAP
Increasing Resilience Together

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Texas

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 518 square miles and contains 1,925 census blocks. The region contains over 14 thousand households and has a total population of 43,205 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 15,593 buildings in the region with a total building replacement value (excluding contents) of 3,553 million dollars (2010 dollars). Approximately 93.12% of the buildings (and 80.74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 15,593 buildings in the region which have an aggregate total replacement value of 3,553 million (2014 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,868,290	80.7%
Commercial	256,565	7.2%
Industrial	264,333	7.4%
Agricultural	27,731	0.8%
Religion	44,161	1.2%
Government	14,018	0.4%
Education	77,621	2.2%
Total	**3,552,719**	**100.0%**

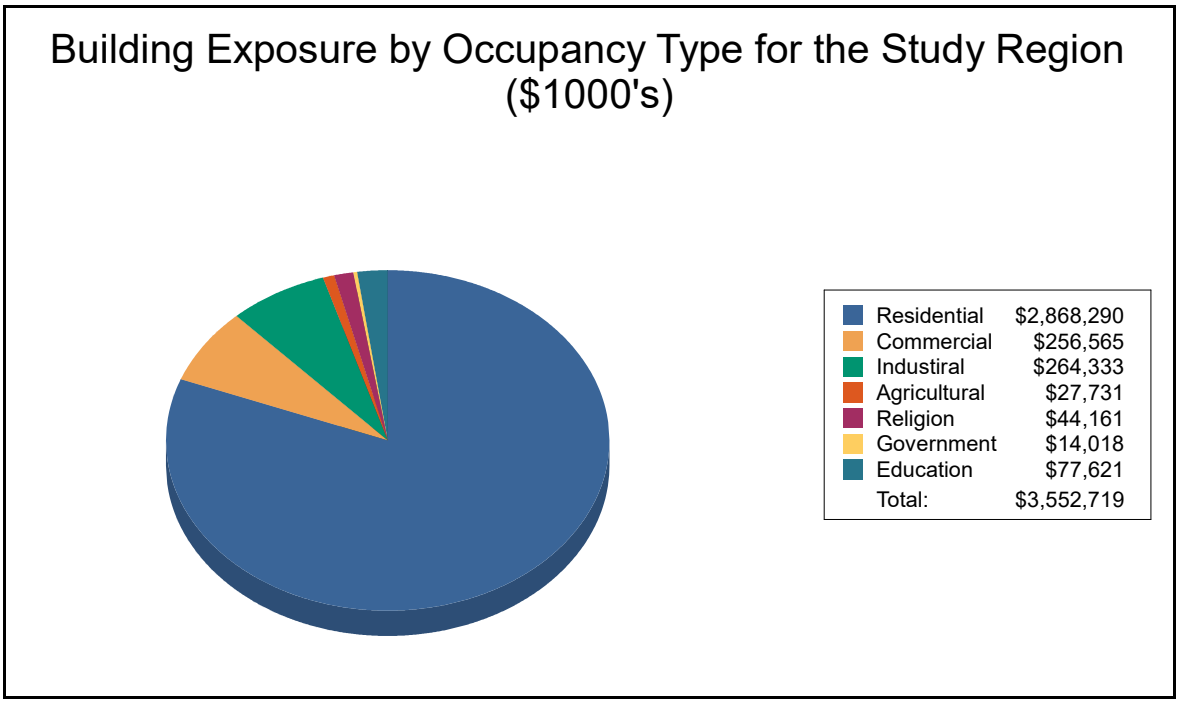
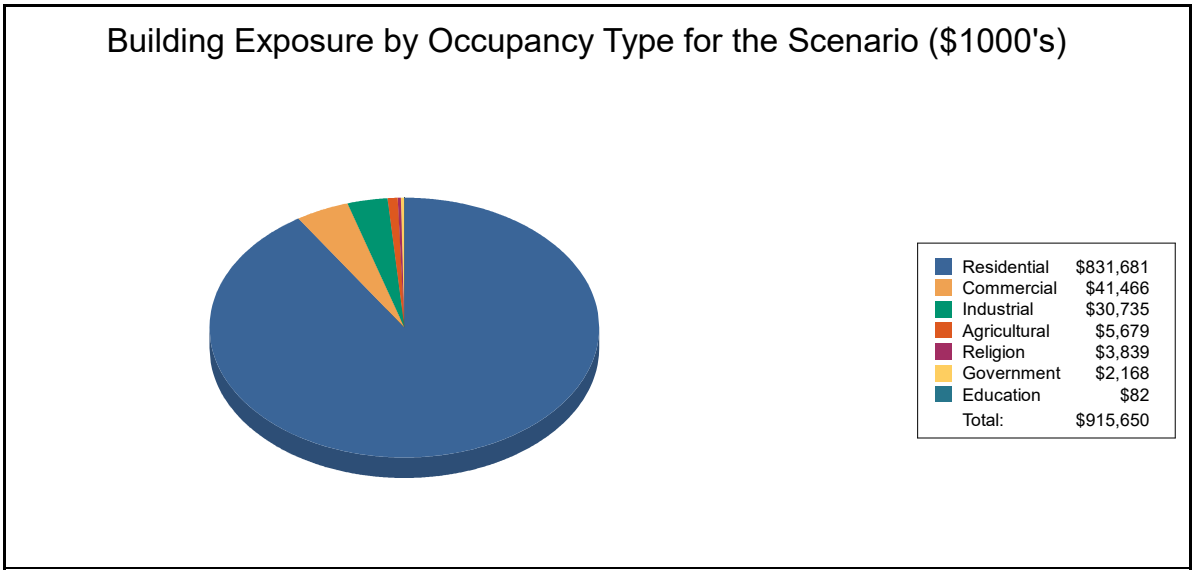


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	831,681	90.8%
Commercial	41,466	4.5%
Industrial	30,735	3.4%
Agricultural	5,679	0.6%
Religion	3,839	0.4%
Government	2,168	0.2%
Education	82	0.0%
Total	**915,650**	**100.0%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 6 fire stations, 6 police stations and no emergency operation centers.

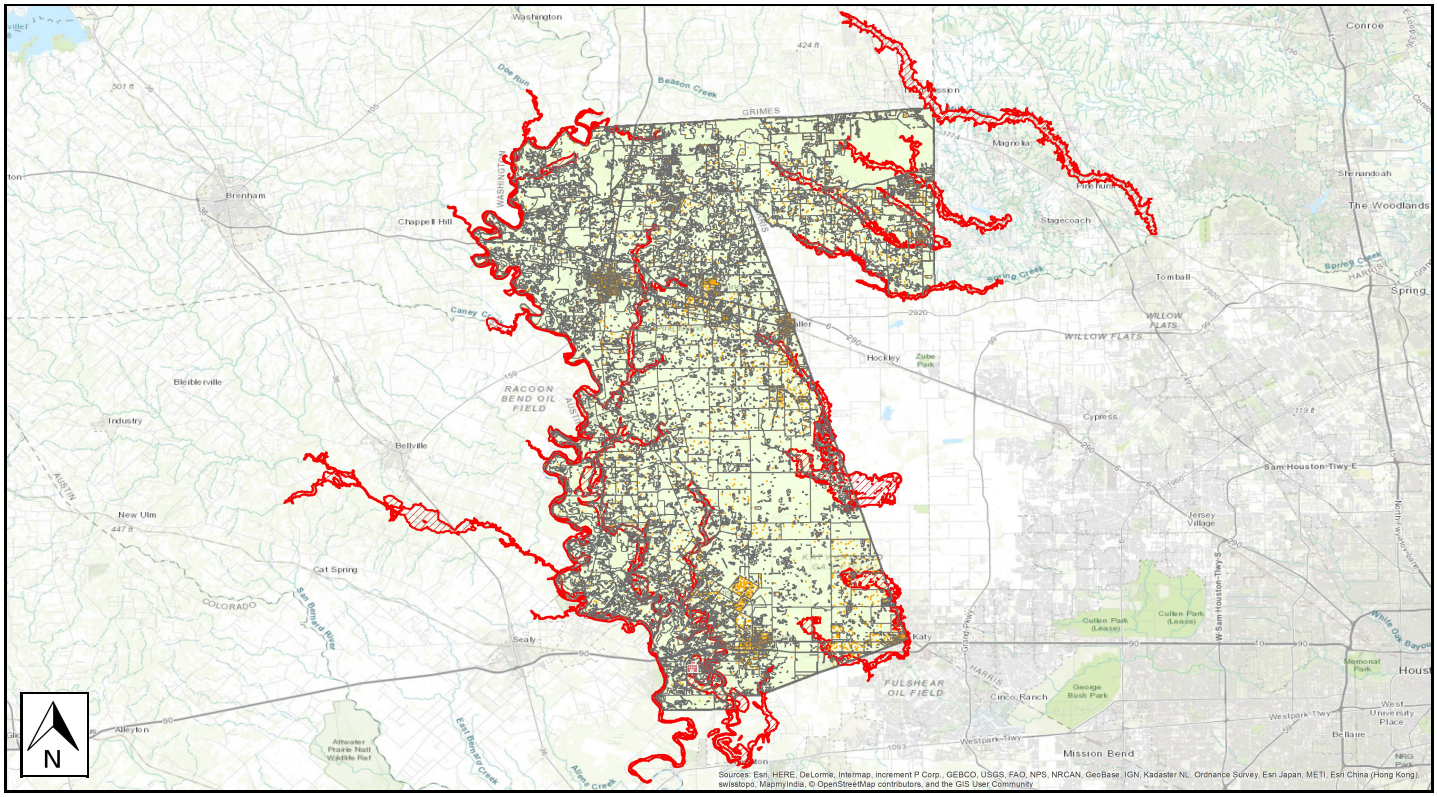
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Waller County
Scenario Name:	500-Year
Return Period Analyzed:	500
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 54 buildings will be at least moderately damaged. This is over 67% of the total number of buildings in the scenario. There are an estimated 3 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

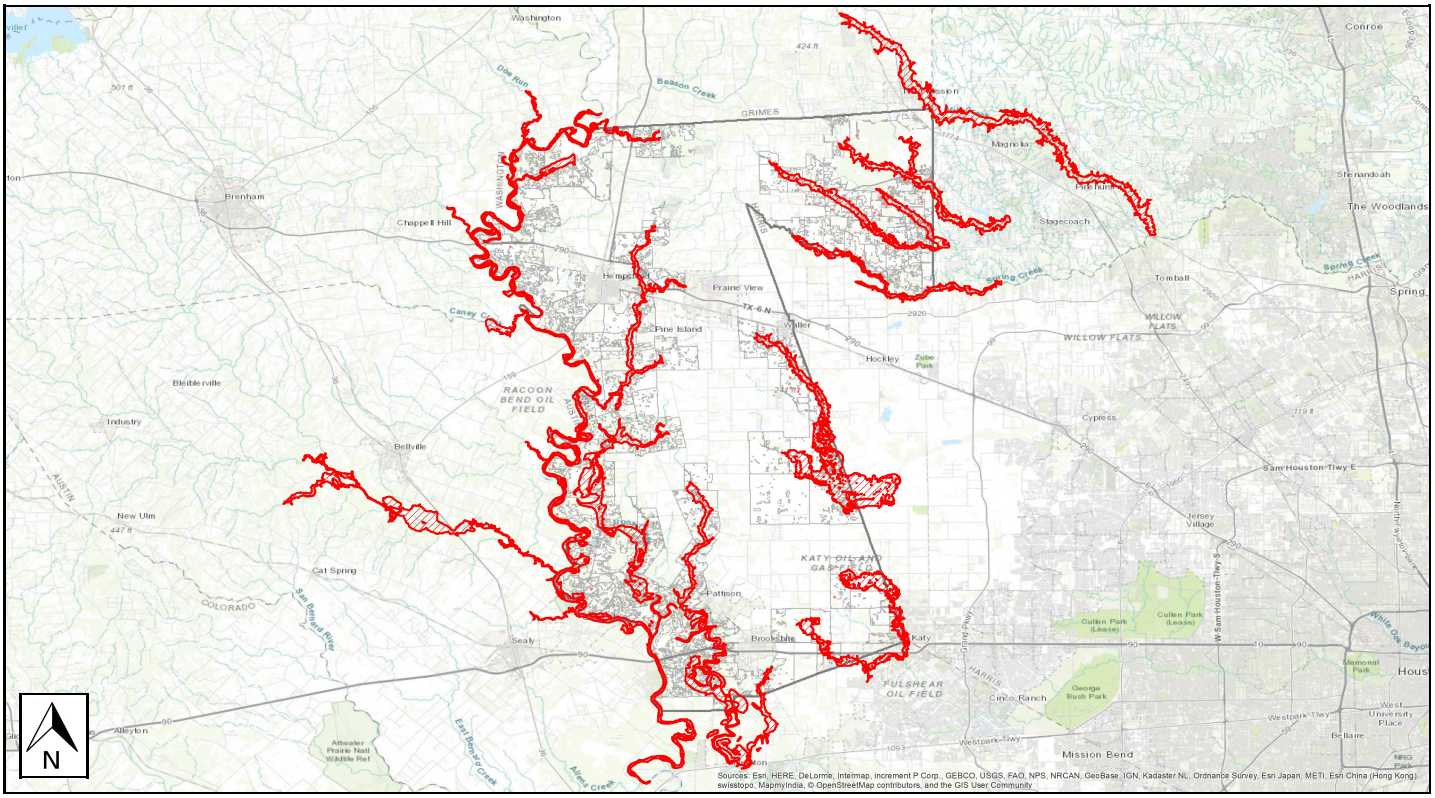


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	1	100.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	29	35.37	33	40.24	9	10.98	5	6.10	3	3.66	3	3.66
Total	**29**		**33**		**9**		**5**		**4**		**3**	

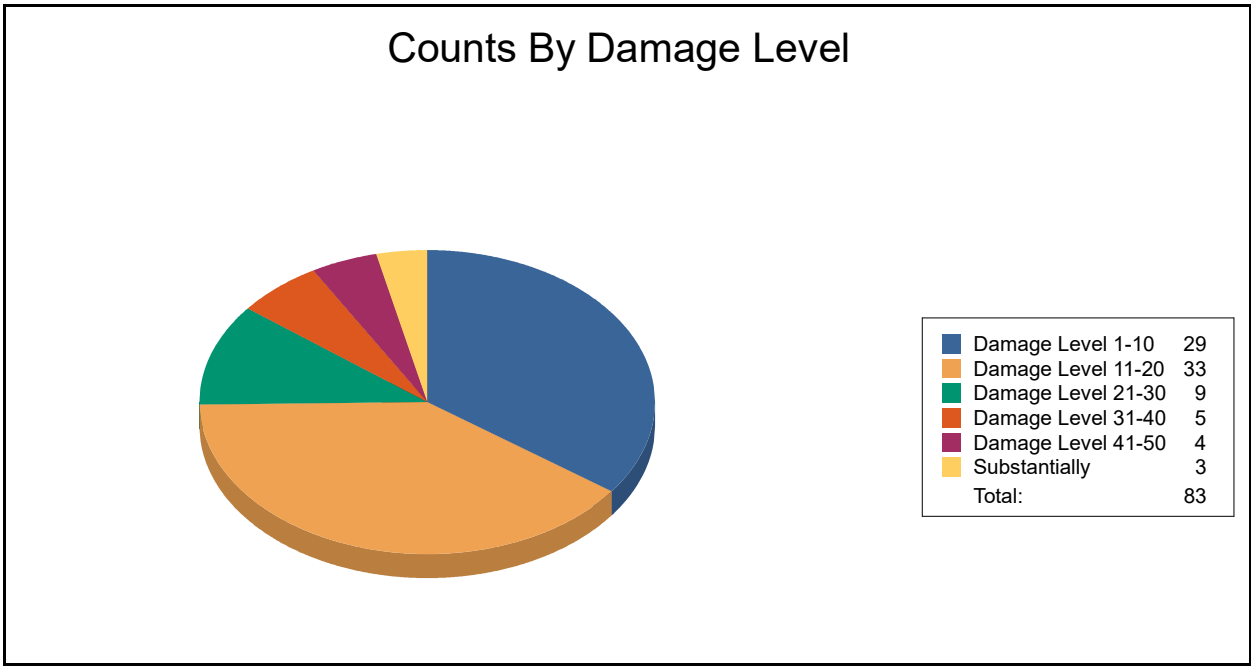


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	2	40	3	60
Masonry	1	50	1	50	0	0	0	0	0	0	0	0
Steel	0	0	0	0	0	0	0	0	1	100	0	0
Wood	28	37	32	43	9	12	5	7	1	1	0	0

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	6	0	0	0
Hospitals	0	0	0	0
Police Stations	6	0	0	0
Schools	15	1	0	1

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

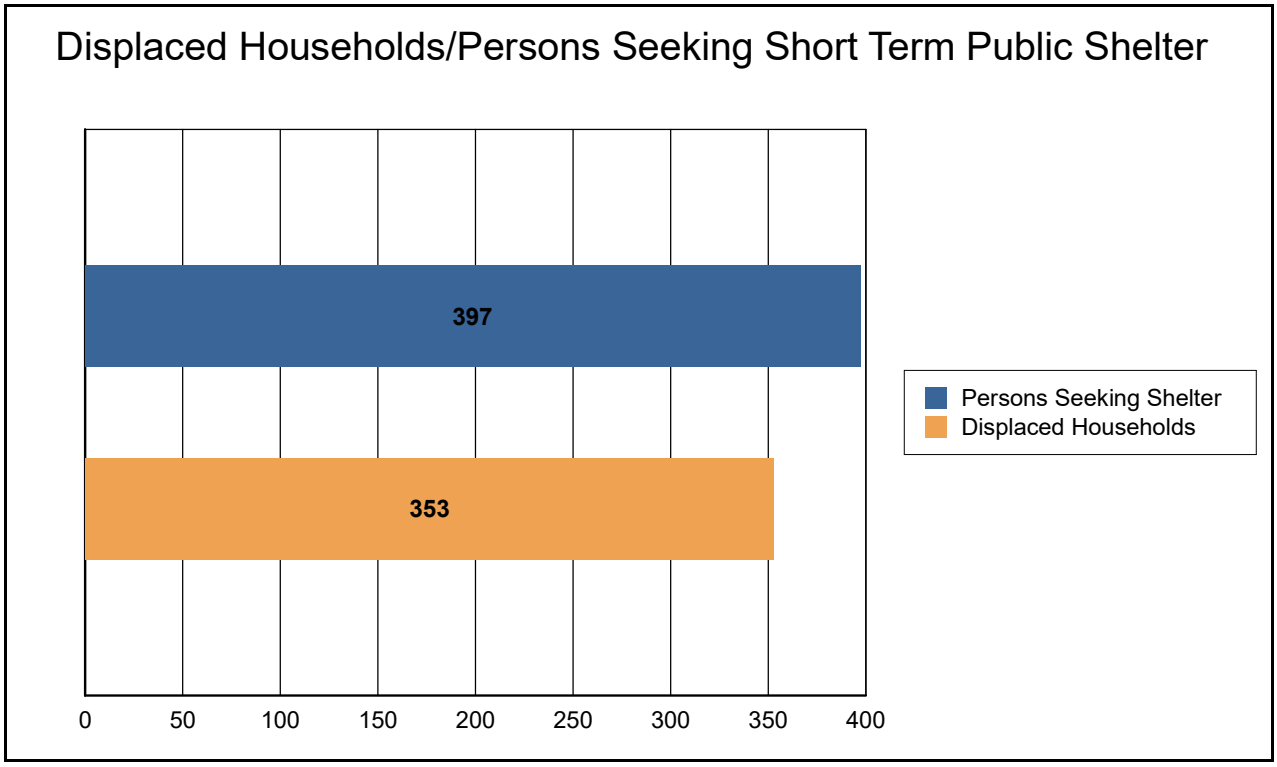
Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

Analysis has not been performed for this Scenario.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 353 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 397 people (out of a total population of 43,205) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 28.84 million dollars, which represents 3.15 % of the total replacement value of the scenario buildings.

Building-Related Losses

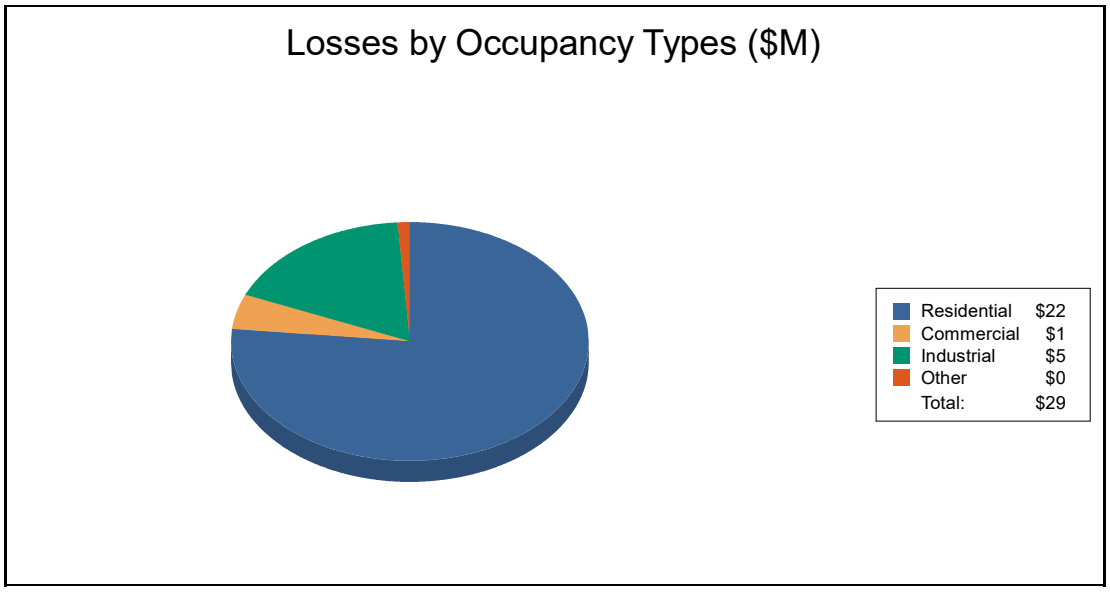
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 28.80 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 76.59% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	14.25	0.34	1.61	0.04	16.24
	Content	7.82	1.03	3.05	0.25	12.15
	Inventory	0.00	0.03	0.38	0.01	0.41
	Subtotal	**22.07**	**1.40**	**5.04**	**0.29**	**28.80**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.01
	Relocation	0.01	0.00	0.00	0.00	0.02
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.01	0.01
	Subtotal	**0.02**	**0.01**	**0.00**	**0.01**	**0.04**
ALL	**Total**	**22.09**	**1.41**	**5.04**	**0.30**	**28.84**



Appendix A: County Listing for the Region

Texas

- Waller

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Texas				
Waller	43,205	2,868,290	684,429	3,552,719
Total	**43,205**	**2,868,290**	**684,429**	**3,552,719**
Total Study Region	**43,205**	**2,868,290**	**684,429**	**3,552,719**

Quick Assessment Report

November 8, 2017

Study Region : Waller County

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	518
Number of Census Tracts	6
Number of People in the Region	43,205

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	14,520	2,868,290
Commercial	617	256,565
Other	456	427,864
Total	15,593	3,552,719

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	3	0	0	0	3
20	108	4	0	0	111
50	1,068	110	4	7	1,189
100	2,328	376	26	33	2,763
200	3,365	816	96	98	4,374
500	4,216	1,530	291	268	6,305
1000	5,025	2,501	608	545	8,679

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	6	0	0	0	6
20	119	4	0	0	123
50	1,139	128	7	8	1,282
100	2,470	431	37	34	2,971
200	3,566	924	123	100	4,713
500	4,462	1,712	358	273	6,804
1000	5,300	2,758	726	555	9,339

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	1	0
200	19	1
500	170	38
1000	456	106

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		***Business Interruption***
ReturnPeriod	***Residential***	***Total***	***(Income) Losses***
10	306	307	0
20	5,767	5,935	273
50	27,161	30,514	3,199
100	62,848	72,242	9,520
200	120,981	143,939	22,223
500	240,883	297,195	47,698
1000	422,377	502,212	80,881
Annualized	2,823	3,295	439

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

Hazus-MH: Hurricane Global Risk Report

Region Name: WL

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Wednesday, November 08, 2017

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Texas

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 517.82 square miles and contains 6 census tracts. There are over 14 thousand households in the region and has a total population of 43,205 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 15 thousand buildings in the region with a total building replacement value (excluding contents) of 3,553 million dollars (2014 dollars). Approximately 93% of the buildings (and 81% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 15,593 buildings in the region which have an aggregate total replacement value of 3,553 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

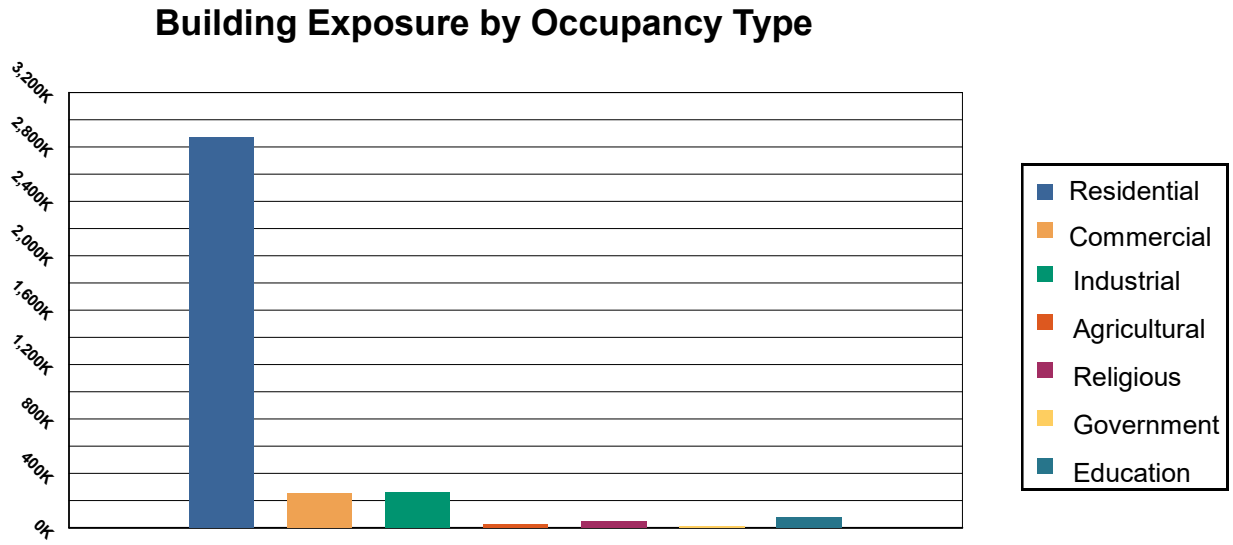


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	2,868,290	80.74 %
Commercial	256,565	7.22%
Industrial	264,333	7.44%
Agricultural	27,731	0.78%
Religious	44,161	1.24%
Government	14,018	0.39%
Education	77,621	2.18%
Total	**3,552,719**	**100.00%**

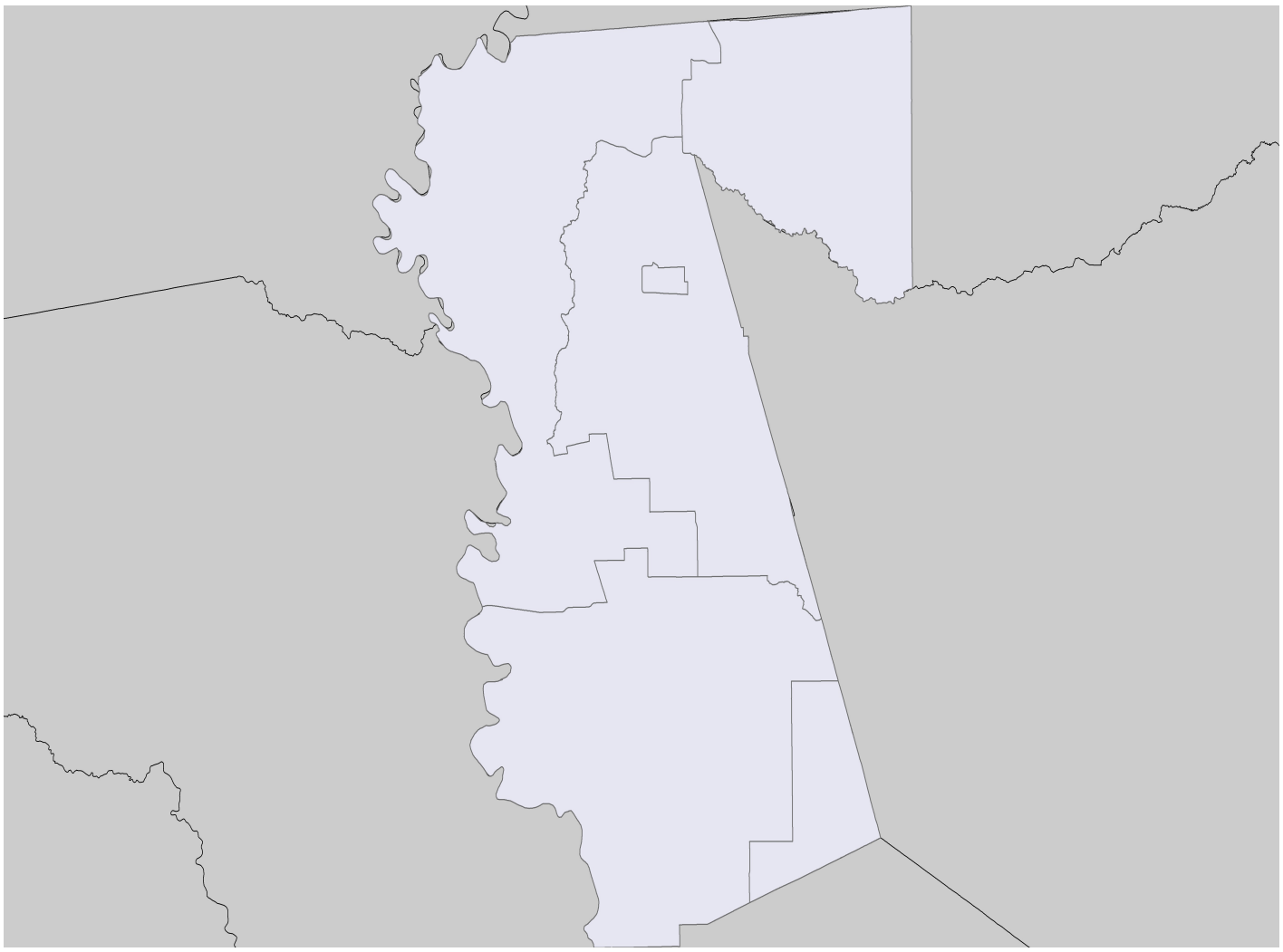
Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 6 fire stations, 6 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Thematic Map with peak gust windfield and HU track



Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 501 buildings will be at least moderately damaged. This is over 3% of the total number of buildings in the region. There are an estimated 34 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

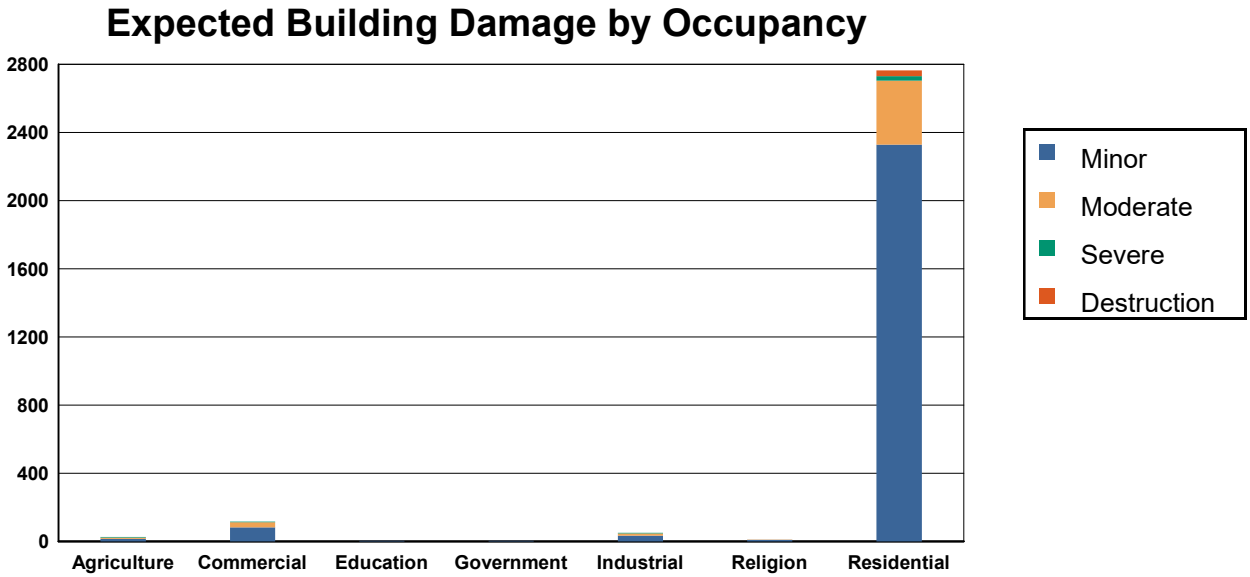


Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	83	75.78	14	12.79	7	6.73	4	3.95	1	0.74
Commercial	501	81.21	81	13.18	31	5.01	4	0.58	0	0.01
Education	19	85.64	2	10.95	1	3.12	0	0.29	0	0.00
Government	17	86.86	2	10.41	1	2.53	0	0.20	0	0.00
Industrial	191	79.45	34	14.04	13	5.50	2	0.95	0	0.06
Religion	54	84.30	8	12.33	2	3.08	0	0.29	0	0.00
Residential	11,757	80.97	2,328	16.03	376	2.59	26	0.18	33	0.23
Total	**12,622**		**2,470**		**431**		**37**		**34**	

Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	102	80.09	18	13.91	7	5.48	1	0.51	0	0.00
Masonry	883	79.07	180	16.11	46	4.09	6	0.58	2	0.16
MH	3,603	98.57	30	0.82	14	0.39	1	0.02	7	0.20
Steel	195	80.17	31	12.76	15	6.14	2	0.92	0	0.01
Wood	7,507	77.75	1,848	19.14	262	2.72	22	0.22	16	0.17

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

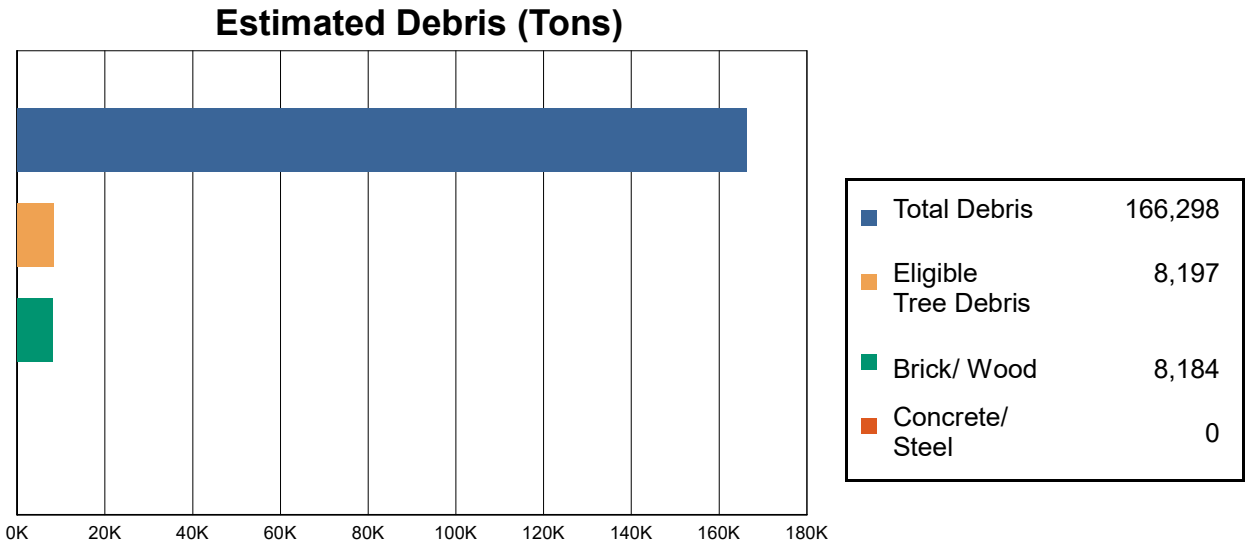
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	6	0	0	6
Police Stations	6	0	0	6
Schools	15	0	0	9

Induced Hurricane Damage

Debris Generation

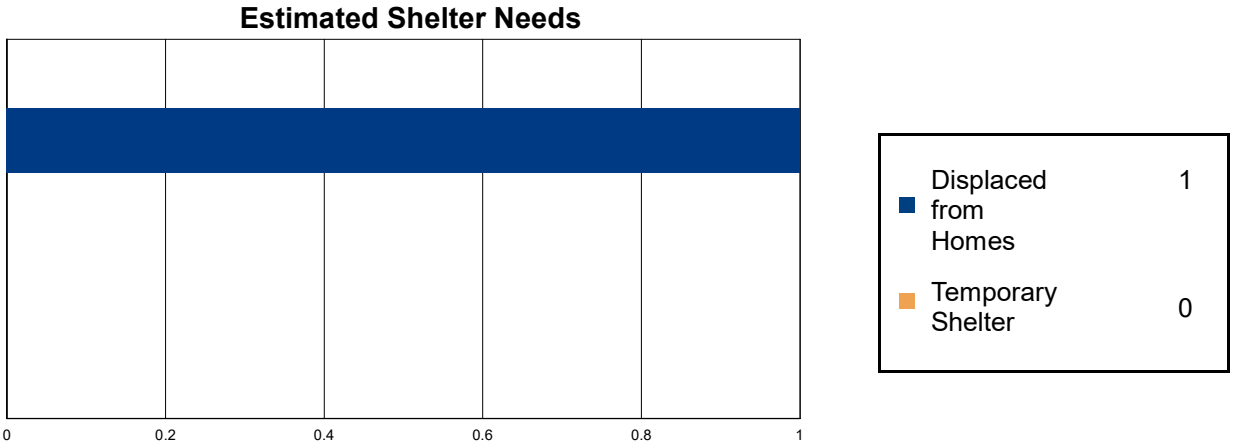


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 166,298 tons of debris will be generated. Of the total amount, 149,931 tons (90%) is Other Tree Debris. Of the remaining 16,367 tons, Brick/Wood comprises 50% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 327 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 8,197 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 1 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 43,205) will seek temporary shelter in public shelters.

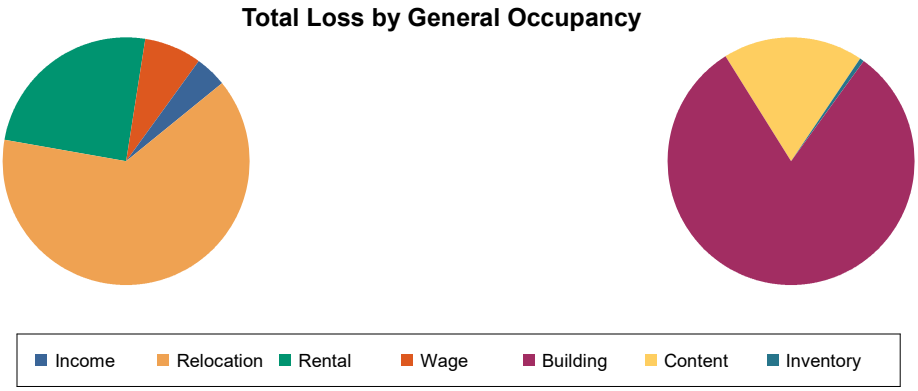
Economic Loss

The total economic loss estimated for the hurricane is 81.8 million dollars, which represents 2.30 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 82 million dollars. 4% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 86% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.



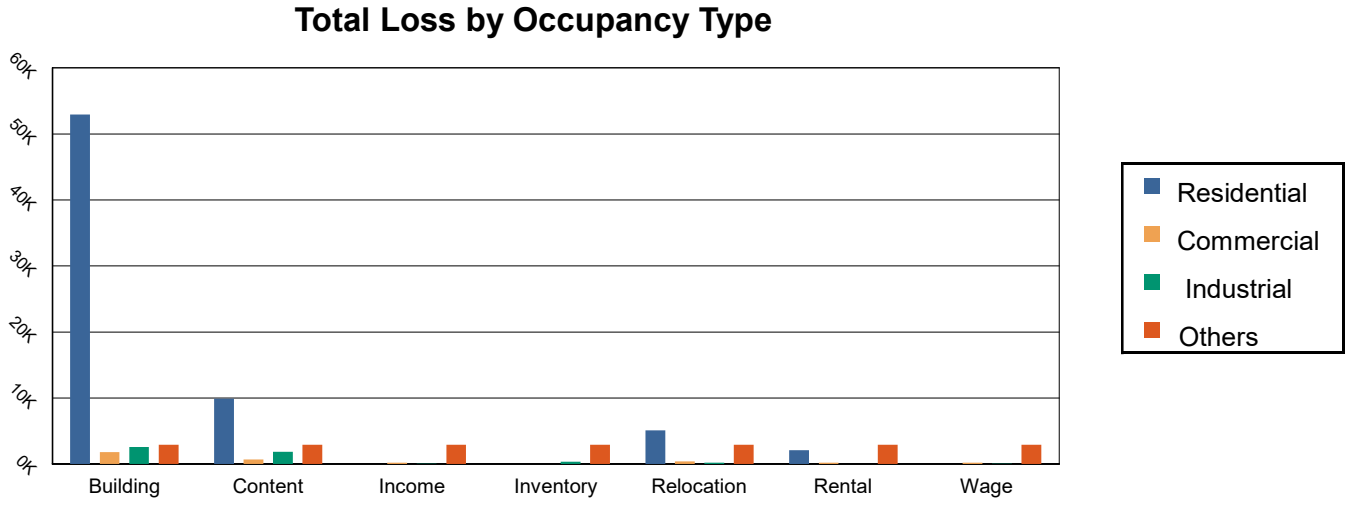


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	52,962.15	1,831.21	2,601.28	1,276.63	58,671.27
	Content	9,886.01	674.29	1,849.04	760.30	13,169.64
	Inventory	0.00	27.47	335.06	38.13	400.66
	Subtotal	**62,848.16**	**2,532.97**	**4,785.39**	**2,075.06**	**72,241.57**
Business Interruption Loss						
	Income	3.70	224.57	51.32	105.36	384.95
	Relocation	5,129.74	412.96	200.29	329.03	6,072.02
	Rental	2,088.42	215.45	35.57	15.32	2,354.77
	Wage	8.66	230.89	62.68	405.87	708.10
	Subtotal	**7,230.51**	**1,083.87**	**349.86**	**855.59**	**9,519.83**
Total						
	Total	**70,078.67**	**3,616.84**	**5,135.25**	**2,930.65**	**81,761.40**

Appendix A: County Listing for the Region

Texas
- Waller

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Texas				
Waller	43,205	2,868,290	684,429	3,552,719
Total	**43,205**	**2,868,290**	**684,429**	**3,552,719**
Study Region Total	**43,205**	**2,868,290**	**684,429**	**3,552,719**

Hazus-MH: Hurricane Global Risk Report

Region Name: WL

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Wednesday, November 08, 2017

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Texas

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 517.82 square miles and contains 6 census tracts. There are over 14 thousand households in the region and has a total population of 43,205 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 15 thousand buildings in the region with a total building replacement value (excluding contents) of 3,553 million dollars (2014 dollars). Approximately 93% of the buildings (and 81% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 15,593 buildings in the region which have an aggregate total replacement value of 3,553 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

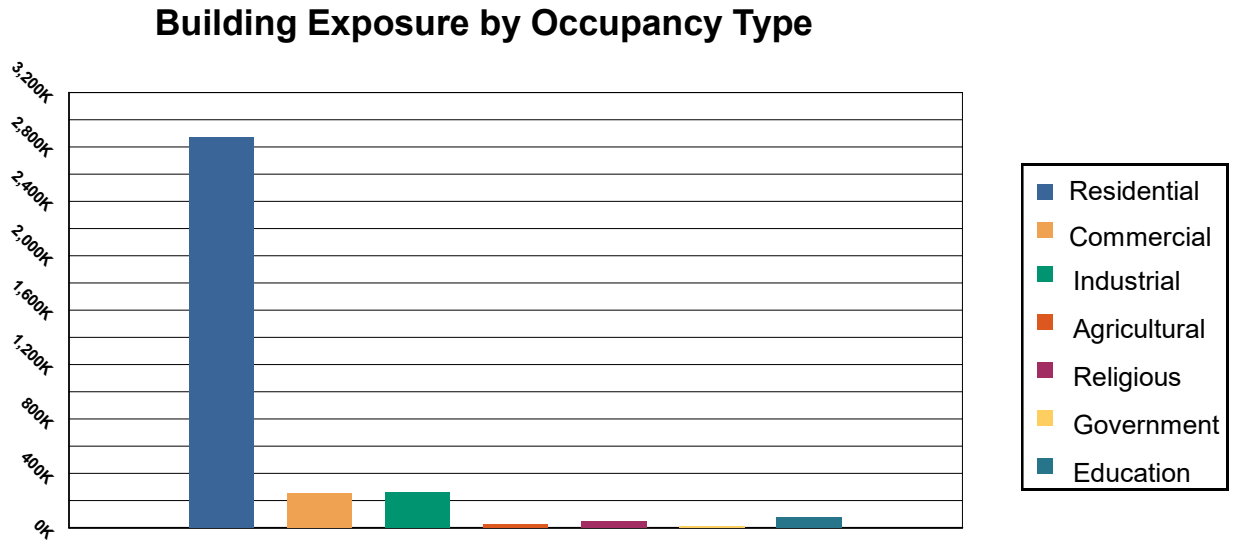


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	2,868,290	80.74 %
Commercial	256,565	7.22%
Industrial	264,333	7.44%
Agricultural	27,731	0.78%
Religious	44,161	1.24%
Government	14,018	0.39%
Education	77,621	2.18%
Total	**3,552,719**	**100.00%**

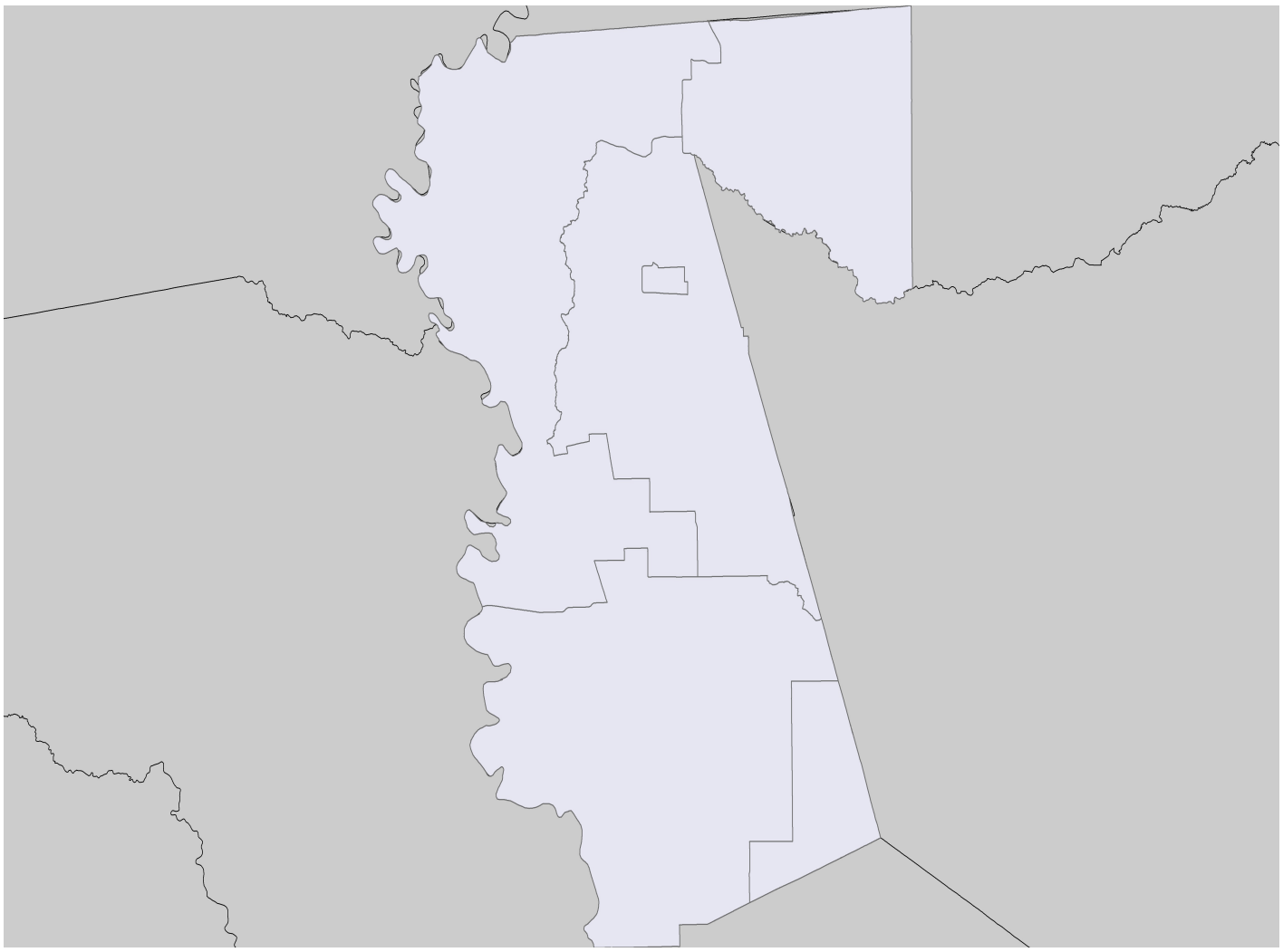
Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 6 fire stations, 6 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Thematic Map with peak gust windfield and HU track



Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 2,343 buildings will be at least moderately damaged. This is over 15% of the total number of buildings in the region. There are an estimated 273 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

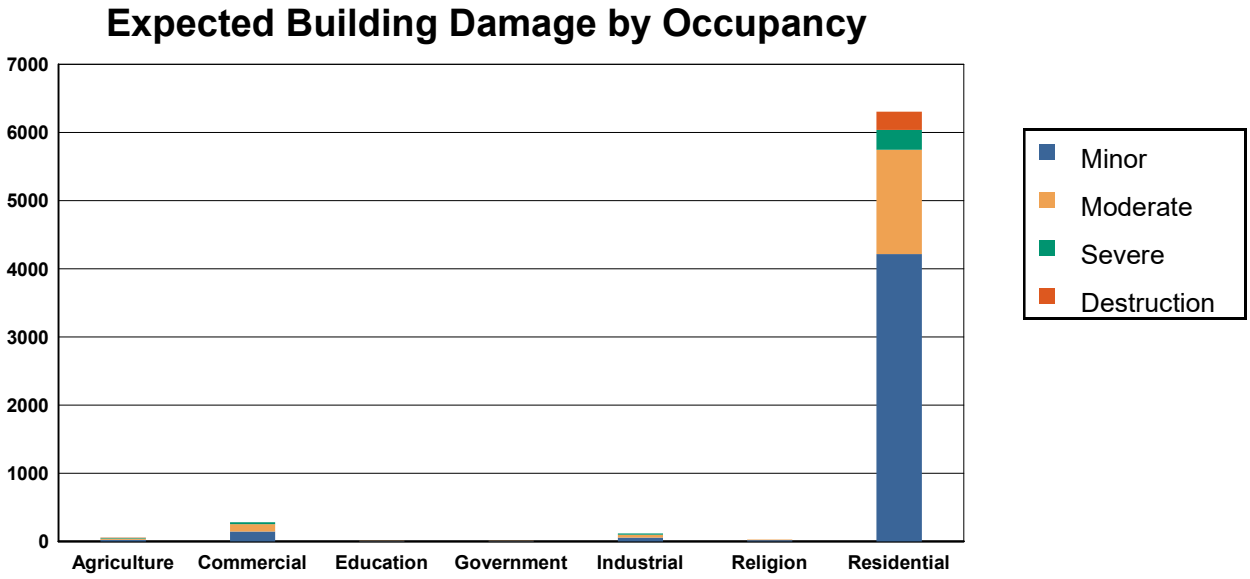


Table 2: Expected Building Damage by Occupancy : 500 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	54	49.08	21	18.86	18	16.26	13	12.04	4	3.76
Commercial	335	54.25	145	23.50	106	17.17	31	4.97	1	0.11
Education	13	58.86	5	21.98	3	14.66	1	4.50	0	0.00
Government	12	59.06	5	22.81	3	14.22	1	3.92	0	0.00
Industrial	124	51.47	54	22.40	43	18.01	19	7.83	1	0.29
Religion	36	56.37	16	25.38	9	14.11	3	4.14	0	0.00
Residential	8,215	56.58	4,216	29.04	1,530	10.53	291	2.00	268	1.84
Total	**8,789**		**4,462**		**1,712**		**358**		**273**	

Table 3: Expected Building Damage by Building Type : 500 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	65	51.57	28	22.05	26	20.47	7	5.90	0	0.00
Masonry	590	52.83	321	28.70	158	14.12	36	3.25	12	1.09
MH	3,453	94.48	78	2.12	68	1.85	7	0.20	49	1.34
Steel	128	52.50	48	19.76	48	19.64	19	7.98	0	0.12
Wood	4,906	50.81	3,306	34.23	1,070	11.08	228	2.36	146	1.51

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

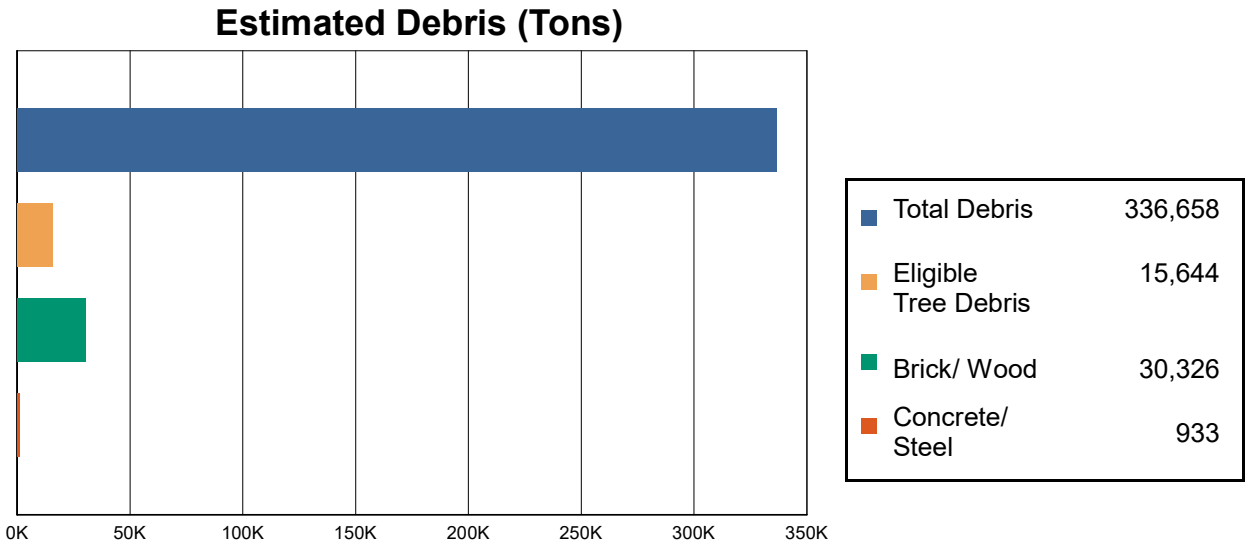
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	6	0	0	6
Police Stations	6	0	0	6
Schools	15	4	0	0

Induced Hurricane Damage

Debris Generation

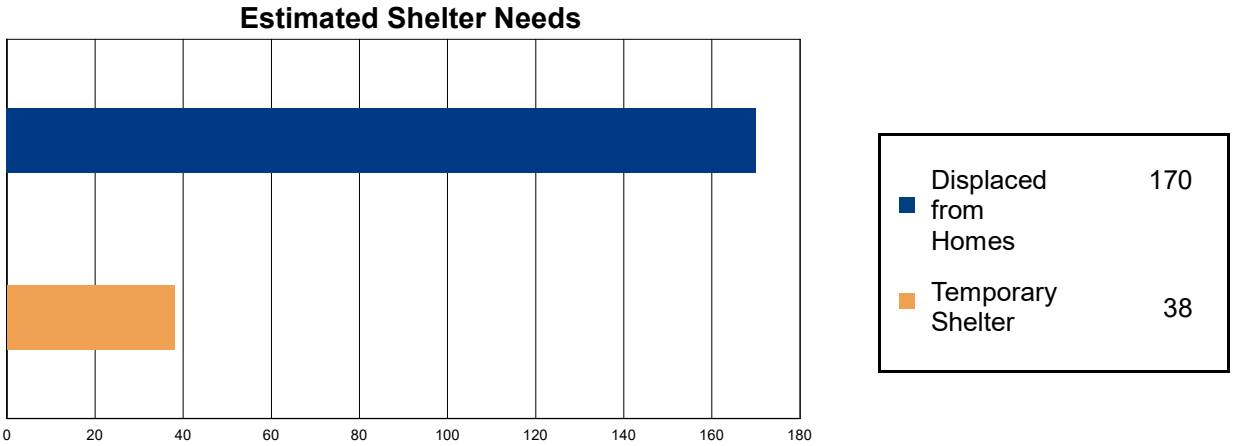


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 336,658 tons of debris will be generated. Of the total amount, 290,003 tons (86%) is Other Tree Debris. Of the remaining 46,655 tons, Brick/Wood comprises 65% of the total, Reinforced Concrete/Steel comprises of 2% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 1240 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 15,644 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 170 households to be displaced due to the hurricane. Of these, 38 people (out of a total population of 43,205) will seek temporary shelter in public shelters.

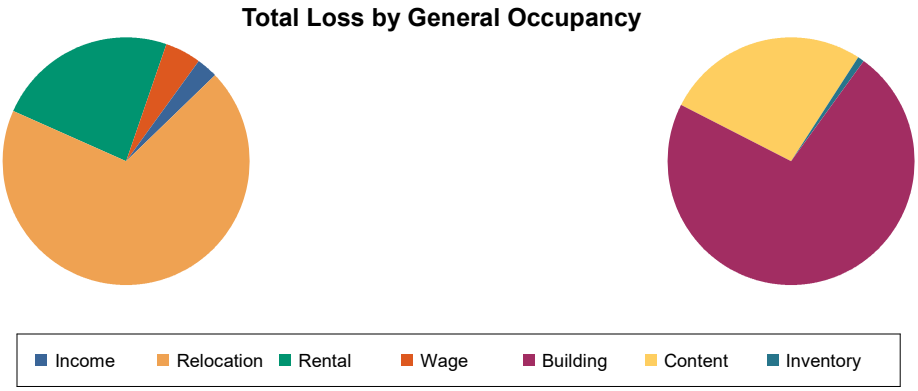
Economic Loss

The total economic loss estimated for the hurricane is 344.9 million dollars, which represents 9.71 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 345 million dollars. 4% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 81% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.



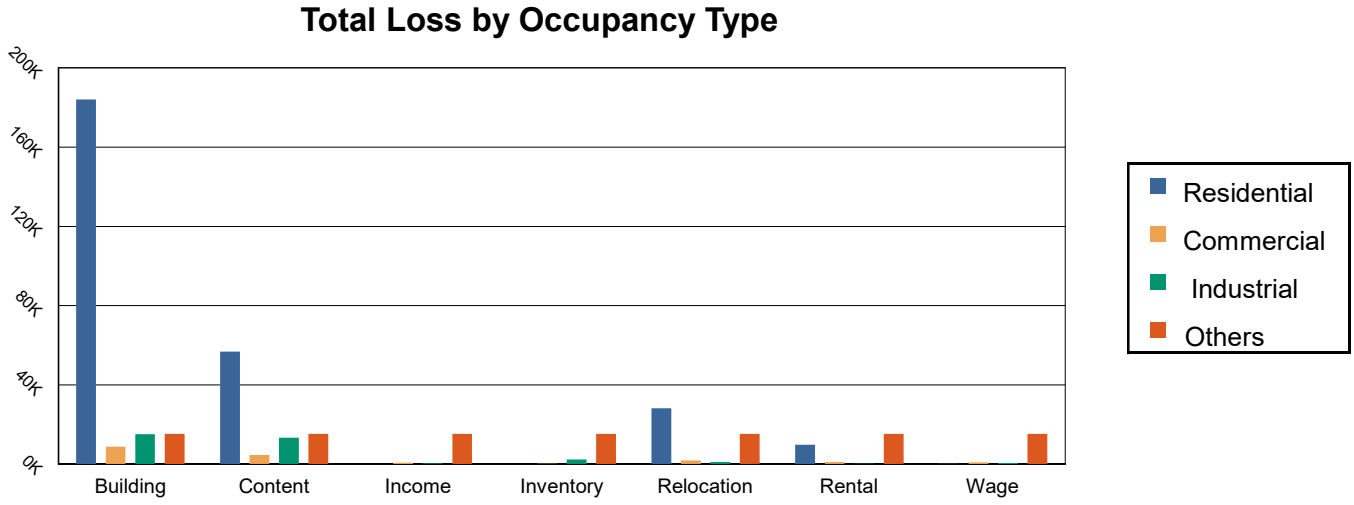


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	184,128.71	8,759.43	15,017.29	7,267.73	215,173.15
	Content	56,754.27	4,534.90	13,292.15	4,832.65	79,413.97
	Inventory	0.00	179.86	2,267.02	160.63	2,607.51
	Subtotal	**240,882.98**	**13,474.18**	**30,576.45**	**12,261.01**	**297,194.62**
Business Interruption Loss						
	Income	69.72	731.43	349.26	212.93	1,363.34
	Relocation	28,148.20	1,895.01	1,038.87	1,798.66	32,880.74
	Rental	9,823.21	1,055.80	216.57	97.65	11,193.23
	Wage	163.29	798.97	490.19	808.66	2,261.11
	Subtotal	**38,204.43**	**4,481.22**	**2,094.88**	**2,917.90**	**47,698.43**
Total						
	Total	**279,087.40**	**17,955.40**	**32,671.34**	**15,178.91**	**344,893.05**

Appendix A: County Listing for the Region

Texas
- Waller

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Texas				
Waller	43,205	2,868,290	684,429	3,552,719
Total	**43,205**	**2,868,290**	**684,429**	**3,552,719**
Study Region Total	**43,205**	**2,868,290**	**684,429**	**3,552,719**

2017

Appendix D – Repetitive Loss Properties

APPENDIX D: REPETITIVE LOSS PROPERTIES

Prop Locatr	Community Name	Insured?	Occupancy	Total Losses	Total Paid	SRL Indicator
0249632	Brookshire, City of	Yes	Single Family	3	130,478.45	
0258504	Brookshire, City of	Yes	Single Family	2	67,444.30	
0257763	Brookshire, City of	Yes	Single Family	2	134,316.81	
0118780	Hempstead, City of	Yes	Single Family	3	91,983.06	
0239615	Hempstead, City of	Yes	Single Family	4	86,593.47	V
0258676	Pattison, City of	Yes	Single Family	2	46,733.92	
0247157	Prairie View, City of	Yes	Single Family	2	56,014.28	
0249945	Prairie View, City of	Yes	Single Family	2	68,149.99	
0248041	Prairie View, City of	No	Single Family	3	95,269.04	
0249789	Prairie View, City of	Yes	Single Family	2	153,142.09	
0248012	Prairie View, City of	Yes	2-4 Family	3	88,345.83	
0248938	Prairie View, City of	Yes	Single Family	2	100,271.72	
0249806	Waller County	Yes	Other-Nonres	2	77,644.60	
0260855	Waller County	Yes	Single Family	2	99,518.31	
0104665	Waller County	No	Single Family	2	26,843.51	
0243412	Waller County	No	Single Family	2	81,421.82	
0249906	Waller County	No	Single Family	2	5,500.57	
0249189	Waller County	No	Single Family	2	11,349.28	
0249043	Waller County	Yes	Single Family	3	381,649.21	
0071438	Waller County	SDF	Single Family	5	366,471.58	V
0262057	Waller County	Yes	Single Family	2	115,342.04	
0248967	Waller County	Yes	Single Family	2	34,997.60	
0097241	Waller County	No	Single Family	4	230,429.87	VU
0097249	Waller County	No	Single Family	6	66,604.96	VU
0249857	Waller County	Yes	Single Family	3	564,840.95	P
0071980	Waller County	No	Single Family	7	283,549.41	VU
0251441	Waller County	No	Single Family	3	647,551.48	
0248092	Waller County	Yes	Single Family	2	162,211.26	
0247874	Waller County	Yes	Single Family	3	114,569.23	
0258287	Waller County	Yes	Single Family	2	279,452.29	
0242106	Waller County	SDF	Single Family	4	253,762.17	V
0097234	Waller County	SDF	Single Family	8	365,555.87	V
0249809	Waller County	Yes	Single Family	2	19,294.64	
0247851	Waller County	Yes	Single Family	3	27,371.13	
0250075	Waller County	No	Single Family	2	90,281.29	
0249344	Waller County	No	Single Family	2	51,298.06	
0262390	Waller County	Yes	Single Family	2	130,563.50	
0117183	Waller County	Yes	Single Family	2	19,255.59	
0251386	Waller County	Yes	Single Family	3	810,666.25	
0248279	Waller County	Yes	Single Family	2	98,618.82	
0259375	Waller County	Yes	Single Family	2	186,188.87	P

0247174	Waller County	Yes	Single Family	3	215,628.65	
0258597	Waller County	Yes	Single Family	2	136,611.46	
0259633	Waller County	Yes	Single Family	2	321,060.17	
0249039	Waller County	Yes	Single Family	2	138,734.72	
0099038	Waller County	Yes	Single Family	3	97,148.59	
0098379	Waller County	No	Single Family	4	77,800.91	VU
0246933	Waller County	Yes	Single Family	2	11,840.14	
0213231	Waller County	No	Single Family	2	3,752.71	
0249141	Waller County	Yes	Single Family	3	195,406.97	
0250825	Waller County	Yes	Single Family	2	112,869.47	
0246994	Waller County	No	Single Family	2	35,717.49	
0250452	Waller County	Yes	Single Family	2	246,741.43	
0247900	Waller County	Yes	Single Family	2	70,113.06	
0250896	Waller County	No	Single Family	2	95,308.97	
0118893	Waller County	SDF	Single Family	4	132,145.85	V
0249015	Waller County	Yes	Single Family	2	40,586.06	
0258523	Waller County	Yes	Single Family	2	8,100.35	
0185573	Waller County	No	Single Family	3	151,756.70	
0103636	Waller County	Yes	Single Family	2	26,569.96	
0099000	Waller County	Yes	Single Family	2	33,288.48	
0040759	Waller County	No	Single Family	3	28,848.53	
0118890	Waller County	No	Single Family	2	19,361.54	
0248046	Waller County	Yes	Single Family	2	54,137.53	
0247880	Waller County	Yes	Single Family	2	182,325.02	
0249742	Waller County	Yes	Single Family	2	67,757.94	
0100212	Waller County	Yes	Single Family	4	81,893.50	V
0249633	Waller County	No	Single Family	2	123,924.15	
0097310	Waller County	Yes	Single Family	5	64,705.47	
0249103	Waller County	No	Single Family	2	48,579.24	
0262109	Waller County	Yes	Single Family	2	292,714.41	
0098400	Waller County	No	Single Family	3	110,132.30	
0168150	Waller County	No	Single Family	2	55,407.32	
0238920	Waller County	No	Single Family	2	13,695.71	
0080793	Waller County	Yes	Single Family	6	162,697.79	V
0250737	Waller County	Yes	Single Family	2	188,621.05	
0257942	Waller County	Yes	Single Family	2	103,713.03	
0249021	Waller County	Yes	Single Family	2	4,744.17	
0112415	Waller County	SDF	Single Family	5	97,731.29	V
0101011	Waller County	Yes	Single Family	6	191,574.67	V
0089472	Waller County	SDF	Single Family	6	167,753.90	V
0243798	Waller County	No	Single Family	4	555,730.92	VU
0248992	Waller County	Yes	Single Family	2	107,831.53	
0036263	Waller County	No	Single Family	11	219,465.83	MVU

2017

Appendix F: Plan Adoption

RESOLUTION
For Adoption of the Hazard Mitigation Plan for the H-GAC Region

WHEREAS, certain areas of Waller County are subject to periodic flooding and other natural hazards with the potential to cause damage to people and properties within the area; and

WHEREAS, the County desires to prepare and mitigate for such circumstances; and

WHEREAS, under the Disaster Mitigation Act of 2000, the United States Federal Emergency Management Agency ("FEMA") requires that local jurisdictions have in place a FEMA-approved Hazard Mitigation Action Plan as a condition of receipt of certain future Federal mitigation funding after November 1, 2004; and

WHEREAS, the cities and counties in the H-GAC Region, in order to meet this requirement, have initiated development of a regional, multi-jurisdictional Hazard Mitigation Plan, including Waller County;

NOW, THEREFORE, BE IT RESOLVED, that this Commissioners' Court of Waller County, Texas, hereby:

Adopts the Houston-Galveston Area Council of Governments – Regional Hazard Mitigation Plan; and

Vests the Office of Emergency Management with the responsibility, authority, and the means to:

a) Inform all concerned parties of this action;

b) Develop an addendum to this Hazard Mitigation Plan if the County's unique situation warrants such an addendum; and

Appoints the Office of Emergency Management to ensure that the Hazard Mitigation Plan be reviewed at least annually and that any needed adjustments to the County's addendum to the Hazard Mitigation Plan be developed and presented to the Commissioners Court of Waller County, Texas for consideration; and

Agrees to take such other official action as may be reasonably necessary to carry out the objectives of the Hazard Mitigation Plan.

Adopted, this the 26th day of September 2018.

Carbett "Trey" J. Duhon, III
County Judge

John A. Amsler
Commissioner, Precinct 1

Russell Klecka
Commissioner, Precinct 2

Jeron Barnett
Commissioner, Precinct 3

Justin Beckendorff
Commissioner Precinct 4