HAZARD MITIGATION PLAN

Jackson County

Prepared For:

Jackson County

Office of Emergency Management

Jackson County
HAZARD MITIGATION PLAN UPDATE

Mar. 2022

Prepared for:

Jackson County Office of Emergency Management
115 W. Main, Room 104
Edna, TX 77957

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EXECUTIVE SUMMARY

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

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

Jackson County and a partnership of local governments within the county have developed and maintained a hazard mitigation plan to reduce risks from natural disasters and to comply with the DMA.

PLAN UPDATE

Federal regulations require monitoring, evaluation, and updating of hazard mitigation plans. An update provides an opportunity to reevaluate recommendations, monitor the impacts of implemented actions, and evaluate whether there is a need to change the focus of mitigation strategies. A jurisdiction covered by a hazard mitigation plan that has expired is no longer in compliance with the DMA.

Jackson County and its communities participated in previous hazard mitigation plans as part of the Texas Colorado River Floodplain Coalition (TCRFC). In accordance with FEMA guidelines that require individual hazard mitigation plans for each county and Texas Division of Emergency Management's 2010 "two-county maximum" policy, an update was developed to be specific to Jackson County and its participating communities: the Cities of Edna and Ganado.

In accordance with update requirements, this update to *Jackson County Hazard Mitigation Plan Update 2016* was conducted. Specifically, this update encompasses the hazard mitigation analysis of Jackson County and its participating communities: the cities of Edna, Ganado, and La Ward. It should be noted that La Ward was added as a separately profiled area in this update of the hazard mitigation plan. In previous plans, analysis and mitigation actions for La Ward were included within Jackson County.

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

- **Phase 1: Organize and Review**
  A planning team was assembled to provide technical support for the plan update, consisting of Scheibe Consulting representatives, key county and city staff. The first step in developing the plan update was to re-establish a planning partnership. Planning partners participating in the update were the Cities of Edna, Ganado, and La Ward. A Steering Committee was assembled to oversee the plan update, consisting of planning partner staff and community representatives from the planning area. Coordination with other county, state, and federal agencies involved in hazard mitigation occurred throughout the plan update process. This phase included a comprehensive review of the previous *Jackson County Hazard Mitigation Plan Update 2016* and existing programs that may support or enhance hazard mitigation actions

- **Phase 2: Update the Risk Assessment**
  Risk assessment is the process of measuring the potential loss of life, personal injury, economic impact, and property damage resulting from natural hazards. This process assesses the vulnerability of people, buildings, and infrastructure to natural hazards. All facets of the risk assessment of the plan were re-visited by the planning team and updated with the best available data and technology. The work included the following:
  - Hazard identification and profiling
  - Assessment of the impact of hazards on physical, social, and economic assets
  - Vulnerability identification
  - Estimation of the cost of potential damage
- **Phase 3: Engage the Public**
  A public involvement strategy agreed upon by the Steering Committee was implemented by the planning team. All meetings were open to the public. Meetings were held to present the risk assessment as well as the draft plan. The public was encouraged to participate through a county-specific hazard mitigation survey, drafting process, and the county website that included information on the plan.
- **Phase 4: Assemble the Updated Plan**
  The planning team and Steering Committee assembled key information into a document to meet the DMA requirements for all planning partners.
- **Phase 5: Adopt/Implement the Plan**
  Once pre-adoption approval has been granted by the Texas Division of Emergency Management and FEMA Region VI, the final adoption phase will begin. Each planning partner will individually adopt the updated plan. The plan maintenance process includes a schedule for monitoring and evaluating the plan's progress annually and producing a plan revision every 5 years. Throughout the life of this plan, a representative of the original Steering Committee will be available to provide consistent guidance and oversight.

MITIGATION GUIDING PRINCIPLE, GOALS, AND OBJECTIVES

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

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

The following plan goals and objectives were determined by the Steering Committee:

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

- **Goal 2:** Protect existing and new properties.
  - **Objective 2.1:** Reduce repetitive losses to the National Flood Insurance Program.
  - **Objective 2.2:** Use the most cost-effective approaches to protect existing buildings and public infrastructure from hazards.
  - **Objective 2.3:** Enact and enforce regulatory measures to ensure that development will not put people in harm's way or increase threats to existing properties.
- **Goal 3:** Increase public understanding, support, and demand for hazard mitigation.
  - **Objective 3.1:** Heighten public awareness of the full range of natural hazards they face.
  - **Objective 3.2:** Educate the public on actions they can take to prevent or reduce the loss of life or property from natural hazards.
  - **Objective 3.3:** Publicize and encourage the adoption of appropriate hazard mitigation measures.
- **Goal 4:** Build and support local capacity and commitment to continuously become less vulnerable to hazards.
  - **Objective 4.1:** Build and support local partnerships to continuously become less vulnerable to hazards.
  - **Objective 4.2:** Build a cadre of committed volunteers to safeguard the community before, during, and after a disaster.
  - **Objective 4.3:** Build hazard mitigation concerns into planning and budgeting processes.
- **Goal 5:** Promote growth in a sustainable manner.
  - **Objective 5.1:** Incorporate hazard mitigation into the long-range planning and development activities.
  - **Objective 5.2:** Promote beneficial uses of hazardous areas while expanding open space and recreational opportunities.
  - **Objective 5.3:** Utilize regulatory approaches to prevent creation of future hazards to life and property.
- **Goal 6:** Maximize the resources for investment in hazard mitigation.
  - **Objective 6.1:** Maximize the use of outside sources of funding.
  - **Objective 6.2:** Maximize participation of property owners in protecting their properties.
  - **Objective 6.3:** Maximize insurance coverage to provide financial protection against hazard events.
  - **Objective 6.4:** Prioritize mitigation projects, based on cost-effectiveness and starting with those sites facing the greatest threat to life, health and property.

IDENTIFIED HAZARD OF CONCERN

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

- Coastal Erosion
- Dam/Levee Failure
- Drought
- Expansive Soils
- Extreme Heat
- Earthquake
- Flood
- Hail
- Hazardous Materials
- Hurricane and Tropical Storm
- Land Subsidence
- Lightning
- Pandemic
- Tornado
- Wildfire
- Wind
- Winter/Ice Storm

MITIGATION ACTIONS

Mitigation actions presented in this plan update are activities designed to reduce or eliminate losses resulting from natural hazards. The update process resulted in the identification of 65 mitigation actions targeted for implementation by individual planning partners as listed in Table ES-1. The Steering Committee ranked the mitigation actions in order of priority, with 1 being the highest priority. The highest priority mitigation actions are shown in red on the table, medium priority actions are shown in yellow, and low priority actions are shown in green.

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
JACKSON COUNTY										
1	Purchase and install shutters for Jackson County Hospital District Facility	Installation of Aluminum All Weather Wind Grade Shutters to protect against hail, hurricane/tropical storms, tornado, and wind.	8	SIP	G1, G2, G6	Court	$10,000 TO $100,000	County Funds	36	Low
2	Flood Plan to include water pumps to vacate standing water from hospital	Property Protection Plan for the Jackson County Hospital District including a drainage study for facility and water pumps to alleviate floodwaters.	18	LPR	G1, G2, G4, G6	Court	$10,000 TO $100,000	County Funds	24	High
3	Parmetto Bend Spillway - Emergency Stop Log Deployment System	Complete preliminary engineering and submit to State Dam Safety Team and other participating agencies for review and comment. Develop and prepare contract documents for procurement. Solicit and accept proposals. Enter into construction agreement. Construct project.	25	SIP	G1, G2, G5, G6	Court	> $100,000	BRIC, HMGP, FMA	48	Medium
4	Bank Stabilization Project	Provide rock riprap to fit the slope of the bank and stabilize the shoreline.	26	SIP	G4,G6	Court	> $100,000	BRIC, HMGP, FMA	36	Low

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
5	Planting Vegetation on Slopes	Planting grasses, vines, shrubs, and minor trees are slope planning techniques to manage coastal erosion at strategic locations	17	NSP	G1, G2, G5, G6	Court	$10,000 TO $100,000	County Funds	36	Low
6	Purchase Flow Water Tanks	Obtain elevated, high volume/high flow water tanks (high volume at least 6000 gal, and high flow at least 3, preferably 8) spaced throughout the area for additional potable water source. Area is 114 square miles.	16	SIP	G1, G2, G4, G5, G6	Court	$10,000 TO $100,000	BRIC, HMGP, FMA	36	Medium
7	Provide for traffic control on non-regulated intersections.	Provide for traffic control on non- regulated intersections (signs, traffic officer, and one-way routes) during flood events when intersection is flooded.	7	SIP	G1, G2, G4, G5, G6	Court	$10,000 TO $100,000	County Funds	36	Medium
8	Create and Implement a Drought and Expansive Soils Contingency Plan	Develop a Drought Contingency Plan with water conservation stages to use during extreme heat, an additional potable water source, and develop ordinance to mitigate foundation expansive soil problems. It will address measures to minimize expansive soils around foundations and infrastructure as groundwater is	9	LPR	G1, G2, G3, G4, G5, G6	Court	$10,000 TO $100,000	County Funds	36	Low

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		depleted from drought and extreme heat conditions.								
9	Reduce fire fuels and potential fire risk in County	Remove downed trees, cedar trees, and brush to reduce fire fuels and potential fire risk.	12	EAP	G1, G2, G3, G4, G5, G6	Court	$10,000 TO $100,000	County Funds	48	Low
10	Implement a tree trimming program	Implement a program to trim trees hanging in right-of-way of streets that when downed during severe winter storm, pose a threat to structures, cars and citizens.	14	NSP	G1, G2, G4, G6	Court	$10,000 TO $100,000	County Funds	36	Medium
11	Retrofit county courthouse for a hurricane shelter	Obtain funding to retrofit county courthouse for a hurricane shelter that can also withstand hail and wind events.	6	SIP	G1, G4	Court	> $100,000	BRIC, HMGP, FMA	36	High

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
12	Develop water conservation and preventative measures program	Develop program to educate homeowners and provide them incentives to: install low-flow plumbing for toilets, energy-efficient washer/dryer, rain harvesting devices, property perimeter drainage systems, applying soil stabilizers, and use R-value building materials.	24	LPR	G1, G3, G4, G5, G6	Court	$10,000 TO $100,000	County Funds	36	Medium
13	Install automatic switch for the County Services Building generator	Transfer from manual to automatic switch for the County Services Building generator to be used from the hazard events of earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	5	SIP	G1, G2, G6	Court	$10,000 TO $100,000	BRIC, HMGP, FMA	36	High
14	Harden critical facilities	Critical facilities will be hardened by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low-flow plumbing; replacing landscaping with drought and fire	4	SIP	G1, G2, G6	Court	> $100,000	BRIC, HMGP, FMA	36	Medium

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		resistant plants; implementing higher standards for foundations from expansive soil issues, and using R-value building materials to resist heat.								
15	Strengthen County Road 480 with the development of a headwall.	Strengthen County Road 480 with the development of a headwall.	15	SIP	G1, G2, G6	Court	> $100,000	BRIC, HMGP, FMA	24	Medium
16	Purchase message board trailers (solar boards) in event of emergency	Purchase message board trailers (solar boards) in event of emergency.	19	EAP	G1, G3, G4, G6	Court	$10,000 TO $100,000	County Funds	36	Medium
17	Purchase Emergency Generator for Jackson County – Pct. 1 Barn	Acquire a generator (portable or stationary) large enough to power the County Pct. 1 Barn and gas pumps for refueling that will need to be operational during and after a from the hazard events of earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	3	SIP	G1, G2, G6	Court	> $100,000	BRIC, HMGP, FMA	24	High

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
18	Debris Removal and Drainage Enhancements – Pct. 1 County Roads	Reduce obstacles including debris and incorporate drainage enhancements that will reduce flooding on county roads. Aggressive debris control and culvert replacement is essential to mitigate against further road erosion costing extensive repairs and further culvert replacements.	13	SIP, NSP	G1, G2, G6	Court	$10,000 TO $100,000	County Funds	36	High
19	Navidad River Property Acquisition	There is a flood prone property at 1EWP- Chase Cemetery and acquisition can mitigate the problem.	20	SIP	G1, G2, G5, G6	LNRA	> $100,000	LNRA	48	Low
20	Property Acquisition at Site 5- LaSalle RC&D	There is a flood prone property at Site 5- LaSalle RC&D that acquisition can mitigate the problem of repetitive flooding.	21	SIP	G1, G2, G5, G6	JCCWDD	> $100,000	JCCWDD	48	Low
21	Lavaca River Acquisition	There is a flood prone property at Site 6 – Goat Trail and acquisition can mitigate the problem of repetitive flooding.	22	SIP	G1, G2, G5, G6	JCCWDD	> $100,000	JCCWDD	48	Low

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
22	Arenosa Creek Acquisition at Site 8 – Gasch/Kutach.	A flood prone property acquisition can mitigate the problem of repetitive flooding.	23	SIP	G1, G2, G5, G6	JCCWDD	> $100,000	JCCWDD	48	Low
23	Provide training for elected officials and professional technical staff	Provide training for elected officials and professional technical staff (including emergency management coordinators) on emergency management issues.	11	EAP	G2, G4, G5	Court	$10,000 TO $100,000	County Funds	24	Low
24	Implement major clearing of trees and brush from all main creeks and ditches.	Implement major clearing of trees and brush from all main creeks and ditches. Increase dimensions of drainage culverts in troublesome areas. Get easements to private property.	10	NSP	G1, G2, G6	JCCWDD	$10,000 TO $100,000	JCCWDD	36	High
25	Weather Resistant windows courthouse	Implement weather resistant windows for the Courthouse to improve energy efficiency.	2	SIP	G1, G2, G6	Court	$10,000 TO $100,000	County Funds	36	Medium

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
26	Update Flood Damage Prevention Order	Update ordinance to improve clarity on what is expected of developers in the County.	1	LPR	G1, G2, G5, G6	Court / Floodplain Adm.	$10,000 TO $100,000	County Funds	12	High
CITY OF EDNA										
1	Purchase 100kw generator for Community Safe Room	Purchase and install 100kw generator to power Community Safe Room that is designated as a triage center, satellite emergency management office, radio communication and first responder shelter, and public shelter due to loss of power from earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	6	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	BRIC, HMGP, FMA	36	High
2	Purchase emergency generator for City of Edna Sewer Lift Station	Purchase and install 30kw generator to maintain continuity of waste water treatment services and prevent potential health impacts due to loss of power from earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter	7	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	BRIC, HMGP, FMA	36	High

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		weather.								
3	Construction of combined/harden First Responder station for EMS/Fire/Police departments.	Purchase land, design and construct a harden, energy efficient, and xeriscape landscaped combined EMS/Fire/Police facility to maintain continuity of government services and enhance rapid restoration of all emergency response and public services and cooling center. This facility will be hardened by being elevated two feet above base floos elevation, use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, constuction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low-flow plumbing; replacing landsxaping	8	SIP	G1, G4	Public Works	> $100,000	BRIC, HMGP, FMA	48	Medium

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		with drought and fire resistant plants; implementing higher standards for foundations for expansive soil issues, and using R-value building materials to resist heat.								
4	Portable electronic road signs/ message boards	Portable electronic signs can provide traveler instructions and can also be used to provide alerting and instructions for other hazardous conditions during flooding, fire and winter storm events. Portable signs will reduce need for man- power at stationed routes of evacuations locations.	10	EAP	G1, G3, G4, G6	Public Works	< $10,000	City	24	Low
5	Implement a tree trimming program	Develop and implement tree trimming program to clear limbs hanging in right-of- way and in drainage systems that when downed, pose threat to structures, cars, and citizens during severe weather events.	9	NSP	G1, G2, G4, G6	Public Works	$10,000 to $100,000	City	24	Low
6	Retrofit and harden existing public facilities	Retrofit and harden existing facility by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof	18	SIP	G1, G4	Public Works	> $100,000	BRIC, HMGP, FMA	48	Medium

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low-flow plumbing; replacing landscaping with drought and fire resistant plants; implementing higher standards for foundations, and using R-value building materials to resist heat								
7	Floodproof sewage treatment plant	Floodproof sewage treatment plant located in flood hazard by installing dikes and pumping system.	11	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High
8	Develop project to divert rainwater and runoff that flows through town	Develop project to divert rainwater and runoff that flows through town by installing a system of dikes and drainage ditches to Lavaca River.	16	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
9	Drainage Improvements – Mexico Street/ MLK Boulevard	Replace current drainage culverts with larger box culverts with parallel wings across MLK Boulevard to Mexico Street.	17	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High
10	Purchase emergency generator for City of Edna Fire/EMS Building, Police Department, City Hall	Purchase and install 30kw generator to maintain continuity of government in case of loss of power due to earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	15	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	BRIC, HMGP, FMA	36	High
11	Drill additional water wells to increase water supply	Drill additional water wells to increase water supply during times of drought.	12	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	BRIC, HMGP, FMA	48	High
12	Install Emergency Notification System	Install a new ENS for residents to register their land-lines and cell phone numbers with system for emergency notification of hazard events.	13	EAP	G1, G3, G4, G6	Public Works	< $10,000	City	36	Low

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
13	Educate homeowners on hazards	Provide education to homeowners on how to mitigate hazard damage from their homes. Use city website and public forums.	14	EAP	G1, G3, G4, G6	Planning	< $10,000	City	24	Medium
14	Drainage Improvements throughout City	Implement drainage improvements, including culvert upgrades, channel widening, regional detention, bridge upgrades, and stormsewer improvements	1	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High
15	Update Drainage Master Plan	Develop a City-wide Drainage Master Plan focused on local drainage issues. This plan will merge with the regional FIF study of Dry Creek	2	LPR	G1, G2, G4, G5, G6	Public Works	> $100,000	TWDB, BRIC	36	High
16	Update Development Codes, Subdivision Ordinances, and Drainage Criteria	Update development codes and min. finish floor elevation standards.	3	LPR	G1, G2, G4, G5, G6	Public Works	$10,000 to $100,000	City	36	Medium

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
17	Improve Water/Sewer Infrastructure Throughout City	Improve water mains, wastewater mains, forcemains, and improve water main pressure balances	5	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High
18	Improve Wastewater Treatment Plant	Improve wastewater treatement plant to make it more flood resilient and improve treatment capacity and I&I.	4	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High
CITY OF GANADO										
1	Install Outdoor Warning Sirens	Install Outdoor Warning Sirens. The city needs ways to warn residents about impending weather conditions when they are outside.	8	SIP, EAP	G1, G2, G3, G4, G6	Public Works	< $10,000	City	24	Medium
2	Clean and remove debris from ditches and creeks in community.	The city will clean and remove debris from ditches and creeks.	9	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	City	36	High

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
3	Replace sewer lines.	The city will replace sewer lines as needed.	10	SIP, NSP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High
4	Create a public educational campaign	The city will create a public educational campaign for schools and homeowners on how to mitigate their schools and homes from natural hazards.	3	EAP	G1, G3, G4, G6	Planning	< $10,000	City	24	Medium
5	Retrofit and harden City Hall and install a safe room.	The city will retrofit and harden City Hall by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry- proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low-flow plumbing; replacing landscaping with drought and fire resistant plants; implementing higher standards for foundations for expansive soils, and installing a safe room.	14	SIP	G1, G4	Public Works	> $100,000	BRIC, HMGP, FMA	48	Medium

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
6	Construct a new harden Emergency Services Building.	Purchase land, design and construct a harden, energy efficient, and xeriscape landscaped combined EMS/FIRE/POLICE facility to maintain Continuity of Government services and enhance rapid restoration of all Emergency Response and Public Services. The facility by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low- flow plumbing; replacing landscaping with drought and fire resistant plants; implementing higher standards for foundations for expansive soils	13	SIP	G1, G4	Public Works	> $100,000	BRIC, HMGP, FMA	48	Medium

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
7	Emergency generators for Sewer Lift Stations	Install permanent 30kw generator to maintain continuity of waste water treatment services and prevent potential health impacts due to loss of power from earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	4	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	BRIC, HMGP, FMA	48	High
8	Emergency generators for water system	New generators for water system to ensure adequate pumping is available for water tower during hazards.	5	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	BRIC, HMGP, FMA	48	High
9	Devers Creek Drainage Improvements	Coordinate with JCCWDD to develop region detention and channel widening improvements along Devers Creek.	6	SIP	G1, G2, G6	JCCWDD	> $100,000	BRIC, HMGP, FMA	48	High
10	Drainage Improvements	Drainage improvements throughout the City, including culvert improvements, detention, channel improvements, bridge improvements, and stormsewer improvements	7	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
11	Rehab Water Storage Tanks	Improve existing water storage tanks and possibly increasing storage capacity.	11	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, TWDB	48	High
12	Long-term Water Supply Planning	Develop a long-term water supply plan that includes a new water model and overall plan to manage development.	12	LPR	G1, G2, G3, G4, G5, G6	Public Works	$10,000 to $100,000	City	48	Medium
13	Drainage Master Planning	Develop a drainage master plan with a focus on identifying flood reduction projects for local drainage issues.	1	LPR	G1, G2, G4, G5, G6	Public Works	$10,000 to $100,000	BRIC, TWDB	36	High
14	Update of Subdivision Ord.	Develop improved drainage standards for development throughout the City. Including improved finish floor and detention standards.	2	LPR	G1, G2, G4, G5, G6	Planning	< $10,000	City	36	Medium
CITY OF LA WARD										

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
1	Drainage Master Plan	Develop a drainage master plan with a focus on local drainage issues using Atlas 14 rainfall	1	LPR	G1, G2, G4, G5, G6	City Council	$10,000 to $100,000	City	24	High
2	Purchase Back-up generators	Purchase generators to help provide power during power outages similar to the Winter Storm of 2021.	3	SIP	G1, G2, G6	City Council	$10,000 to $100,000	BRIC, HMGP, FMA	48	High
3	Road Reconstruction	Reconstruct roads that have deteriorated due to flooding and other issues.	2	SIP	G1, G2, G6	City Council	> $100,000	City	48	High
4	Water and Sewer Infrastructure Reconstruction	Improve water and wastewater supply, improve water mains, lift stations, wastewater mains, and water supply resiliency.	4	SIP	G1, G2, G6	City Council	> $100,000	BRIC, HMGP, FMA	48	High

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
5	Educate homeowners on hazards	Provide education to homeowners on how to mitigate hazard damage from their homes. Use city website and public forums.	5	EAP	G1, G3, G4, G6	City Council	< $10,000	City	24	Medium
6	Update Development Codes, Subdivision Ordinances, and Drainage Criteria	Update development codes and min. finish floor elevation standards.	6	LPR	G1, G2, G4, G5, G6	City Council	$10,000 to $100,000	City	36	Medium
7	Portable electronic road signs/ message boards	Portable electronic signs can provide traveler instructions and can also be used to provide alerting and instructions for other hazardous conditions during flooding, fire and winter storm events. Portable signs will reduce need for man- power at stationed routes of evacuations locations.	7	EAP	G1, G3, G4, G6	City Council	< $10,000	City	24	Low

Notes:

CEM	Community Emergency Manager	IRC	International Residential Code
CFM	Community Floodplain Manager	LPR	Local Plans and Regulations

TABLE ES-1. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit

CRS	Community Rating System	N/A	Not Applicable
EAP	Education and Awareness Programs	NFIP	National Flood Insurance Program
FEMA	Federal Emergency Management Agency	NSP	Natural Systems Protection
FIRM	Flood Insurance Rate Map	NWS	National Weather Service
FMA	Flood Mitigation Assistance	PDM	Pre-Disaster Mitigation
GIS	Geographic Information System	SIP	Structure and Infrastructure Project
HMGP	Hazard Mitigation Grant Program	TCRFC	Texas Colorado River Floodplain Coalition
IBC	International Building Code		

PART 1
PLAN ELEMENTS AND PARTICIPATING COMMUNITIES

Chapter 1.
Introduction

1.1 WHY PREPARE THIS PLAN?

1.1.1 The Big Picture

Hazard mitigation is the way to alleviate the loss of life, personal injury, and property damage that can result from a disaster through long- and short-term strategies. Hazard mitigation involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of hazards. The responsibility for hazard mitigation lies with many, including private property owners; business and industry; and local, state, and federal government.

The federal Disaster Mitigation Act of 2000 (DMA) (Public Law 106-390) required state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. Prior to 2000, federal disaster funding focused on disaster relief and recovery, with limited funding for hazard mitigation planning. The DMA increased the emphasis on planning for disasters before they occur.

The DMA encourages state and local authorities to work together on pre-disaster planning. It promotes "sustainable hazard mitigation," which includes the sound management of natural resources and the recognition that hazards and mitigation must be understood in the largest possible social and economic context. The planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in the faster allocation of funding and more cost-effective risk reduction projects.

1.1.2 Local Concerns

This hazard mitigation plan considers local concerns when evaluating natural hazards and developing mitigation actions. Several factors specific to Jackson County initiated this planning effort:

- Jackson County is exposed to hazards that have caused past damage.
- Limited local resources make it difficult to be pre-emptive in reducing risk. Eligibility for federal financial assistance is paramount to promote successful hazard mitigation in the area.
- Jackson County and its partners participating in this plan want to be proactive in preparing for the probable impacts from natural hazards.
- Federal Emergency Management Agency (FEMA) approval of the previous hazard mitigation plan will expire in 2021. If this plan is not updated, Jackson County would not have a FEMA-approved mitigation plan in place, limiting county access to emergency funds after a disaster declaration.

1.1.3 Purposes for Planning

This hazard mitigation plan update identifies resources, information, and strategies for reducing risk from natural hazards. Elements and strategies in the plan were selected because they meet a program requirement and because they best meet the needs of the planning partners and their citizens. One of the benefits of multi-jurisdictional planning is the ability to pool resources and eliminate redundant activities within a planning area that has uniform risk exposure and vulnerabilities. FEMA encourages multi-jurisdictional planning under its guidance for the DMA. This plan will help guide and coordinate mitigation activities throughout the planning area.

This plan update was developed to meet the following objectives:

- Meet or exceed requirements of the DMA.
- Enable all planning partners to continue using federal grant funding to reduce risk through mitigation.
- Meet the needs of each planning partner as well as state and federal requirements.
- Create a risk assessment that focuses on Jackson County's hazards of concern.
- Create a single planning document that integrates all planning partners into a framework that supports partnerships within the county, and puts all partners on the same planning cycle for future updates.
- Coordinate existing plans and programs so that high-priority actions and projects to mitigate possible disaster impacts are funded and implemented.

1.2 WHO WILL BENEFIT FROM THIS PLAN?

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

1.3 ELEMENTS OF THIS PLAN

This plan includes all federally required elements of a disaster mitigation plan:

- Countywide elements:
  - A description of the planning process
  - The public involvement strategy
  - A list of goals and objectives
  - A countywide hazard risk assessment
  - Countywide mitigation actions
  - A plan maintenance strategy
- Jurisdiction-specific elements for each participating jurisdiction:
  - A description of the participation requirements established by the Steering Committee
  - Jurisdiction-specific mitigation actions

The following appendices include information or explanations to support the main content of the plan:

- Appendix A: A glossary of acronyms and definitions.
- Appendix B: The FEMA Local Mitigation Plan Review Tool.
- Appendix C: Public outreach information, including the hazard mitigation survey and summary, and documentation of public meetings.

- Appendix D: Plan adoption resolutions from planning partners.
- Appendix E: A template for progress reports to be completed as this plan is implemented.
- All planning partners will adopt this Jackson County Hazard Mitigation Plan Update in its entirety.

Chapter 2.
Plan Update – What Has Changed

2.1 THE PREVIOUS PLAN

Jackson County and its communities participated in previous hazard mitigation plans as part of the Texas Colorado River Floodplain Coalition (TCRFC). The TCRFC is a non-profit, 501(c)(3) organization formed in June 2001 by the cities and counties of the Lower Colorado River Authority (LCRA) in response to flood devastation requiring more coordinated damage prevention efforts. A 2016 update to a previous plan was published in May 2016 entitled *Jackson County Hazard Mitigation Plan Update 2016*. In compliance with FEMA guidelines, this plan was updated for Jackson County and the participating communities, the City of Edna and the City of Ganado.

The 2016-2021 update ranked 13 hazards from high (H) to very low (L), or not applicable (N/A) for Jackson County and the participating Cities of Edna and Ganado. Table 2-1 lists the hazards and their ranking. These 14 hazards were evaluated in the TCRFC plan.

TABLE 2-1.
HAZARD RISK SUMMARY IN THE 2016-2021 JACKSON COUNTY HAZARD MITIGATION PLAN UPDATE

Jurisdiction	Coastal Erosion	Dam/Levee Failure	Drought	Earthquake	Expansive Soils	Extreme Heat	Flood	Hail	Hurricane/Tropical Storm	Lightning	Tornado	Wildfire	Wind	Winter Weather
Jackson County	**N/A**	**L**	**M**	**N/A**	**L**	**L**	**H**	**L**	**H**	**L**	**L**	**L**	**L**	**L**
City of Edna	N/A	N/A	H	L	M	H	H	L	H	L	L	N/A	L	L
City of Ganado	N/A	N/A	M	N/A	H	M	H	H	H	M	N/A	N/A	L	L

The *Jackson County Hazard Mitigation Plan Update 2016* identified goals, objectives, and mitigation actions for these hazards. The overall goal of the 2016 plan was:

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

Six goals were identified for mitigating the hazards, with one or more objectives defined for each goal. These goals and their associated objectives are as follows:

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

- **Objective 1.4:** Protect critical facilities and services.

- **Goal 2:** Protect existing and new properties.
  - **Objective 2.1:** Reduce repetitive losses to the National Flood Insurance Program.
  - **Objective 2.2:** Use the most cost-effective approaches to protect existing buildings and public infrastructure from hazards.
  - **Objective 2.3:** Enact and enforce regulatory measures to ensure that development will not put people in harm's way or increase threats to existing properties.
- **Goal 3:** Increase public understanding, support and demand for hazard mitigation.
  - **Objective 3.1:** Heighten public awareness of the full range of natural and man-made hazards they face.
  - **Objective 3.2:** Educate the public on actions they can take to prevent or reduce the loss of life or property from all hazards.
  - **Objective 3.3:** Publicize and encourage the adoption of appropriate hazard mitigation measures.
- **Goal 4:** Build and support local capacity and commitment to continuously become less vulnerable to hazards.
  - **Objective 4.1:** Build and support local partnerships to continuously become less vulnerable to hazards.
  - **Objective 4.2:** Build hazard mitigation concerns into planning and budgeting processes.
- **Goal 5**: Promote growth in a sustainable manner.
  - **Objective 5.1:** Incorporate hazard mitigation into the long-range planning and development activities.
  - **Objective 5.2:** Promote beneficial uses of hazardous areas while expanding open space and recreational opportunities.
  - **Objective 5.3:** Utilize regulatory approaches to prevent creation of future hazards to life and property.
- **Goal 6:** Maximize the resources for investment in hazard mitigation.
  - **Objective 6.1:** Maximize the use of outside sources of funding.
  - **Objective 6.2:** Maximize participation of property owners in protecting their properties.
  - **Objective 6.3:** Maximize insurance coverage to provide financial protection against hazard events.
  - **Objective 6.4:** Prioritize mitigation projects, based on cost-effectiveness and starting with those sites facing the greatest threat to life, health and property.

The *Jackson County Hazard Mitigation Plan Update 2016* then identified one or more mitigation actions to accomplish each objective. The current status of each of these actions identified in the plan is shown in Table 2-2. Within Table 2-2, an asterisk (*) denotes actions that encompass actions carried forward from the 2011-2016 Plan.

TABLE 2-2.
JACKSON COUNTY PROJECT IMPLEMENTATION WORKSHEET (2016-2021 PLAN PROJECTS)

Action No.	Title	Description	Project Status: Ongoing	Delayed	Competed	Deleted	Funding: Budgeted	Apply for Grant	Grant Received	Target Completion	Comments
JACKSON COUNTY											
1	Purchase and install shutters for Jackson County Hospital District Facility	Installation of Aluminum All Weather Wind Grade Shutters to protect against hail, hurricane/tropical storms, tornado, and wind.		X			X	X			Will be brought forward into the new list of action items.
2	Flood Plan to include water pumps to vacate standing water from hospital	Property Protection Plan for the Jackson County Hospital District including a drainage study for facility and water pumps to alleviate floodwaters.				X					
3	Palmetto Bend Spillway - Emergency Stop Log Deployment System	• Complete preliminary engineering and submit to State Dam Safety Team and other participating agencies for review and comment. • Develop and prepare contract documents for procurement. • Solicit and accept proposals. • Enter into construction agreement. • Construct project.	X				X			2022	Conducted through LNRA. Chose to rehabilitate the existing stop log system. The project is currently 60% complete. Will be brought forward into the new list of action items.
4	Bank Stabilization Project	Provide rock riprap to fit the slope of the bank and stabilize the shoreline.			X		X				Completed in 2018 by LNRA for one area, but this mitigation will be carried forward to cover future bank stabilization issues that may arise.
5*	Planting Vegetation on Slopes	Planting grasses, vines, shrubs, and minor trees are slope planning techniques to manage coastal erosion at strategic locations.	X				X		X		Will be brought forward into the new list of action items.

TABLE 2-2.
JACKSON COUNTY PROJECT IMPLEMENTATION WORKSHEET (2016-2021 PLAN PROJECTS)

			Project Status				Funding				
Action No.	Title	Description	Ongoing	Delayed	Competed	Deleted	Budgeted	Apply for Grant	Grant Received	Target Completion	Comments
6	Purchase Flow Water Tanks	Obtain elevated, high volume/high flow water tanks (high volume at least 6000 gal, and high flow at least 3, preferably 8) spaced throughout the area for additional potable water sources. Area is 114 square miles.			X						This was completed, but will be carried over to cover future flow water tank upgrades.
7*	Provide for traffic control on non-regulated intersections.	Provide for traffic control on non-regulated intersections (signs, traffic officer, and one-way routes) during flood events when intersection is flooded.	X				X				Will be brought forward into the new list of action items.
8*	Install a network of dry hydrants	Install a network of dry hydrants in stack ponds, creeks, small lakes, and Lake Texana to increase the supply of water for fire protection before the next drought and extreme heat periods.			X				X		
9*	Create and Implement a Drought and Expansive Soils Contingency Plan	Develop a Drought Contingency Plan with water conservation stages to use during extreme heat, an additional potable water source, and develop ordinance to mitigate foundation expansive soil problems. It will address measures to minimize expansive soils around foundations and infrastructure as groundwater is depleted from drought and extreme heat conditions.		X							Will be brought forward into the new list of action items.
10*	Reduce fire fuels and potential fire risk in County	Remove downed trees, cedar trees, and brush to reduce fire fuels and potential fire risk.	X				X	X			Will be brought forward into the new list of action items.

TABLE 2-2. JACKSON COUNTY PROJECT IMPLEMENTATION WORKSHEET (2016-2021 PLAN PROJECTS)											
			Project Status				Funding				
Action No.	Title	Description	Ongoing	Delayed	Competed	Deleted	Budgeted	Apply for Grant	Grant Received	Target Completion	Comments
11*	Implement a tree trimming program	Implement a program to trim trees hanging in right-of-way of streets that when downed during severe winter storms, pose a threat to structures, cars, and citizens.	X				X	X			Will be brought forward into the new list of action items.
12*	Protect building by adding window glazing to county courthouse	Obtain funding and add window glazing to county courthouse to protect from hail, hurricane/tropical storms, tornados, and winds.			X		X				
13*	Retrofit county courthouse for a hurricane shelter	Obtain funding to retrofit county courthouse for a hurricane shelter that can also withstand hail and wind events.	X				X	X			Consists of the County Courthouse and other County Facilities. Will be brought forward into the new list of action items.
14*	Develop water conservation and preventative measures program	Develop program to educate homeowners and provide them incentives to: install low-flow plumbing for toilets, energy-efficient washer/dryer, rain harvesting devices, property perimeter drainage systems, applying soil stabilizers, and use R-value building materials.	X				X	X			Will be brought forward into the new list of action items.
15*	Install auto generator switch	To switch from a manual generator switch to an auto generator switch from hazard events of earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.			X		X		X		

TABLE 2-2.
JACKSON COUNTY PROJECT IMPLEMENTATION WORKSHEET (2016-2021 PLAN PROJECTS)

Action No.	Title	Description	Project Status: Ongoing	Delayed	Competed	Deleted	Funding: Budgeted	Apply for Grant	Grant Received	Target Completion	Comments
16*	Purchase generator for the county courthouse	Purchase generator for the county courthouse for back-up power protection of EOC staff and records from the hazard events of earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.			X						
17*	Install automatic switch for the County Services Building generator	Transfer from manual to automatic switch for the County Services Building generator to be used from the hazard events of earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.		X							Will be brought forward into the new list of action items.
18*	Retrofit building for emergency generator	Retrofit building for emergency generator to stormproof it from the hazard events of earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.				X					
19*	Harden critical facilities	Critical facilities will be hardened by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low- flow plumbing; replacing landscaping with drought and fire resistant plants; implementing higher standards for foundations from expansive soil issues, and using R-value building materials to resist heat.	X								Will be brought forward into the new list of action items.

TABLE 2-2. JACKSON COUNTY PROJECT IMPLEMENTATION WORKSHEET (2016-2021 PLAN PROJECTS)											
			Project Status				Funding				
Action No.	Title	Description	Ongoing	Delayed	Competed	Deleted	Budgeted	Apply for Grant	Grant Received	Target Completion	Comments
20*	Strengthen County Road 480 with the development of a headwall.	Strengthen County Road 480 with the development of a headwall.	X				X				Will be brought forward into the new list of action items.
21*	Purchase message board trailers (solar boards) in event of emergency	Purchase message board trailers (solar boards) in event of emergency.	X					X			Will be brought forward into the new list of action items.
22	Purchase a permanent back-up generator for Hospital	To minimize loss of life for patients at the hospital that require electricity for their healthcare needs from the hazard events of earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.			X						
23	Purchase Emergency Generator for Jackson County – Pct. 1 Barn	Acquire a generator (portable or stationary) large enough to power the County Pct. 1 Barn and gas pumps for refueling that will need to be operational during and after a from the hazard events of earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	X								Will be brought forward into the new list of action items.
24	Debris Removal and Drainage Enhancements – Pct. 1 County Roads	Reduce obstacles including debris and incorporate drainage enhancements that will reduce flooding on county roads. Aggressive debris control and culvert replacement is essential to mitigate against further road erosion costing extensive repairs and further culvert replacements.	X		X						This was completed but is an on-going action and will be carried over to the next plan.

TABLE 2-2. JACKSON COUNTY PROJECT IMPLEMENTATION WORKSHEET (2016-2021 PLAN PROJECTS)											
			Project Status				Funding				
Action No.	Title	Description	Ongoing	Delayed	Competed	Deleted	Budgeted	Apply for Grant	Grant Received	Target Completion	Comments
25	Navidad River Property Acquisition	There is a flood-prone property at 1EWP- Chase Cemetery and acquisition can mitigate the problem.		X							Will be brought forward into the new list of action items.
26	Property Acquisition at Site 5- LaSalle RC&D	There is a flood-prone property at Site 5- LaSalle RC&D that acquisition can mitigate the problem of repetitive flooding.		X							Will be brought forward into the new list of action items.
27	Lavaca River Acquisition	There is a flood-prone property at Site 6 – Goat Trail and acquisition can mitigate the problem of repetitive flooding.		X							Will be brought forward into the new list of action items.
28	Arenosa Creek Acquisition at Site 8 – Gasch/Kutach.	A flood-prone property acquisition can mitigate the problem of repetitive flooding.		X							Will be brought forward into the new list of action items.
29*	Provide training for elected officials and professional technical staff	Provide training for elected officials and professional technical staff (including emergency management coordinators) on emergency management issues.	X				X				Will be brought forward into the new list of action items.
30*	Implement major clearing of trees and brush from all main creeks and ditches.	Implement major clearing of trees and brush from all main creeks and ditches. Increase dimensions of drainage culverts in troublesome areas. Get easements to private property.	X				X				Will be brought forward into the new list of action items.
CITY OF EDNA											

TABLE 2-2.
JACKSON COUNTY PROJECT IMPLEMENTATION WORKSHEET (2016-2021 PLAN PROJECTS)

Action No.	Title	Description	Project Status				Funding				Comments
			Ongoing	Delayed	Competed	Deleted	Budgeted	Apply for Grant	Grant Received	Target Completion	
1*	Drainage Improvements – Mexico Street/ MLK Boulevard	Replace current drainage culverts with larger box culverts with parallel wings across MLK Boulevard to Mexico Street.	X				X				Will be brought forward into the new list of action items.
2	Purchase emergency generator for City of Edna Fire/EMS Building, Police Department, City Hall	Purchase and install 30kw generator to maintain continuity of government in case of loss of power due to earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	X				X			End of 2021	Generator located at City of Edna Fire Building and Police Department. EMS is no longer included. Will be brought forward into the new list of action items.
3	Purchase 100kw generator for Community Safe Room	Purchase and install 100kw generator to power Community Safe Room that is designated as a triage center, satellite emergency management office, radio communication and first responder shelter, and public shelter due to loss of power from earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	X						X	End of 2021	Community Safe Room is located at City Hall. Will be brought forward into the new list of action items.
4	Purchase emergency generator for City of Edna Sewer Lift Station	Purchase and install 30kw generator to maintain continuity of waste water treatment services and prevent potential health impacts due to loss of power from earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	X						X	End of 2021	Generators purchased thus far: 2 for sewer, 1 for water, and 3 portable. Will be brought forward into the new list of action items.

TABLE 2-2. JACKSON COUNTY PROJECT IMPLEMENTATION WORKSHEET (2016-2021 PLAN PROJECTS)												
			Project Status				Funding				
Action No.	Title	Description	Ongoing	Delayed	Competed	Deleted	Budgeted	Apply for Grant	Grant Received	Target Completion	Comments
5	Construction of combined/harden First Responder station for EMS/Fire/Police departments.	Purchase land, design and construct a hardened, energy-efficient, and xeriscape landscaped combined EMS/Fire/Police facility to maintain continuity of government services and enhance rapid restoration of all emergency response and public services and cooling center. This facility will be hardened by being elevated two feet above base flood elevation, use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low-flow plumbing; replacing landscaping with drought and fire resistant plants; implementing higher standards for foundations for expansive soil issues, and using R-value building materials to resist heat.	X				X			2022	Will be brought forward into the new list of action items.
6*	Portable electronic road signs/ message boards	Portable electronic signs can provide traveler instructions and can be used to provide alerting and instructions for other hazardous conditions during flooding, fire, and winter storm events. Portable signs will reduce the need for manpower at stationed routes of evacuation locations.	X					X			Will be brought forward into the new list of action items.

TABLE 2-2. JACKSON COUNTY PROJECT IMPLEMENTATION WORKSHEET (2016-2021 PLAN PROJECTS)											
			Project Status				Funding				
Action No.	Title	Description	Ongoing	Delayed	Competed	Deleted	Budgeted	Apply for Grant	Grant Received	Target Completion	Comments
7*	Implement a tree trimming program	Develop and implement tree trimming program to clear limbs hanging in right-of-way and drainage systems that when downed, pose threat to structures, cars, and citizens during severe weather events.	X				X				Conducted by the City of Edna Street Department. Will be brought forward into the new list of action items.
8*	Retrofit and harden existing public facilities	Retrofit and harden existing facility by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low- flow plumbing; replacing landscaping with drought and fire resistant plants; implementing higher standards for foundations, and using R-value building materials to resist heat	X				X				Will be brought forward into the new list of action items.
9*	Floodproof sewage treatment plant	Floodproof sewage treatment plant located in flood hazard by installing dikes and pumping system.	X					X			Will be brought forward into the new list of action items.
10*	Develop project to divert rainwater and runoff that flows through town	Develop project to divert rainwater and runoff that flows through town by installing a system of dikes and drainage ditches to Lavaca River.	X						X	June 2023	Will be brought forward into the new list of action items.
11*	Drill additional water wells to increase water supply	Drill additional water wells to increase water supply during times of drought.	X					X			Will be brought forward into the new list of action items.

TABLE 2-2. JACKSON COUNTY PROJECT IMPLEMENTATION WORKSHEET (2016-2021 PLAN PROJECTS)											
			Project Status				Funding				
Action No.	Title	Description	Ongoing	Delayed	Competed	Deleted	Budgeted	Apply for Grant	Grant Received	Target Completion	Comments
12	Install Emergency Notification System	Install a new ENS for residents to register their landlines and cell phone numbers with system for emergency notification of hazard events.	X				X				Reverse 911 is conducted through the county system. Will be brought forward into the new list of action items.
13	Educate homeowners on hazards	Provide education to homeowners on how to mitigate hazard damage from their homes. Use city website and public forums.	X				X				Education is conducted through social media and town hall meetings. Will be brought forward into the new list of action items.
CITY OF GANADO											
1	Install Outdoor Warning Sirens	Install Outdoor Warning Sirens. The city needs ways to warn residents about impending weather conditions when they are outside.	X				X				Will be brought forward into the new list of action items.
2*	Clean and remove debris from ditches and creeks in community.	The city will clean and remove debris from ditches and creeks.	X				X				Will be brought forward into the new list of action items.
3*	Replace sewer lines.	The city will replace sewer lines as needed.	X				X	X	X	5 years	Will be brought forward into the new list of action items.
4*	Create a public educational campaign	The city will create a public education campaign for schools and homeowners on how to mitigate their schools and homes from natural hazards.	X				X				Will be brought forward into the new list of action items.

TABLE 2-2. JACKSON COUNTY PROJECT IMPLEMENTATION WORKSHEET (2016-2021 PLAN PROJECTS)											
			Project Status				Funding				
Action No.	Title	Description	Ongoing	Delayed	Competed	Deleted	Budgeted	Apply for Grant	Grant Received	Target Completion	Comments
5*	Retrofit and harden City Hall and install a safe room.	The city will retrofit and harden City Hall by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low-flow plumbing; replacing landscaping with drought and fire resistant plants; implementing higher standards for foundations for expansive soils, and installing a safe room.		X				X			Will be brought forward into the new list of action items.
6	Construct a new harden Emergency Services Building.	Purchase land, design and construct a hardened, energy-efficient, and xeriscape landscaped combined EMS/FIRE/POLICE facility to maintain Continuity of Government services and enhance rapid restoration of all Emergency Response and Public Services. The facility by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low- flow plumbing; replacing landscaping with drought and fire resistant plants; implementing higher standards for foundations for expansive soils.		X				X			Will be brought forward into the new list of action items.

TABLE 2-2. JACKSON COUNTY PROJECT IMPLEMENTATION WORKSHEET (2016-2021 PLAN PROJECTS)											
			Project Status				Funding				
Action No.	Title	Description	Ongoing	Delayed	Competed	Deleted	Budgeted	Apply for Grant	Grant Received	Target Completion	Comments
7	Emergency generators for Sewer Lift Stations	Install permanent 30kw generator to maintain continuity of waste water treatment services and prevent potential health impacts due to loss of power from earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	X						X	March 2022	In-progress as of August 2021. Will be brought forward into the new list of action items.

Notes:

EMS	Emergency Medical Services	LNRA	Lavaca-Navidad River Authority
ENS	Emergency Notification System	Pct.	Precinct
EOC	Emergency Operations Center		
gal	Gallon	kw	Kilowatt

2.2 WHY UPDATE?

Title 44 of the Code of Federal Regulations (44 CFR) stipulates that hazard mitigation plans must present a schedule for monitoring, evaluating, and updating the plan. As mentioned previously, Jackson County participated in a mitigation planning process in 2016 as part of the TCRFC and will expire in 2021. This update process provides an opportunity to reevaluate recommendations, monitor the impacts of actions that have been accomplished, and evaluate whether there is a need to change the focus of mitigation strategies. A jurisdiction covered by a plan that has expired is not able to pursue elements of federal funding under the Robert T. Stafford Act for which a current hazard mitigation plan is a prerequisite.

2.3 THE PLAN – WHAT IS DIFFERENT?

The Scheibe Consulting plan has been focused on Jackson County and its participating communities using the best and most current data and technology available. All participating municipalities were fully involved in the preparation of this plan update. The updated plan includes a more robust hazard analysis. Mitigation actions were reviewed and amended to include only those that would move the community towards a higher degree of resiliency while being feasible, practical, and implementable given current finances. Federal and state funds for projects have become difficult to obtain. The update recommends 65 mitigation actions:

- 26 countywide actions
- 18 actions specifically for the City of Edna
- 14 actions specifically for the City of Ganado
- 7 actions specifically for the City of La Ward

Actions from the previous plan were carried forward into the mitigation actions if they were identified as delayed or in progress. These actions are indicated in Table 2-2.

2.4 LOCAL MITIGATION PLAN REVIEW TOOL

The Local Mitigation Plan Review Tool demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers states and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-Jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of each element of the plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference the Local Mitigation Plan Review Guide when completing the Local Mitigation Plan Review Tool. The Local Mitigation Plan Review Tool is included in this hazard mitigation plan as Appendix B.

Chapter 3.
Plan Methodology

3.1 GRANT FUNDING

The current Hazard Mitigation Plan will expire in December of 2021. Therefore, the local community initiated steps to begin the update at the beginning of 2021. The local communities, consisting of the City of Edna, City of Ganado, City of La Ward, and Jackson County all elected to enter into an interlocal agreement and have Jackson County act as the lead entity for this Hazard Mitigation Plan Update. Jackson County then selected Scheibe Consulting, LLC to assist with the development and implementation of the plan update. No grant funding was obtained for this Hazard Mitigation Plan update, and thus all funding for this update came from the local participating communities. Each participating member contributed both monetarily and through in-kind contributions.

3.2 ESTABLISHMENT OF THE PLANNING PARTNERSHIP

Jackson County opened this planning effort to all eligible local governments in the county. The planning partners covered under this plan are shown in Table 3-1.

TABLE 3-1.
COUNTY AND CITY PLANNING PARTNERS

Jurisdiction	Point of Contact	Title
Jackson County	Kelly Janica	Emergency Management Coordinator
City of Edna	Gary Broz	City Manager
City of Ganado	Blake Petrash	Mayor Pro-Tem
City of La Ward	Richard Koch	Mayor

Each jurisdiction wishing to join the planning partnership was asked to commit to the process and have a clear understanding of expectations. These include:

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

Attendance will be tracked at these activities, and attendance records will document participation for each planning partner. All participating communities are expected to attend and actively participate in all meetings and activities.

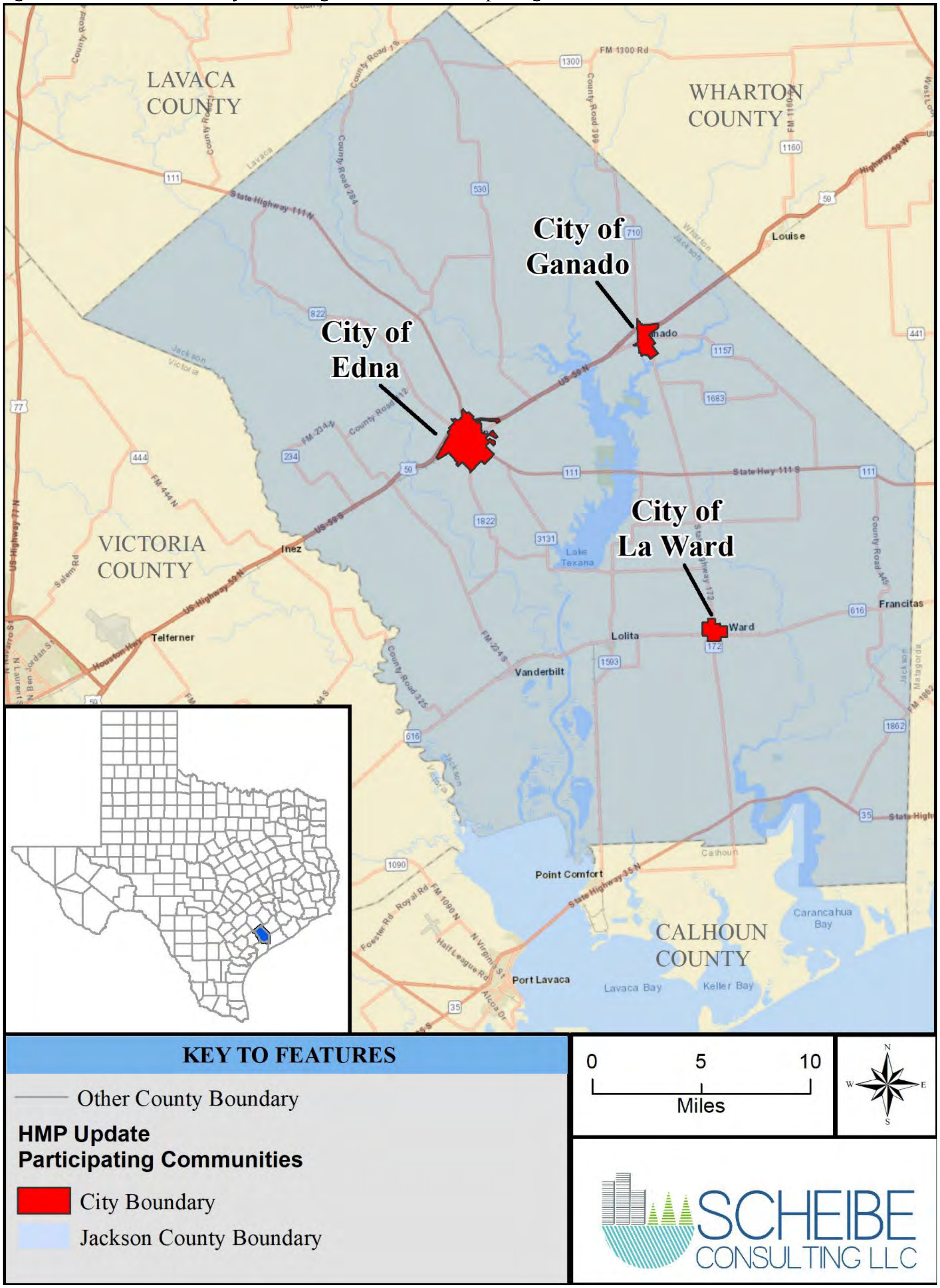
- Each partner will be expected to review the risk assessment and identify hazards and vulnerabilities specific to its jurisdiction. Contract resources will provide jurisdiction-specific mapping and technical consultation to aid in this task, but the determination of risk and vulnerability ranking will be up to each partner.
- Each partner will be expected to review the mitigation recommendations chosen for the overall county and evaluate whether they will meet the needs of its jurisdiction. Projects within each jurisdiction consistent with the overall plan recommendations will need to be identified, prioritized, and reviewed to identify their benefits and costs.
- Each partner will be required to formally adopt the plan.
- Each partner will agree to the plan implementation and maintenance protocol.

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

3.3 DEFINING THE PLANNING AREA

The planning area was defined to consist of all of Jackson County. All partners to this plan have jurisdictional authority within this planning area. Planning partners include the Cities of Edna, Ganado, and La Ward. See Figure 3-1 for the Jackson County HMP planning area.

Figure 3-1. Jackson County Planning Area and Participating Communities



3.4 THE PLANNING COMMITTEE

A small planning committee was formed at the beginning of the hazard mitigation update process. This committee consisted of representatives from each of the planning partners. Planning committee members are denoted by an asterisk (*) in Table 3-2. This committee agreed to meet regularly and when additionally when necessary through the completion of the hazard mitigation plan update. The planning committee aided in data collection throughout the process and helped to identify stakeholders in the planning area who were invited to participate in the steering committee. The following stakeholders were identified by the planning committee and invited to take part in the steering committee:

- Matagorda County
- Wharton County
- Calhoun County
- Victoria County
- DeWitt County
- Colorado County
- Texas Department of Transportation (TxDOT)
- Lavaca-Navidad River Authority (LNRA)
- Texas Groundwater Conservation District
- Water Control and Improvement District (WCID) #1
- WCID #2
- Emergency Service District (ESD) #1
- ESD #2
- ESD #3
- Jackson County Hospital District
- Edna Independent School District (ISD)
- Ganado ISD
- Edna Fire Department
- Ganado Volunteer Fire Department (VFD)
- Vanderbilt VFD
- La Ward VFD
- Jackson County County Wide Drainage District (JCCWDD)
- Jackson County Navigation District
- Jackson County Voluntary Organizations Active in Disaster
- Jackson County Knights of Columbas
- Formosa Plastics
- Inteplast Group
- Jackson County Sheriff’s Office
- City of Ganado Police Department
- City of Edna Police Department
- Jackson Electric
- American Electric Power
- YK Communications
- La Ward Telephone Company
- Cross Roads Ham Radio Club
- Waste Management
- Texas Disposal Systems
- Kansas City Souther
- Union Pacific

3.5 THE STEERING COMMITTEE

Hazard mitigation planning enhances collaboration and support among diverse parties whose interests can be affected by hazard losses. A Steering Committee was formed to oversee all phases of the plan update. The members of this committee included key planning partner staff, citizens, and other stakeholders from the planning area. Table 3-2 lists the committee members.

TABLE 3-2. STEERING COMMITTEE MEMBERS		
Name	Title	Jurisdiction
Kelly Janica*	Emergency Management Coordinator	Jackon County
Gary Broz*	City manager	City of Edna
Blake Petrash*	Mayor Pro-Tem	City of Ganado
Jill S Sklar*	Jackson County Judge	Jackon County
Richard Koch*	Mayor	City of La Ward
Charles Givens	JCCWDD Gen. Manager	Jackson County County-Wide DD
Patrick Brzozowski	LNRA Gen. Manager	Lavaca-Navidad River Authority
Tina Matejek	County Floodplain Administrator	Jackson County
Brandon Crow	Senior Director Texas Administration	Inteplast Group
Shanna Lopez	Municipal Solutions Manager	Waste Management
Matt Brogger	Environment Department Manager	Formosa Plastics

The Steering Committee agreed to meet two times or as needed throughout the plan's development. Scheibe Consulting, LLC facilitated each Steering Committee meeting, which addressed a set of objectives based on the work plan established for the plan update. The Steering Committee met two times from September 2021 through November 2021. Meeting agendas, notes, and attendance logs can be found in Appendix C of this document.

The planning team made a presentation at the first Steering Committee meeting on September 29, 2021, to introduce the mitigation planning process as well as the risk assessment findings. The Steering Committee, planning partners, and the public were encouraged to participate in the plan update process. Meeting minutes can be found in Appendix C of this document

3.6 COORDINATION WITH OTHER AGENCIES

Opportunities for involvement in the planning process must be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate development, businesses, academia, and other private and non-profit interests (44 CFR, Section 201.6(b)(2)). This task was accomplished by the planning team as follows:

- **Steering Committee Involvement**
  Agency representatives were invited to participate on the Steering Committee. Scheibe Consulting served as the primary lead/point of contact for stakeholder and community outreach. The planning team took a proactive approach in inviting and seating the Steering Committee for the development of this hazard mitigation plan. The County invited and requested the active participation of a variety of stakeholder interests to form the Jackson County Hazard Mitigation Plan (HMP) Steering Committee. The Steering Committee Members that were invited by the County are identified in section 3.4, and those who participated as stakeholders in the Jackson County mitigation plan are listed in Table 3-2.

  The County utilized personal communication including telephone and email outreach to inform and invite the participation of the Steering Committee. The Steering Committee members were encouraged to attend and actively participate in meetings as well as to review the draft plan and provide questions and comments. Public notices were posted in and around the County offices and the community notifying them of the planning process, upcoming meeting dates, and inviting community participation. Attendance and participation were encouraged.

  In addition, Scheibe Consulting undertook stakeholder/community outreach activities in support of Jackson County. An informational email was sent in the early weeks of the planning process advising various stakeholders and special interest groups about the planning process and inviting interested members to attend the committee meetings. The County and Scheibe Consulting coordinated the response to all questions and comments. Any changes to the plan as part of this stakeholder outreach were coordinated thru the County.

- **Agency Notification**
  The Texas Division of Emergency Management (TDEM) was invited to participate in the plan development process from the beginning. TDEM was notified of any issues which arose during the hazard mitigation update process.

- **Pre-Adoption Review**
  Agency representatives on the Steering Committee and TDEM were provided an opportunity to review and comment on this plan, primarily through the Jackson County Emergency Management Department Website. The complete draft plan was sent to TDEM for a pre-adoption review to ensure program compliance.

This update process was led by Scheibe Consulting. The process was under the direction of a Texas licensed professional engineer and certified floodplain manager, Eric Scheibe, President of Scheibe Consulting. The Scheibe Consulting team updated the hazard mitigation plan and guided the steering committee throughout the update process.

3.7 REVIEW OF EXISTING PROGRAMS

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports, and technical information (44 CFR, Section 201.6(b)(3)). Chapter 6 of this plan provides a review of laws and ordinances in effect within the planning area that can affect hazard mitigation actions. In addition, the following programs can affect mitigation within the planning area:

- Jackson County
  - Jackson County Subdivision Regulations and Recreational Vehicle Regulations

- Jackson County Flood Damage Prevention Order
  - Jackson County Floodplain Map
  - Jackson County Basic Emergency Operations Plan
  - Jackson County Office of Emergency Management
  - Jackson County Office of Permitting and Inspection
  - Jackson County Hospital District
  - Jackson County Commissioner's Court
- City of Edna
  - City of Edna Code of Ordinances
  - City of Edna Emergency Management
  - City of Edna Building and Standard Commission
  - City of Edna Planning and Zoning Commission
  - City of Edna Land Use Management Ordinance
- City of Ganado
  - City of Ganado Code of Ordinances
  - City of Ganado Board of Code Enforcement
- City of La Ward
  - City of La Ward Floodplain Map
  - City of La Ward Drainage Master Plan

An assessment of all planning partners' regulatory, technical, and financial capabilities to implement hazard mitigation actions is presented in Chapter 7. Many of these relevant plans, studies, and regulations are cited in the capability assessment.

The review of existing programs and the assessment of capabilities help to identify the plans, regulations, personnel, and funding mechanisms available to the county and planning partners to impact and mitigate the effects of natural hazards. The review also helps identify opportunities for the planning partners to strengthen their abilities to proactively mitigate natural hazards in the community through the expansion of existing departments and programs; completion of applicable plans; adoption of necessary regulations or ordinances; creation and hiring of new departments and staff; or mutual aid agreements and memorandums of understanding with neighboring communities. The planning partners reviewed the findings of the capabilities assessment to ensure all information was accurate and used this to help identify mitigation actions.

3.8 PUBLIC INVOLVEMENT

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

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

3.8.1 Stakeholders and the Steering Committee

Stakeholders are the individuals, agencies, and jurisdictions that have a vested interest in the recommendations of the hazard mitigation plan, including planning partners. The effort to include stakeholders in this process included stakeholder participation on the Steering Committee. Stakeholders were encouraged to attend and participate in all committee meetings.

3.8.2 Survey/Questionnaire

A hazard mitigation plan questionnaire (see Figure 3-2) was developed to gauge household preparedness for natural hazards; the level of knowledge of tools and techniques that assist in reducing risk and loss from natural hazards; and the perceived impact of hazards on Jackson County residents and businesses. This online questionnaire was designed to help identify areas vulnerable to one or more natural hazards. The answers to these 32 questions as well as any comments submitted helped guide the Steering Committee in prioritizing hazards of impact and in selecting goals, objectives, and mitigation strategies. A total of 140 questionnaires were completed during the course of this planning process with the English translation receiving 139 responses and the Spanish translation receiving 1. A summary of the survey responses can be found in Appendix C.

Figure 3-2. Sample Page from Questionnaire Distributed to the Public

Jackson County TX HMP Update Survey 2021

A partnership of local governments and other stakeholders in Jackson County are working together to create a Jackson County Hazard Mitigation Plan. The original plan was prepared by the Texas Colorado River Floodplain Coalition (TCRFC) for Jackson County and the participating communities: City of Edna, La Ward, and Ganado. The updated plan will reevaluate the hazards identified in Jackson County. The plan is developed in response to Federal programs that enable the partnership to use pre- and post-disaster financial assistance to reduce the exposure of County residents to risks associated with hazards.

In order to identify and plan for future natural disasters, we need your assistance. The questionnaire is designed to help us gauge the level of knowledge local citizens already have about disaster issues and to identify areas vulnerable to various types of disasters. The information you provide will help us coordinate activities to reduce the risk of injury or property damage in the future.

The survey consists of 32 questions plus an opportunity for any additional comments at the end. The survey should take less than 5 minutes to complete and is anonymous.

The Jackson County Hazard Mitigation Steering Committee thanks you for taking the time to participate in the information gathering process.

OK

3.8.3 Meetings

Two Steering Committee meetings were held during the planning process as well as bi-weekly meetings with the planning committee. Steering Committee Meetings were held in the City of Edna on September 29, 2021, and October 20, 2021.

The meeting format allowed attendees to access handouts, maps, and other resources and ask questions during the meetings. Additionally, project staff and county personnel remained after the meeting to have direct conversations with interested attendees. Details regarding the planning and information generated for the risk assessment were shared with attendees via a PowerPoint presentation.

3.8.4 Press Releases/News Articles

Press releases were distributed over the course of the plan's development as key milestones were achieved and as a means of promoting community involvement. Scheibe Consulting coordinated public outreach with the committee members to engage the public and solicit survey participation and comments regarding the plan draft.

3.8.5 Internet

The participating communities posted information regarding the update process, a link to the community survey, and an informational brochure on their community websites as well as on social media outlets such as Facebook. The community was encouraged to take part in the hazard mitigation process through multiple posts and was encouraged to reach out to Scheibe Consulting or planning partners with any concerns or questions throughout the planning process.

The draft plan was posted on the Jackson County website on September 30, 2021, the City of Edna website on September 30, 2021, the City of Ganado website on September 30, 2021, and the City of La Ward website on September 30, 2021 to allow the public to review the plan as described in Chapter 3.7.5.

3.9 PLAN DEVELOPMENT, CHRONOLOGY, AND MILESTONES

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

TABLE 3-3.
PLAN DEVELOPMENT MILESTONES

Date	Event	Description	Attendance
2021			
05/07	Contract signed	Notice to proceed given to Scheibe Consulting, LLC	N/A
07/13	Planning Committee	First Planning Committee meeting	City of La Ward, City of Ganado, City of Edna, Jackson County
09/13	Public Outreach	Community Survey/Community Brochure distributed via multiple outlets	N/A
09/29	Steering Committee Meeting #1	Presentation on plan process given, review hazard identification and risk assessment, community survey, intro to mitigation strategies	
10/20	Steering Committee Meeting #2	Addition of Land Subsidence, Survey Results, Identifying Mitigation Actions	
12/01	Draft Plan	Internal review draft provided to Steering Committee	N/A
Ongoing	Public Outreach	News articles and website posting	N/A
12/01	Public Comment Period	The initial public comment period for the draft plan opens. Draft plan posted on plan website and in hard copy at the courthouse and Edna City Hall, Ganado City Hall, and La Ward City Hall with press release notifying the public of plan availability	N/A
01/22	Plan Review	Final draft plan submitted to Texas Division of Emergency Management for review	N/A
XX/XX	Public Outreach	Final public meeting on draft plan	N/A
XX/XX	Plan Approval Pending Adoption	Plan approval pending adoption by FEMA	N/A
XX/XX	Adoption	Adoption window of final plan opens	N/A
XX/XX	Plan Approval	Final plan approved by FEMA	N/A

FEMA Federal Emergency Management Agency
N/A Not Applicable

Chapter 4.
Guiding Principle, Goals, and Objectives

Hazard mitigation plans must identify goals for reducing long-term vulnerabilities to identified hazards (44 CFR Section 201.6(c)(3)(i)). The Steering Committee reviewed the previous hazard mitigation plan guiding principle, goals, and objectives as part of the update process. Based on data from the preliminary risk assessment and the results of the public involvement strategy the guiding principle, goals, and objectives were deemed applicable in the current update by all planning partners and were brought forward as part of the update. These components are described in further detail below.

4.1 GUIDING PRINCIPLE

A guiding principle focuses on the range of objectives and actions to be considered. This is not a goal because it does not describe a hazard mitigation outcome, and it is broader than a hazard-specific objective. The guiding principle for the Jackson County Hazard Mitigation Plan Update is as follows:

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

4.2 GOALS

The following are the mitigation goals for this plan:

- **Goal 1:** Protect public health and safety.
- **Goal 2:** Protect existing and new properties.
- **Goal 3:** Increase public understanding, support, and demand for hazard mitigation.
- **Goal 4:** Build and support local capacity and commitment to continuously become less vulnerable to hazards.
- **Goal 5:** Promote growth in a sustainable manner.
- **Goal 6:** Maximize the resources for investment in hazard mitigation.

4.3 OBJECTIVES

The objectives are used to help establish priorities and support the agreed upon goals. The objectives are as follows:

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

- Objectives in support of Goal 2:
  - **Objective 2.1:** Reduce repetitive losses to the National Flood Insurance Program.
  - **Objective 2.2:** Use the most cost-effective approaches to protect existing buildings and public infrastructure from hazards.
  - **Objective 2.3:** Enact and enforce regulatory measures to ensure that development will not put people in harm's way or increase threats to existing properties.
- Objectives in support of Goal 3:
  - **Objective 3.1:** Heighten public awareness of the full range of natural hazards they face.
  - **Objective 3.2:** Educate the public on actions they can take to prevent or reduce the loss of life or property from all natural hazards.
  - **Objective 3.3:** Publicize and encourage the adoption of appropriate hazard mitigation measures.
- Objectives in support of Goal 4:
  - **Objective 4.1:** Build and support local partnerships to continuously become less vulnerable to hazards.
  - **Objective 4.2:** Build a cadre of committed volunteers to safeguard the community before, during, and after a disaster.
  - **Objective 4.3:** Build hazard mitigation concerns into planning and budgeting processes.
- Objective in support of Goal 5:
  - **Objective 5.1:** Incorporate hazard mitigation into the long-range planning and development activities.
  - **Objective 5.2:** Promote beneficial uses of hazardous areas while expanding open space and recreational opportunities.
  - **Objective 5.3:** Utilize regulatory approaches to prevent creation of future hazards to life and property.
- Objectives in support of Goal 6:
  - **Objective 6.1:** Maximize the use of outside sources of funding.
  - **Objective 6.2:** Maximize participation of property owners in protecting their properties.
  - **Objective 6.3:** Maximize insurance coverage to provide financial protection against hazard events.
  - **Objective 6.4:** Prioritize mitigation projects, based on cost-effectiveness and starting with those sites facing the greatest threat to life, health and property.

Chapter 5.
Identified Hazards of Concern and Risk Assessment Methodology

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

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

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

5.1 IDENTIFIED HAZARDS OF CONCERNS

For this plan, the Steering Committee considered the full range of natural hazards that could impact the planning area and then listed hazards that present the greatest concern. The process incorporated a review of state and local hazard planning documents, as well as information on the frequency, magnitude, and costs associated with hazards that have impacted or could impact the planning area. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to them was also used. Table 2-1 lists the hazards identified in the previous TCRFC plan and the hazard ranking. Based on the review, this plan addresses the following hazards of concern:

- Coastal Erosion
- Dam/Levee Failure
- Drought
- Expansive Soils
- Extreme Heat
- Earthquake
- Flood
- Hail
- Hazardous Materials
- Hurricane and Tropical Storm
- Land Subsidence
- Lightning
- Pandemic
- Tornado
- Wildfire
- Wind
- Winter/Ice Storm

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

5.2 CLIMATE CHANGE

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

- Snow cover losses will continue, and declining snowpack will affect snow-dependent water supplies and stream flow levels around the world.
- The risk of drought and the frequency, intensity, and duration of heat waves are expected to increase.
- More extreme precipitation is likely, increasing the risk of flooding.
- The world's average temperature is expected to increase.

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

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

5.3 METHODOLOGY

The risk assessments in Chapter 8 through Chapter 21 describe the risks associated with each identified hazard of concern. Each chapter describes the hazard, the planning area's vulnerabilities, and probable event scenarios. The following steps were used to define the risk of each hazard:

- **Identify and profile each hazard -** The following information is given for each hazard:
  - Geographic areas most affected by the hazard
  - Event frequency estimates
  - Severity estimates
  - Warning time likely to be available for response
- **Determine exposure to each hazard -** Exposure was evaluated by overlaying hazard maps, when available, with an inventory of structures, facilities, and systems to identify which of them would be exposed to each hazard. When hazard mapping was not available, a more qualitative discussion of exposure is presented.
- **Assess the vulnerability of exposed facilities -** The vulnerability of exposed structures and infrastructure was evaluated by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as geographic

information system (GIS) and FEMA's hazard modeling program called Hazards United States Multi-Hazard, or HAZUS-MH, were used to perform this assessment for the dam/levee failure, flood, and hurricane hazards. Outputs similar to those from HAZUS-MH were generated for other hazards, using maps generated by the HAZUS-MH program.

5.4 RISK ASSESSMENT TOOLS

5.4.1 Dam Failure, Earthquake, Flood, and Hurricane - HAZUS-MH

Overview

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

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

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

Levels of Detail for Evaluation

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

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

- **Level 3** – This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

Application for This Plan

This risk assessment was conducted using HAZUS-MH and GIS-based analysis methodology. The default HAZUS-MH inventory database for Jackson County was updated with the 2010 U.S. Census data and 2018 RS Means Square Foot Costs. This enabled a HAZUS-MH Level 2 analysis to be performed on some of the profiled hazards.

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

- **Dam/Levee Failure -** Dam failure inundation mapping for the planning area was not available in a format usable with HAZUS-MH. Therefore, dam failure inundation maps were not used for performing HAZUS-MH risk analysis.
- **Earthquake** – No earthquake scenarios were selected for this plan since an earthquake event for the planning area as Texas is at a very low risk of earthquake damage according to the 2018 State of Texas Hazard Mitigation Plan. Only a minimum Level 1 HAZUS-MH analysis was profiled using the 500-Year Probability Event scenario.
- **Flood -** A Level 2 flood analysis was performed using HAZUS-MH.
- **Hurricane -** A HAZUS-MH Level 2 analysis was performed to assess hurricane and tropical storm risk and exposure for coastal and near-coastal communities. The probabilistic option in the HAZUS-MH hurricane module was used for the analysis of this hazard.

5.4.2 Other Hazards of Concern

For hazards of concern that are not directly modeled in HAZUS-MH, annualized losses were estimated using GIS-based analysis, historical data analysis, and statistical risk assessment methodology. Event frequency, severity indicators, expert opinions, and historical knowledge of the region was used for this assessment. The primary data source was the updated HAZUS-MH inventory data updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs and augmented with state and federal data sets. Additional data sources for specific hazards were also used and cited within their respective sections.

5.4.3 Limitations

Loss estimates, exposure assessments, and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic, or economic parameter data
- The unique nature, geographic extent, and severity of each hazard
- Mitigation measures already employed
- The amount of advance notice residents have to prepare for a specific hazard event

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate and not deterministic. The results do not predict precise results and should be used only to understand the relative risk for planning purposes and not engineering. Over the long term, Jackson County and its planning partners will collect additional data to assist in estimating potential losses associated with other hazards.

Chapter 6.
Jackson County Profile

Jackson County covers approximately 829 square miles and is located in the coastal region of Texas (Figure 6-1). A total of 28 square miles of the county is water. Jackson County is bounded by Calhoun, Victoria, Lavaca, Colorado, Wharton, and Matagorda Counties. The Lavaca and Navidad Rivers run through Jackson County. The waters of Brushy and Sandy Creek lead into Mustang Creek, which widens at the center of the county and flows southerly to eventually meet the Lavaca Bay.

The county was one of the original counties of Texas and was named after President Andrew Jackson in 1836. The City of Edna is the largest city in Jackson County and holds the county seat. Other incorporated communities include La Ward and Ganado. As of the 2010 U.S. Census, Jackson County had a population of 14,075. The county has one hospital, Jackson County Hospital District, located in the City of Edna.

Figure 6-1. Location of the Jackson County Planning Area within the State of Texas

Jackson County offers a variety of outdoor recreation (fishing, hunting, boating, swimming, hiking, and bird watching). Anglers can enjoy saltwater fishing in the many bays adjacent to Jackson County and the Gulf of Mexico. Freshwater fishing is available at Lake Texana, the location of numerous annual fishing tournaments. Jackson County has nine popular birdwatching sites included in the Central Coast Section of the Great Texas Coastal Birding Trail, offering a wide variety of bird species for the amateur or avid bird watcher. Leading attractions in the county include the Texana Museum, Brackenridge Plantation campground, and Lake Texana State Park.

6.1 HISTORICAL OVERVIEW

Jackson County was one of the original 23 counties of Texas, created on March 17, 1836, and organized in 1837 from an Old Mexican Municipality. The county seat was Texana (originally known as Santa Anna) from 1836 to 1883, then the county seat became the City of Edna in 1883. The majority of the information in the following section has been summarized from the Handbook of Texas Online (Hardin 2010).

Karankawa Indians were the earliest occupants of the area. In 1528, Europeans made the first contact with Texas Indians. In 1684, René-Robert Cavelier, Sieur de La Salle, explored the area and established a settlement called Fort St. Louis.

Six of Stephen F. Austin's “Old Three Hundred” families settled in the future county. So many of the early colonists came from Alabama that for a time the municipality became known as the "Alabama Settlement." In 1835, the Alabama Settlement met for the Lavaca-Navidad Meeting, where they adopted resolutions protesting the actions of the Mexican government. These resolutions led to the provisional government of Texas, establishing the Jackson Municipality. The old Alabama Settlement continued to grow during the period of the Republic of Texas. In 1836, the municipality was organized into Jackson County.

The decade between 1850 and 1860 saw a marked rise in population; by 1860 the number of residents in Jackson County had increased to 2,612. By 1860, 25,240 acres were being cultivated, however, cattle ranching remained the chief agricultural pursuit. The coastal plains proved well suited for maintaining large herds, and by the eve of the Civil War, nearly 80,000 cattle were maintained in the county.

As national events brought about the unraveling of the Union, a strong majority of Jackson County voters stood with the South; the county voted for secession. Company K of the Second Texas Infantry was organized in Jackson County. In all, more than 100 Jackson County soldiers served in the Confederate army. The end of the war brought wrenching changes in the county's economy. During the 1870s the economy began to recover slowly from the effects of the Civil War. By 1880 the county was again a leading producer of beef and the county became an important shipping point for cattle.

In 1881, Count Joseph Telfener, representing the railroad, approached the businessmen of Texana to construct the line through their town. The citizens declined, thinking that a railroad would be detrimental to the existing shipping trade. Telfener, therefore, selected another route and named one of the main stations on it Edna, after his daughter. A settlement developed around the station, and soon Edna grew into a town. In 1883 county voters chose to make Edna the county seat. The coming of the railroad brought new growth to Jackson County.

With the dawning of the twentieth century, Jackson County remained predominantly agricultural. Cotton was the leading crop, although sugarcane was also produced in sizable quantities. The mainstay of the economy, however, continued to be beef cattle. Between 1910 and 1920, the number of acres devoted to cotton grew and cotton production nearly tripled. Fueling the population surge was a large movement of farmers from the Old South, who were lured to the Coastal Plains region by its abundant fertile land. Many had previously grown cotton and sugar, and they introduced large-scale farming to the area.

The decade of the 1920s was a prosperous period in Jackson County's history with high commodity prices. During the early 1930s, cotton remained the leading cash crop, but droughts, infestations, and shrinking prices drove down cotton production. While many county residents suffered during the Great Depression, the discovery of oil in 1934 served to mitigate some of its worst effects. Oil helped some cashless farmers to settle long-standing debts and made a few landowners rich. Yet not all of the county's residents benefited. During the late 1930s, agricultural prices began to rebound, but the economy did not fully recover until after World War II. Afterward, Jackson County was a leading producer of rice and cattle.

In the early 1990s, rice culture was the leading agricultural activity, with some 30,000 acres under production. Other leading crops included corn, grain sorghums, and beef cattle. Ninety percent of the county was used for farming and ranching. Despite falling oil prices in the 1980s, oil and gas extraction remained the leading nonagricultural county industry. Other important businesses included concrete production, heavy construction, metal fabrication and tooling, and sheet-metal manufacture.

6.2 MAJOR PAST HAZARD EVENTS

Federal disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government. However, no specific dollar loss threshold has been established for these declarations. A federal disaster declaration puts federal recovery programs into motion to help disaster victims, businesses, and public entities. Some of the programs are matched by state programs. The planning area has experienced 23 events between 1967 and March 2021 for which federal disaster declarations were issued. These events are listed in Table 6-1.

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

TABLE 6-1. FEDERAL DISASTER DECLARATIONS IN JACKSON COUNTY		
Disaster Declaration	Description	Incident Date
EM-3554	Severe Winter Storm	2/11/2021 – 2/21/2021
DR-4586	Severe Winter Storms	2/11/2021 – 2/21/2021
EM-3540	Tropical Storms Marco and Laura	8/23/2020 – 8/27/2020
EM-3530	Hurricane Hanna	7/25/2020 – 7/31/2020
EM-3458	COVID-19	1/20/2020 -
DR-4485	COVID-19 Pandemic	1/20/2020 -
DR-4332	Hurricane Harvey	8/23/2017 – 9/15/2017
EM-3294	Hurricane Ike	9/7/2008 – 9/26/2008
EM-3290	Hurricane Gustav	8/27/2008 - 9/7/2008
EM-3277	Hurricane Dean	8/17/2007 - 9/5/2007
DR-1624	Extreme Wildfire Threat	11/27/2005 - 5/14/2006
DR-1606	Hurricane Rita	9/23/2005 - 10/14/2005
EM-3261	Hurricane Rita	9/20/2005 - 10/14/2005
EM-3216	Hurricane Katrina Evacuation	8/29/2005 - 10/1/2005
DR-1479	Hurricane Claudette	7/15/2003 - 7/28/2003
EM-3171	Loss of the Space Shuttle Columbia	2/1/2003 - 2/1/2003
EM-3142	Extreme Fire Hazards	8/1/1999 - 12/10/1999
DR-1257	Texas Flooding 10/18/98	10/17/1998 - 11/15/1998
DR-1239	Tropical Storm Charley	8/22/1998 - 8/31/1998
DR-1041	Severe Thunderstorms and Flooding	10/14/1994 - 11/8/1994
EM-3113	Extreme Fire Hazard	8/30/1993 - 11/15/1993
DR-900	Severe Storms, Tornadoes, and Flooding	4/5/1991 - 4/6/1991
DR-232	Hurricane Beulah	9/28/1967 – 9/28/1967

Notes:
Federal disaster declarations are coded as follows: DR = Major Disaster Declaration; EM = Emergency Declaration
From OpenFEMA Dataset

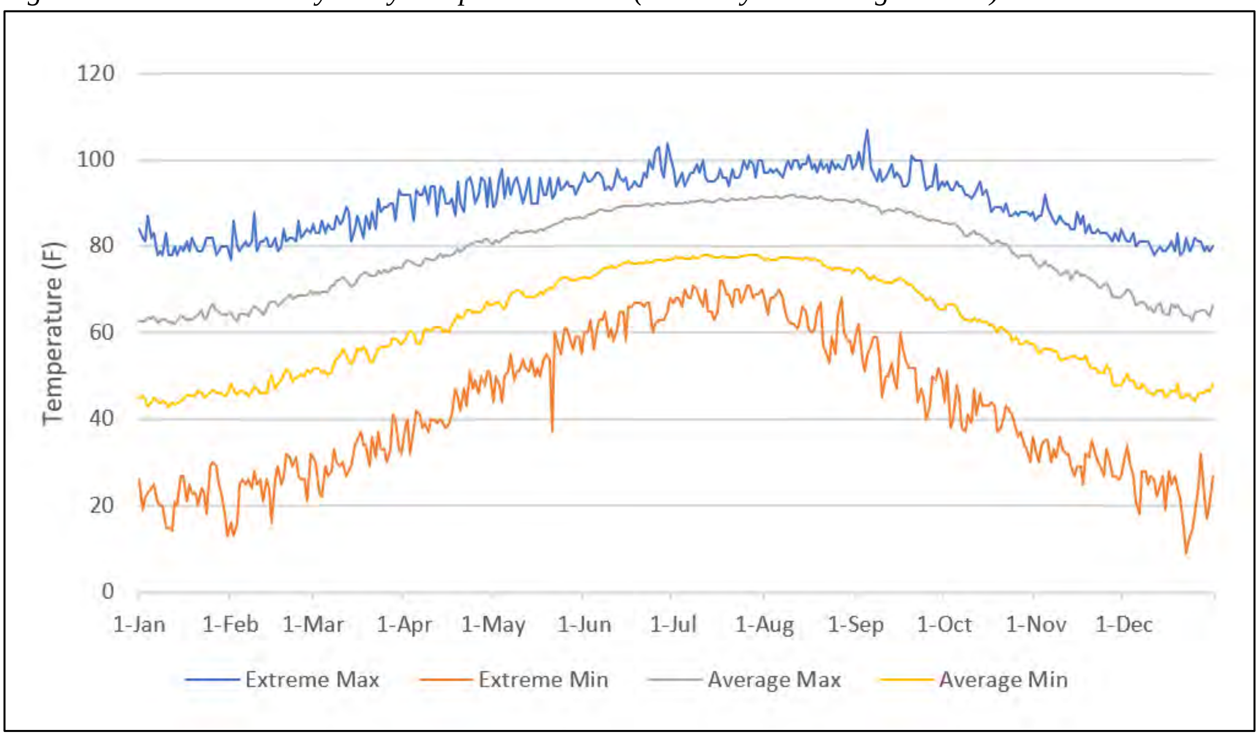
6.3 CLIMATE

Jackson County has a humid, subtropical climate, with hot summer days and generally mild winters. Average temperatures range from 90.3°F in the summer to 46.7°F in the winter. Table 6-2 contains temperature summaries for the Palacios Municipal Airport National Oceanic and Atmospheric Administration (NOAA) weather station. Jackson County does not contain a weather station with continuous data, so the nearest weather station was chosen as the source for climate data for the planning area. Figure 6-2 graphs the daily temperature averages and extremes from1943 through 2021. Figure 6-3 and Figure 6-4, respectively, show the geographic distribution of annual average maximum and annual average minimum temperatures in Jackson County compared to the State of Texas from 1981 to 2010.

TABLE 6-2. JACKSON COUNTY TEMPERATURE SUMMARIES – PALACIOS MUNICIPAL AIRPORT STATION	
Period of Record	1943-2021
Winter[a] Average Minimum Temperature	46.7°F
Winter[a] Mean Temperature	55.9ºF
Summer[a] Average Maximum Temperature	90.3°F
Summer[a] Mean Temperature	83.4ºF
Maximum Temperature (and Date)	107°F; September 5, 2000
Minimum Temperature (and Date)	9°F; December 23, 1989
Average Annual Number of Days >90°F[a]	78.6
Average Annual Number of Days <32°F[a]	7.1

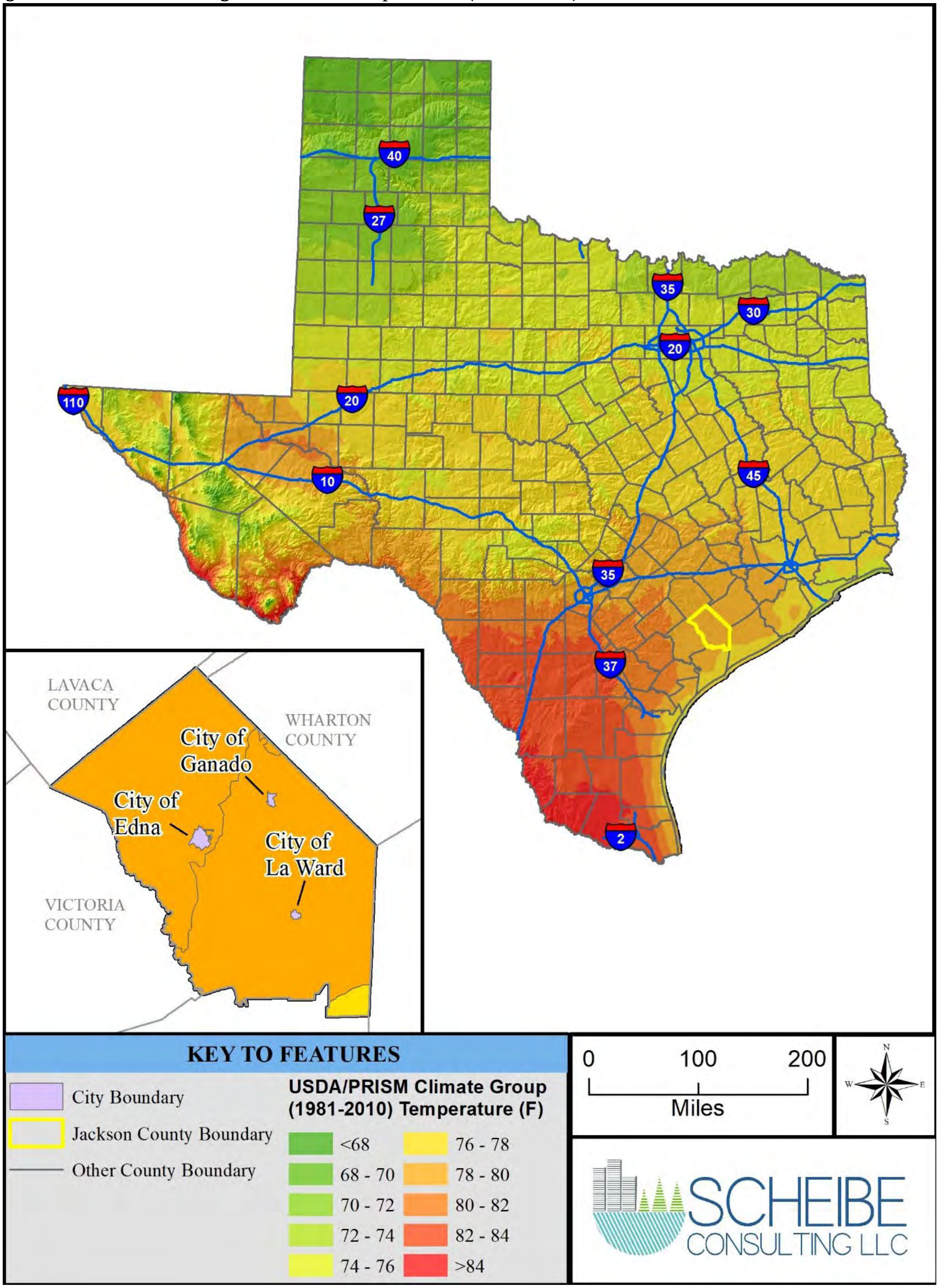
Notes:
Winter: December, January, February; Summer: June, July, August
From NOAA Weather Station Climate Data (February 1943 – August 2021)

Figure 6-2. Jackson County Daily Temperature Data (February 1943– August 2021)



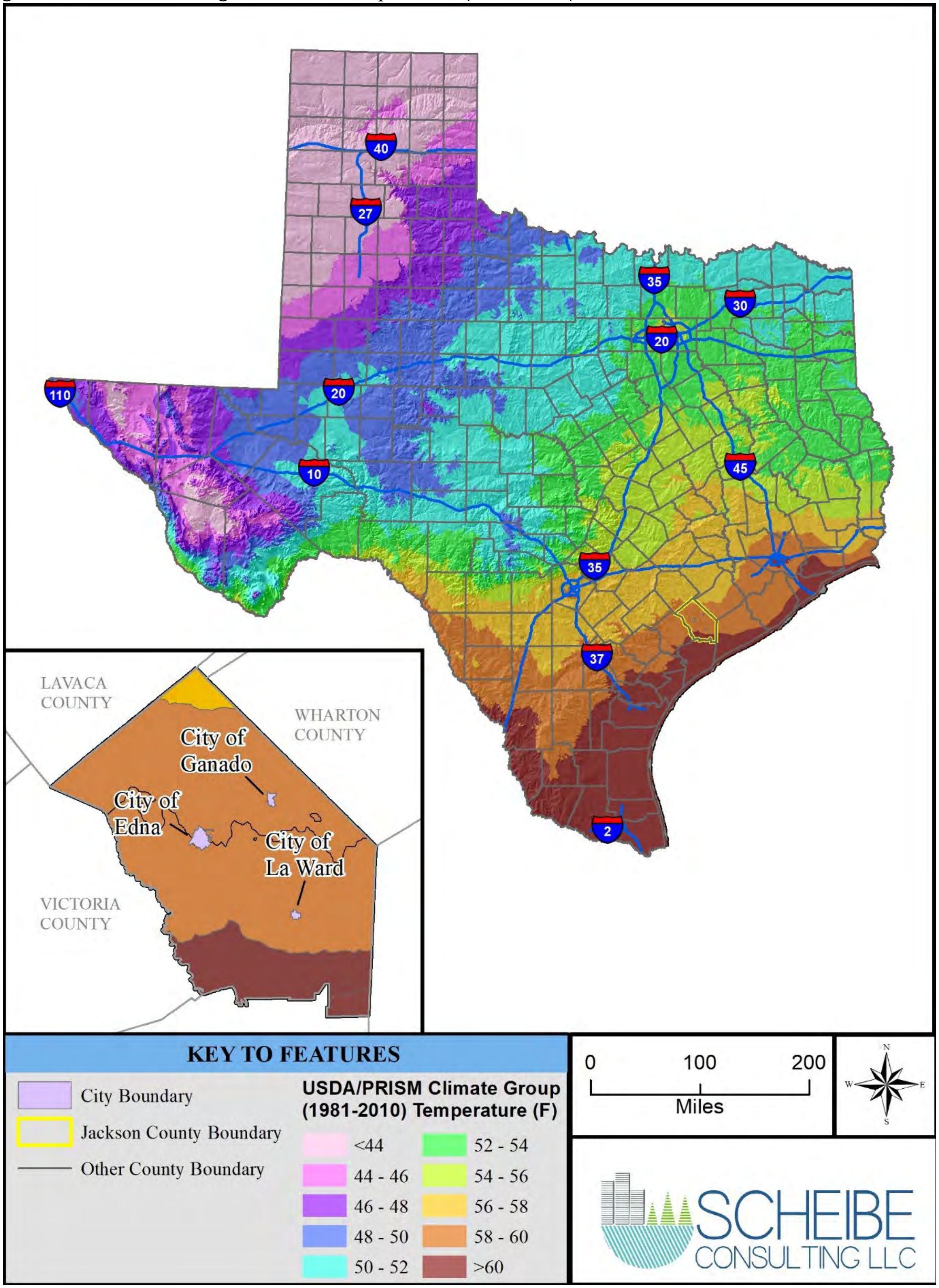
Note: From NOAA Weather Station Climate Data (February 1943 – August 2021)

Figure 6-3. Annual Average Maximum Temperature (1981-2010)



Notes: From USDA/PRISM Climate Group

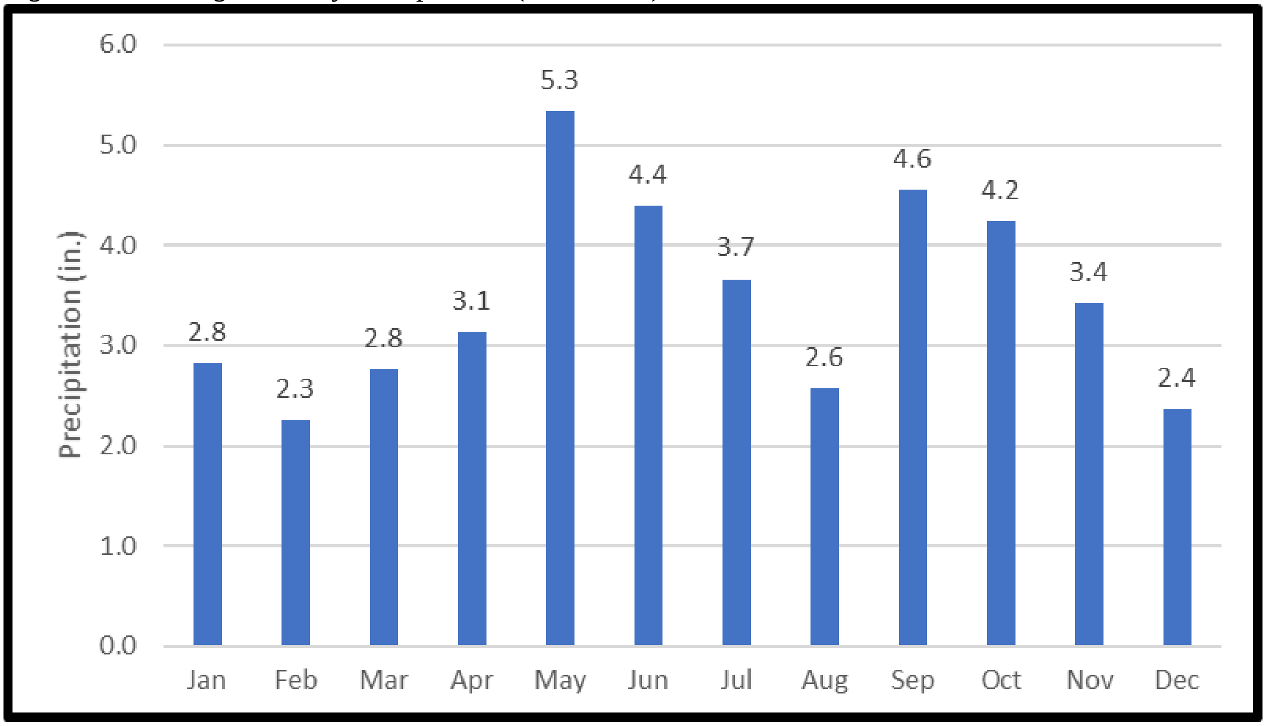
Figure 6-4. Annual Average Minimum Temperature (1981-2010)



Note: From USDA/PRISM Climate Group

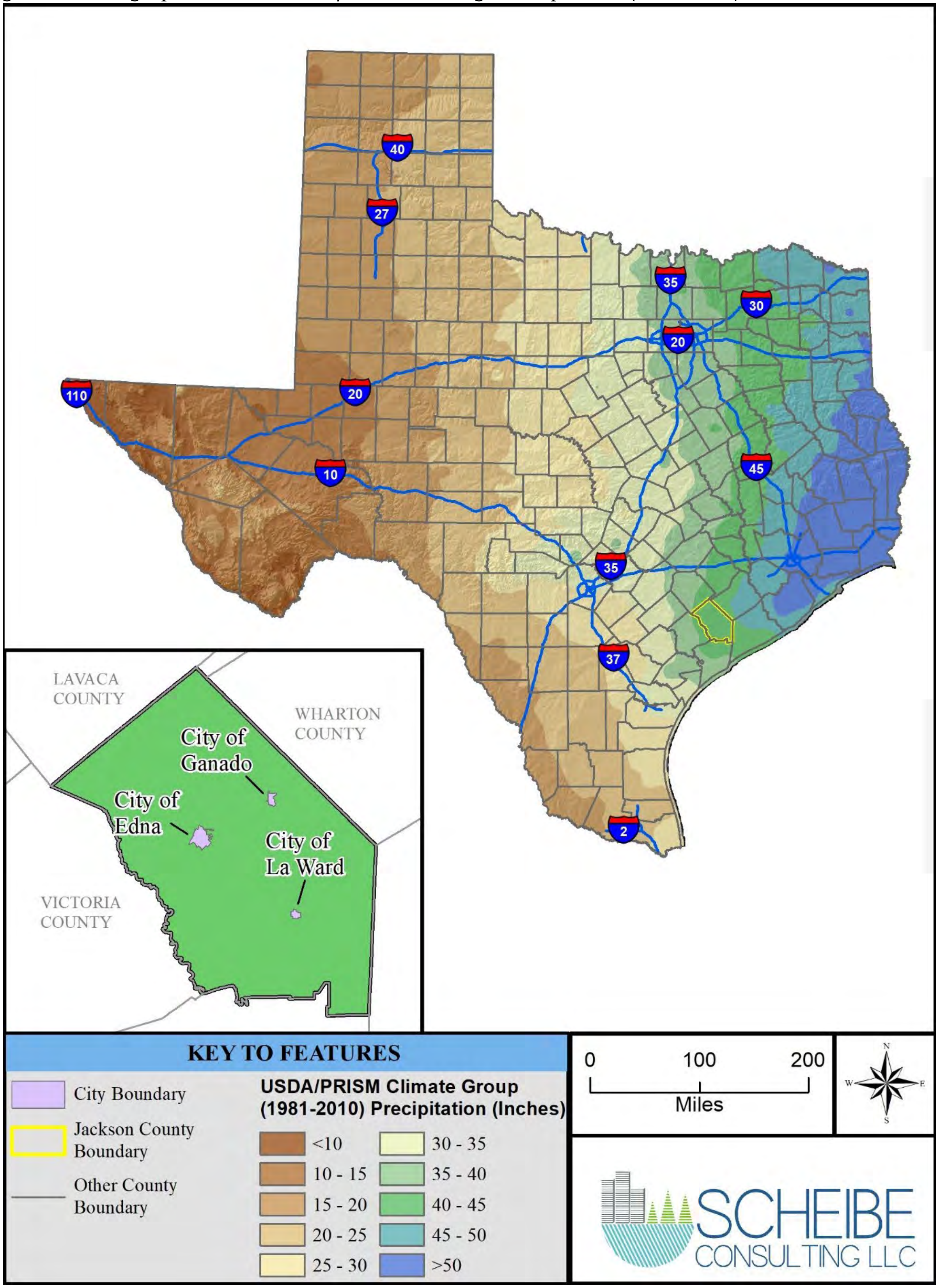
Precipitation is greatest during May and September. The average annual precipitation is 41.52 inches. Severe thunderstorms occur mostly in the spring. Data from the National Lightning Detection Network ranked Texas first in the nation (excluding Alaska and Hawaii) with respect to the number of cloud-to-ground lightning flashes in 2020. Figure 6-5 shows the average monthly precipitation in Jackson County. Figure 6-6 shows the geographic distribution of annual average precipitation in Jackson County compared to the State of Texas from 1981-2010.

Figure 6-5. Average Monthly Precipitation (1943-2021)



Note: From NOAA Weather Station Climate Data (February 1943 – August 2021)

Figure 6-6. Geographic Distribution of Annual Average Precipitation (1981-2010)



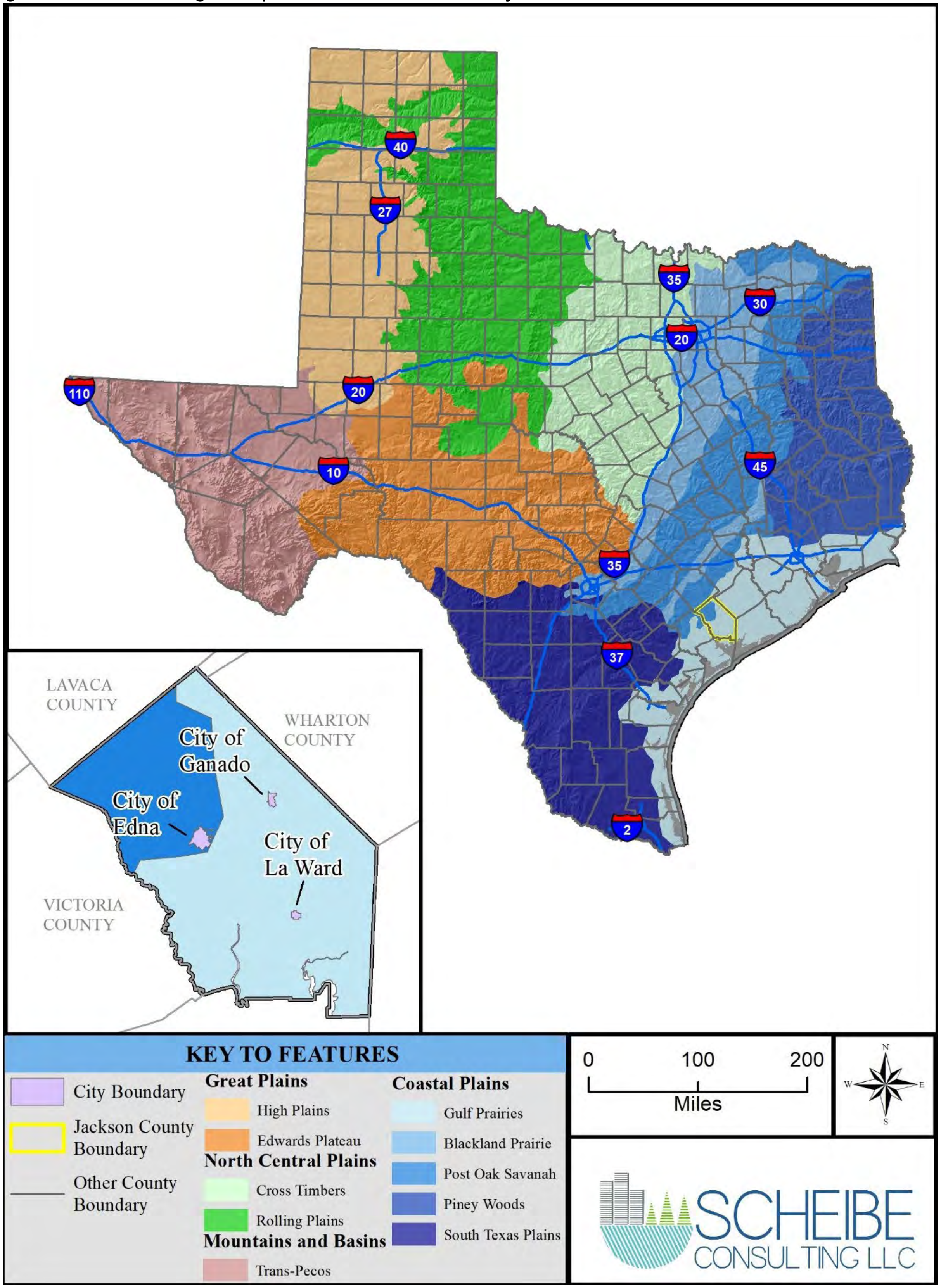
Note: From USDA/PRISM Climate Group

6.4 GEOLOGY AND SOILS

Texas is broadly divided into four regions by physical geography features such as landforms, climate, and vegetation. Jackson County is in the southeastern part of Texas and most of the county is a nearly level to gently sloping plain that is dissected by a few well-defined creeks and rivers. The Lavaca and Navidad Rivers dissect the northwestern and central parts of the county. They flow to the southeast and south. Arenosa and Garcitas Creeks form most of the western boundary of the county. The eastern part of the county is drained by Huisache, West Carancahua, and Carancahua Creeks. The elevation ranges from sea level in the southern part of the county to 150 feet above sea level in the northwestern part.

Jackson County is in the Coast Prairie and Coast Saline Prairie major land resource areas. The soils in the county are dominantly clayey and loamy and dark. The land has very little slope. Because of the topography and the abundant rainfall, these nearly level soils are often seasonally wet and need adequate surface drainage outlets for the production of crops. Some of the soils, such as those in tidal areas, are continuously wet. In unprotected sloping areas, the soils are subject to sheet and gully erosion. Figure 6-7 shows the Texas natural regions and Jackson County.

Figure 6-7. Natural Regions of Texas and Jackson County



Note: From Texas Parks & Wildlife

6.5 CRITICAL FACILITIES AND INFRASTRUCTURE

Critical facilities and infrastructure are essential to the health and welfare of the population. These assets become especially important after a hazard event. As defined for this hazard mitigation plan update, critical facilities include but are not limited to the following:

Essential services facilities:

- Public safety facilities (police stations, fire and rescue stations, emergency vehicle and equipment storage, and, emergency operation centers)
- Emergency medical facilities (hospitals, ambulance service centers, urgent care centers having emergency treatment functions, and non-ambulatory surgical structures but excluding clinics, doctors' offices, and non-urgent care medical structures that do not provide these functions)
- Designated emergency shelters
- Communications (main hubs for telephone, broadcasting equipment for cable systems, satellite dish systems, cellular systems, television, radio, and other emergency warning systems, but excluding towers, poles, lines, cables, and conduits)
- Public utility plant facilities for generation and distribution (hubs, treatment plants, substations and pumping stations for water, power and gas, but not including towers, poles, power lines, buried pipelines, transmission lines, distribution lines, and service lines)
- Air transportation lifelines (airports [municipal and larger], helicopter pads and structures serving emergency functions, and associated infrastructure [aviation control towers, air traffic control centers, and emergency equipment aircraft hangars])

Hazardous materials facilities:

- Chemical and pharmaceutical plants
- Laboratories containing highly volatile, flammable, explosive, toxic, or water-reactive materials
- Refineries
- Hazardous waste storage and disposal sites
- Aboveground gasoline or propane storage or sales centers

At-risk population facilities:

- Eldercare centers (nursing homes)
- Congregate care serving 12 or more individuals (daycare and assisted living)
- Public and private schools (pre-schools, K-12 schools, before-school and after-school care serving 12 or more children)

Facilities vital to restoring normal services:

- Essential government operations (public records, courts, jails, building permitting and inspection services, community administration and management, maintenance and equipment centers)
- Essential structures for public colleges and universities (dormitories, offices, and classrooms only)

Table 6-3 and Table 6-4 summarize the critical facilities and infrastructure in each municipality and unincorporated county areas. This information was obtained from HAZUS-MH, county assessor data, or from community personnel.

**TABLE 6-3.
CRITICAL FACILITIES IN THE PLANNING AREA**

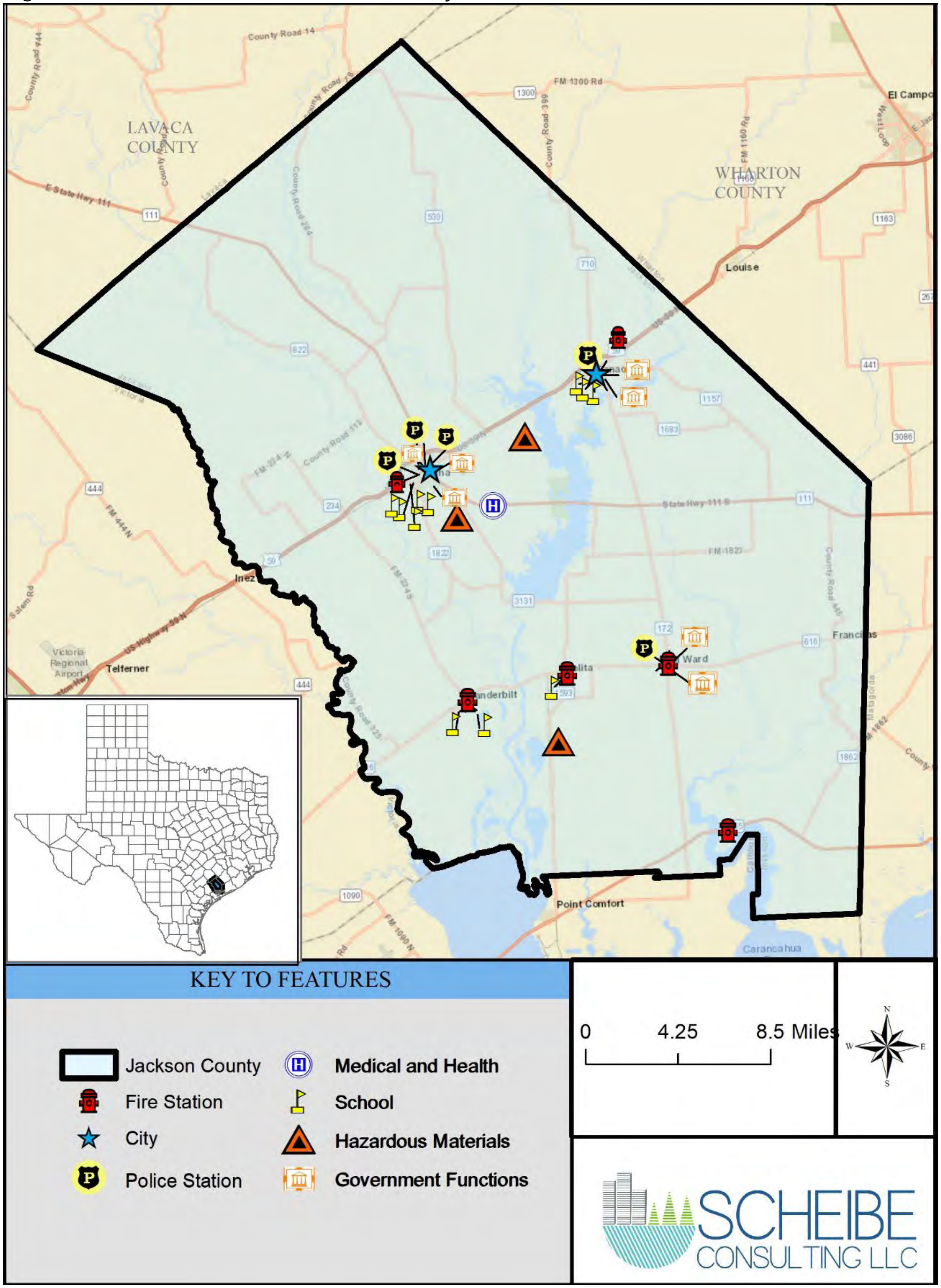
Facility Type	City of Edna	City of Ganado	City of La Ward	Unincorporated or Other	**Jackson County Total**
Fire Stations	1	1	1	4	**6**
Police Stations	3	1	0	0	**4**
Hospital	1	0	0	0	**1**
Emergency Medical and Health	1	2	0	0	**3**
Emergency Operations Center	1	0	0	0	**1**
School	5	3	0	3	**11**
Hazardous Materials	0	0		3	**3**
Government Functions	3	3	1	0	**7**
Total					

**TABLE 6-4.
CRITICAL INFRASTRUCTURE IN THE PLANNING AREA**

Facility Type	City of Edna	City of Ganado	City of La Ward	Unincorporated or Other	**Jackson County Total**
Communication	0	1	0	4	**5**
Natural Gas	0	0	0	1	**1**
Power Facility	0	0	0	1	**1**
Potable Water	2	4	1	0	**7**
Wastewater	1	4	1	4	**10**
Dam Location	0	0	0	6	**6**
Airport	0	0	0	1	**1**
Port	0	0	0	1	**1**
Bus	0	1	0	0	**1**
Rail Facility	0	0	0	0	**0**
Bridge (Rail)	0	0	0	12	**12**
Bridge (Motor)	15	11	0	142	**168**
Total	**18**	**21**	**2**	**172**	**213**

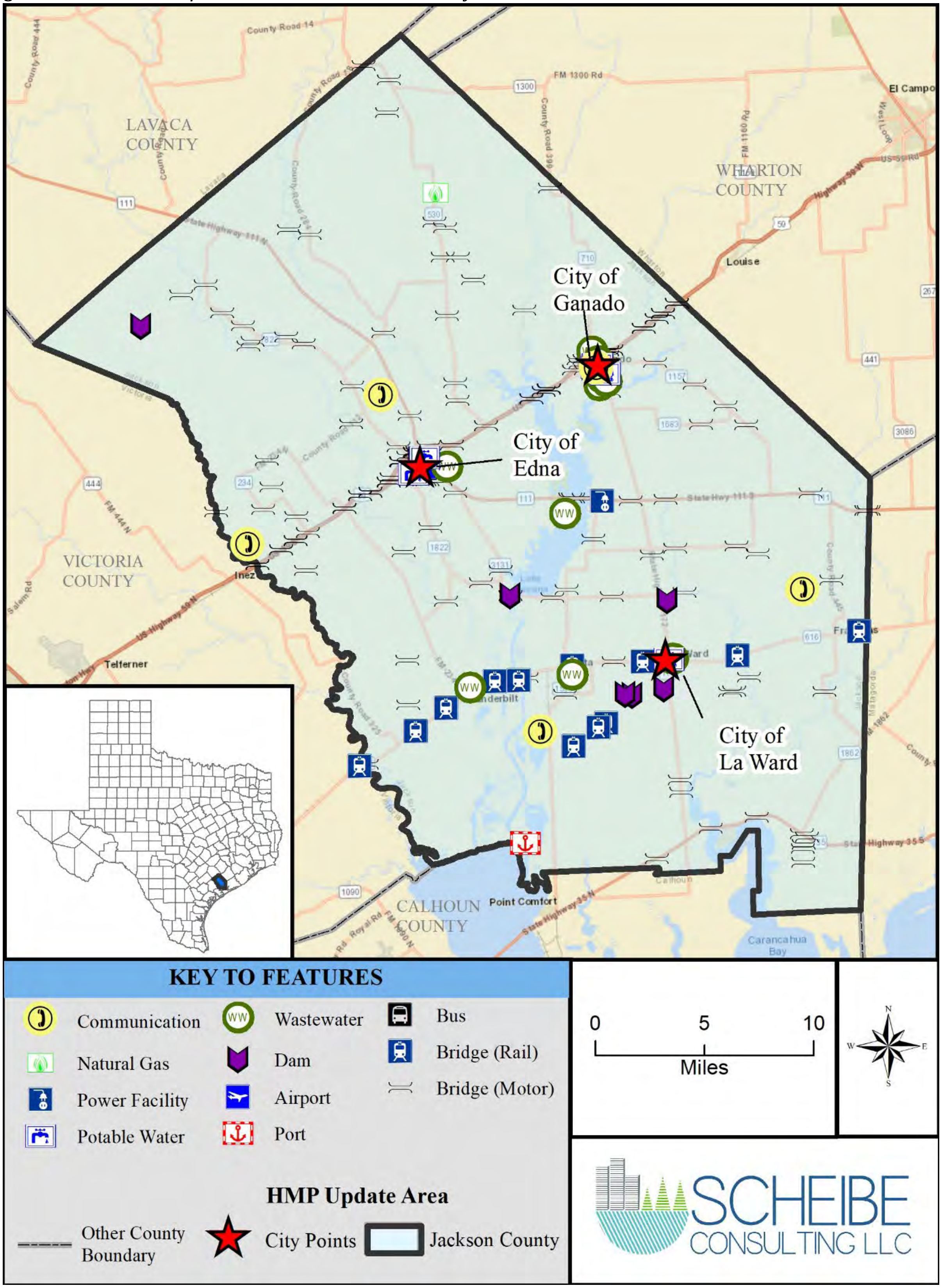
Figure 6-8 through Figure 6-14 show the location of critical facilities and infrastructure in the county and participating communities. Due to the sensitivity of this information, a detailed list of facilities is not provided. The list is on file with each planning partner. Critical facilities and infrastructure were analyzed in HAZUS to help rank risk and identify mitigation actions. The risk assessment for each hazard discusses critical facilities and infrastructure with regard to that hazard.

Figure 6-8. Critical Facilities in Jackson County



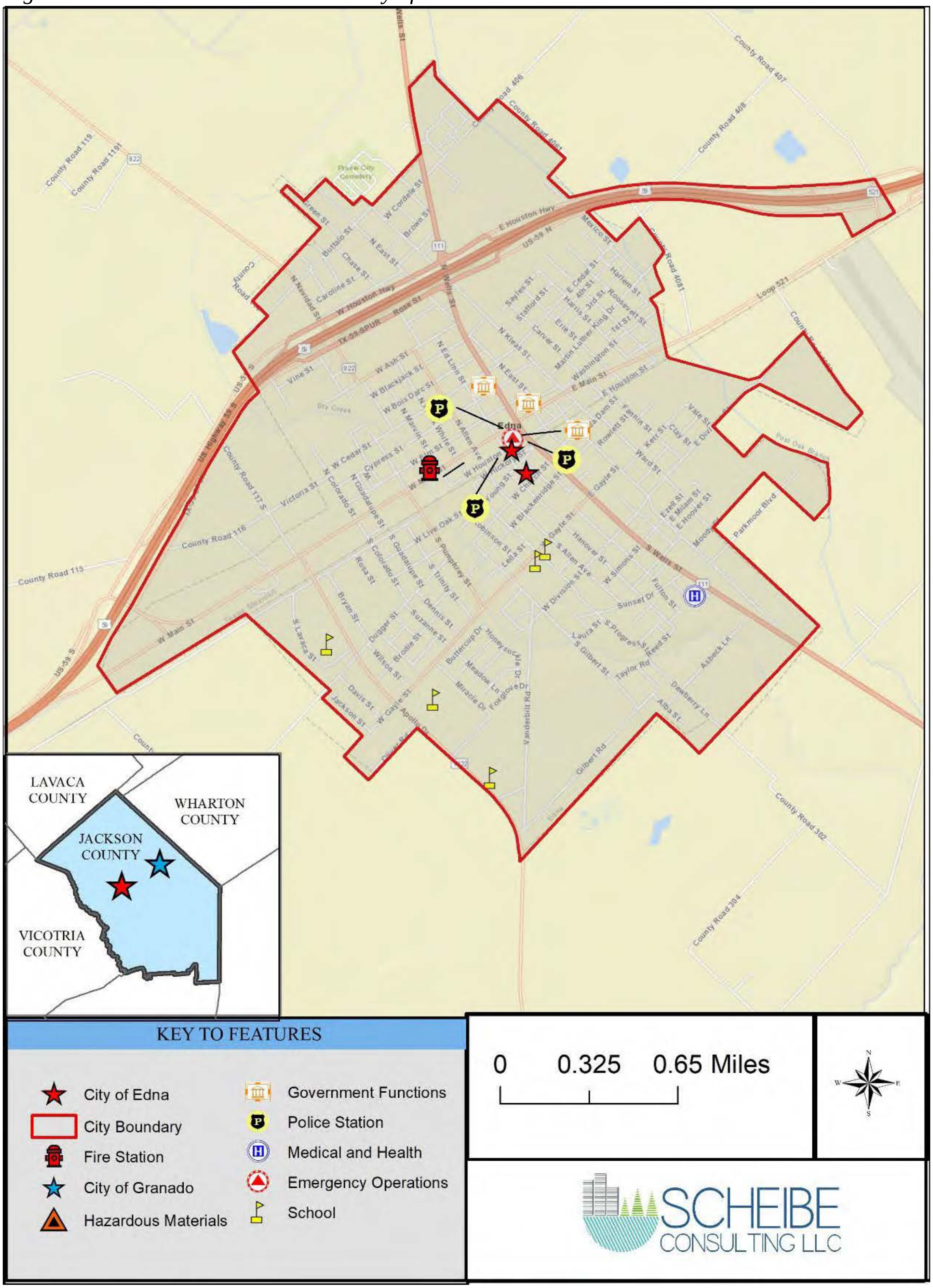
Note: From HAZUS-MH and GIS

Figure 6-9. Critical Infrastructure in Jackson County



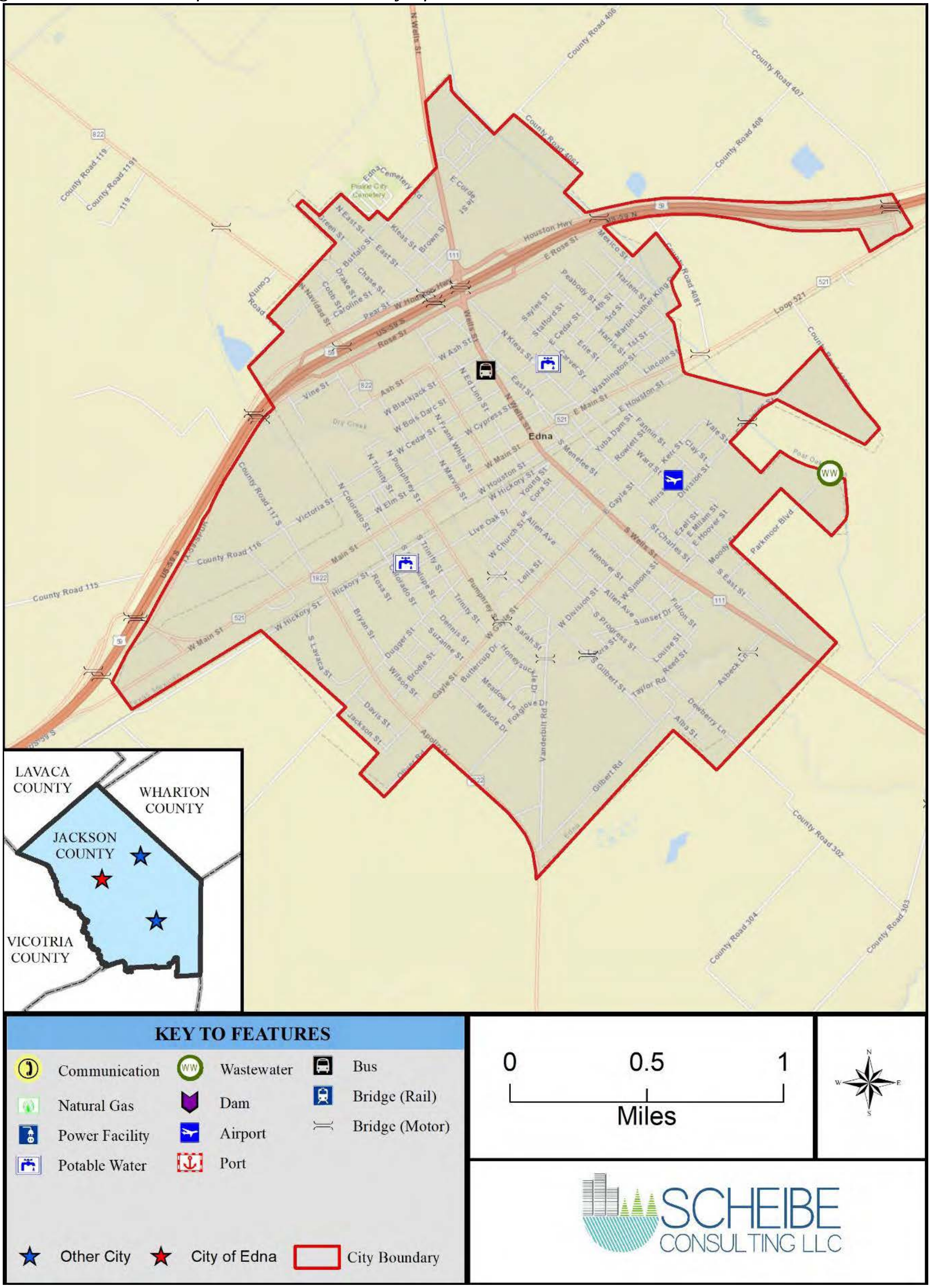
Note: From HAZUS-MH and GIS

Figure 6-10. Critical Facilities in the City of Edna



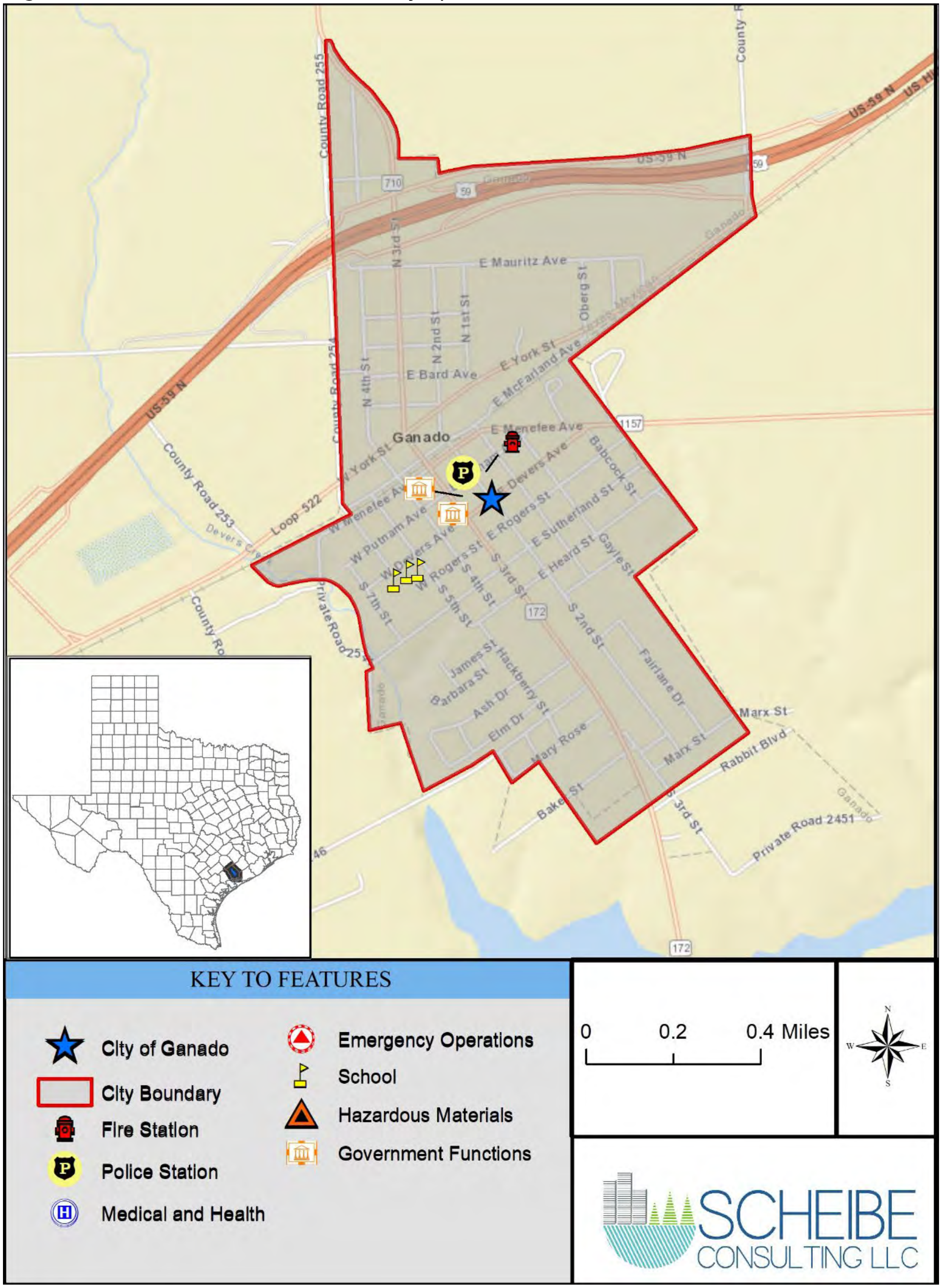
Note: From HAZUS-MH and GIS

Figure 6-11. Critical Infrastructure in the City of Edna



Note: From HAZUS-MH and GIS

Figure 6-12. Critical Facilities in the City of Ganado



Note: From HAZUS-MH and GIS

Figure 6-13. Critical Infrastructure in the City of Ganado

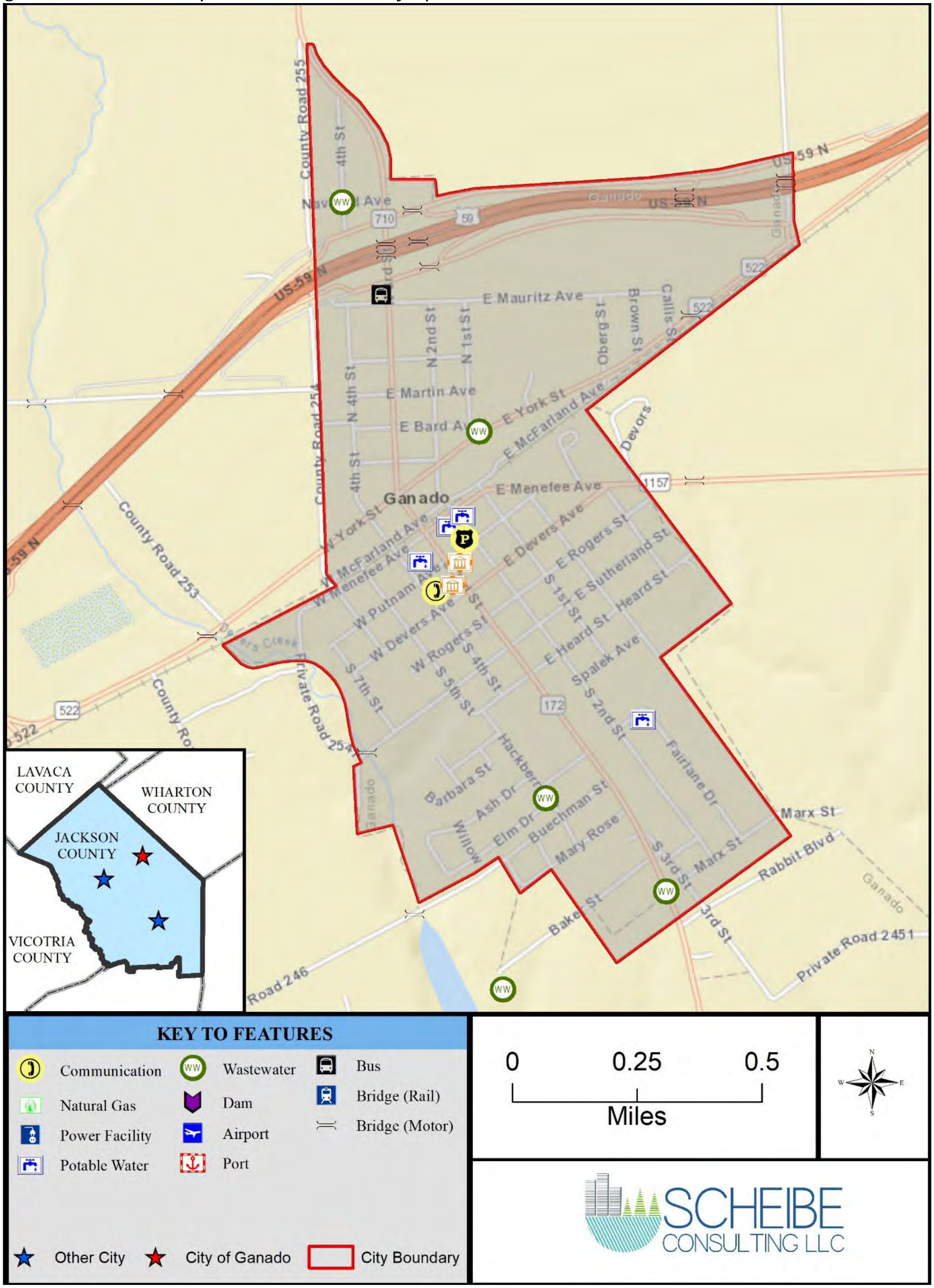
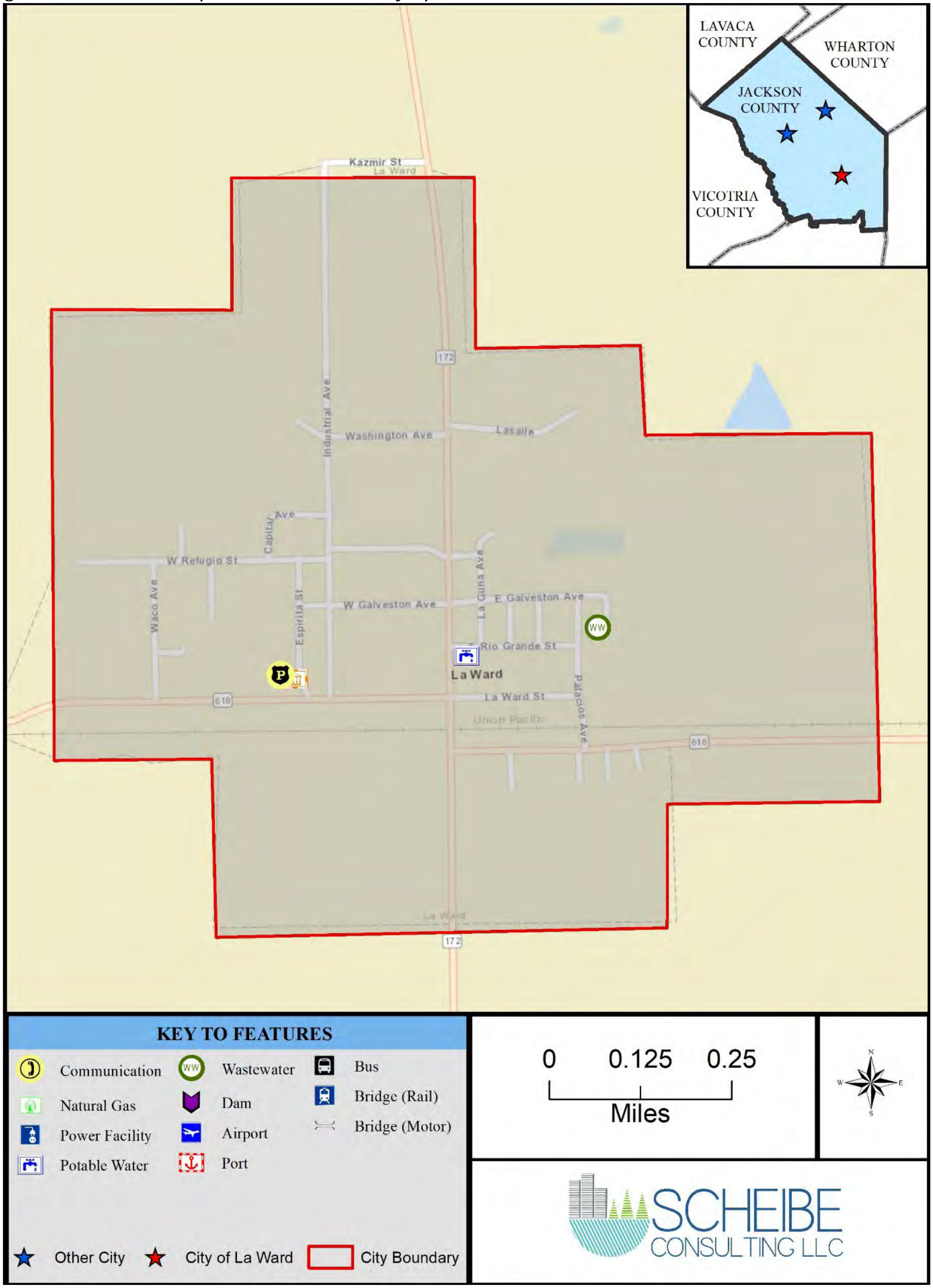


Figure 6-14. Critical Infrastructure in the City of La Ward



6.6 DEMOGRAPHICS

Information on current and historic population levels and future population projections is needed for making informed decisions about future planning. Population directly relates to land needs such as housing, industry, stores, public facilities and services, and transportation. Population changes are useful socio-economic indicators, as a growing population generally indicates a growing economy, and a decreasing population signifies economic decline.

Some populations are at greater risk from hazard events because of decreased resources or physical abilities. Elderly people, for example, may be more likely to require additional assistance. Research has shown that people living near or below the poverty line, the elderly (especially older single men), the disabled, women, children, ethnic minorities, and renters all experience, to some degree, more severe effects from disasters than the general population. These vulnerable populations may vary from the general population in risk perception; living conditions; access to information before, during and after a hazard event; capabilities during an event; and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations. Detailed spatial analysis to locate areas where there are higher concentrations of vulnerable community members would assist the county in extending focused public outreach and education to these most vulnerable citizens. Select U.S. Census demographic and social characteristics estimates for 2015 through 2019 in Jackson County are shown in Table 6-5.

TABLE 6-5.
JACKSON COUNTY DEMOGRAPHICS AND SOCIAL CHARACTERISTICS (2019)

	Jackson County	City of Edna	City of Ganado	City of La Ward
Gender/Age (% of Total Population)				
Male	49.4	46.5	48.8	53.4
Female	50.6	53.5	51.2	46.6
Under 5 years	6.8	6.6	8.0	7.2
65 years and over	17.4	16.4	13.8	7.2
Race/Ethnicity (% of Total Population)				
White	88.7	81.3	88.3	93.1
Black or African American	7.4	16.1	2.1	0.7
American Indian and Alaska Native	0.4	0.6	0.0	0.0
Asian	1.2	1.1	1.5	0.0
Native Hawaiian and Other Pacific Islander	0.1	0.2	0.0	0.0
Some Other Race	4.2	3.1	10.2	6.2
Hispanic or Latino (of any race)[1]	33.1	34.4	57.2	37.0
Education				
High School Graduate or Higher	82.4	81.8	66.7	69.6

Notes:
1. The United States Census Bureau considers the Hispanic/Latino designation an ethnicity, not a race. The population self-identified as “Hispanic/Latino” is also represented within the categories in the “Race” demographic.
From United States Census Bureau

6.6.1 Population

The U.S. Census Bureau estimated a population of 14,760 for Jackson County as of July 2019. Table 6-6 shows planning area population data from 1990 through 2019. The total Jackson County population increased 10.4% from 1990 to 2000, and 4.9% from 2000 to 2019.

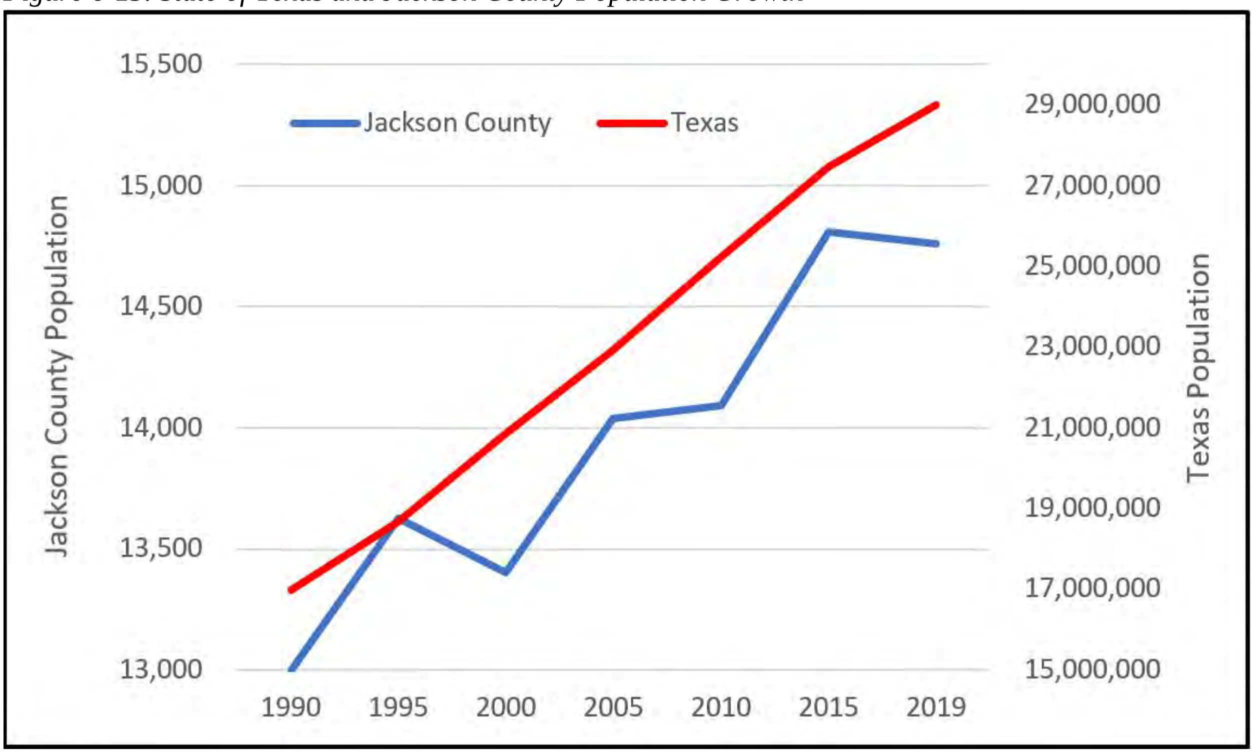
TABLE 6-6.
JACKSON COUNTY POPULATION

	Total Population			
	1990	2000	2010	2019
City of Edna	5,425	5,899	5,499	5,780
City of Ganado	1,707	1,915	2,003	2,055
City of La Ward	162	200	213	224
Unincorporated Areas[a]	5,745	6,377	6,360	6,701
Jackson County Total	**13,039**	**14,391**	**14,075**	**14,760**

Notes:
a. Includes non-participating communities
From U.S. Census Bureau

Figure 6-15 shows 5-year population changes in the planning area and the State of Texas from 1990 to 2010 and the 9-year change from 2010 to 2019. Between 1990 and 2019, the State of Texas' population grew by 70.7% (about 2.4% per year) while the planning area's population increased by 13.2% (approximately 0.46% per year)

Figure 6-15. State of Texas and Jackson County Population Growth



Note: From U.S. Census Bureau

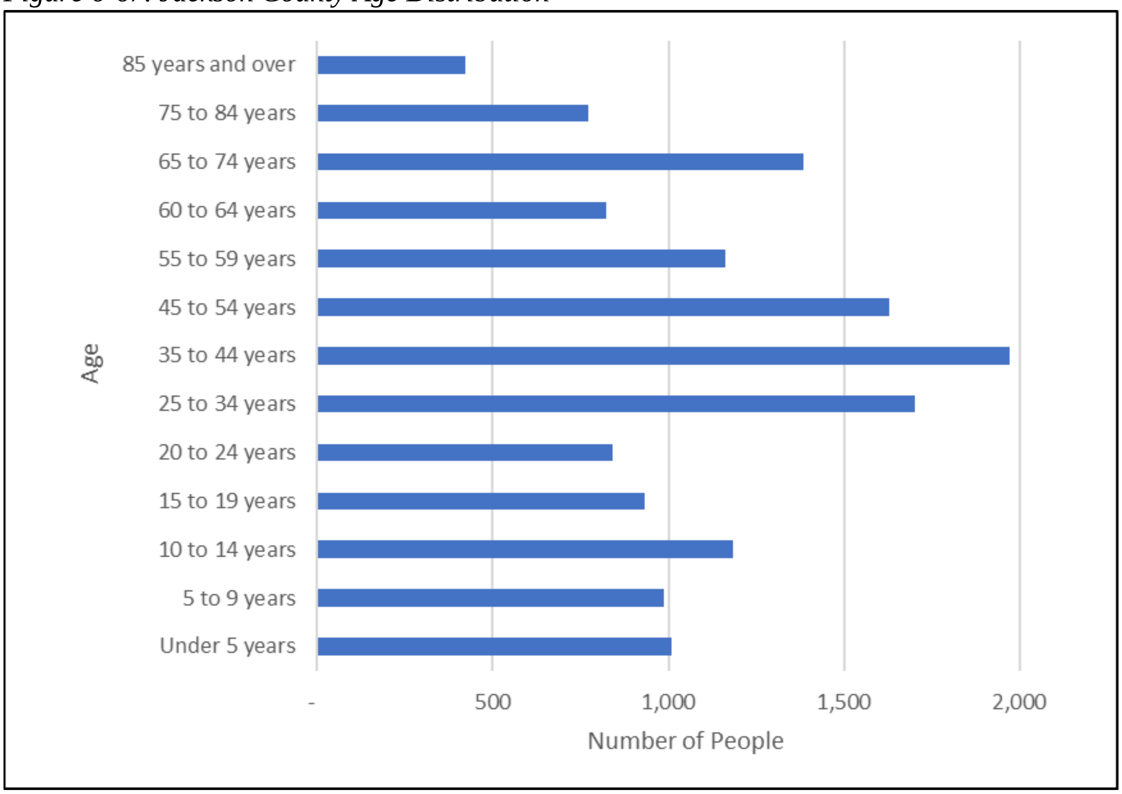
6.6.2 Age Distribution

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

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

The overall age distribution for the planning area is illustrated in Figure 6-16. Based on U.S. Census data estimates, 17.3% of the planning area’s population is 65 or older. U.S. Census data does not provide information regarding disabilities in the Planning Area’s over-65 population. U.S. Census estimates for 2019 indicate that 16.1% of Jackson County families have children under 18 and are below the poverty line.

Figure 6-67. Jackson County Age Distribution



Note: From U.S. Census Bureau

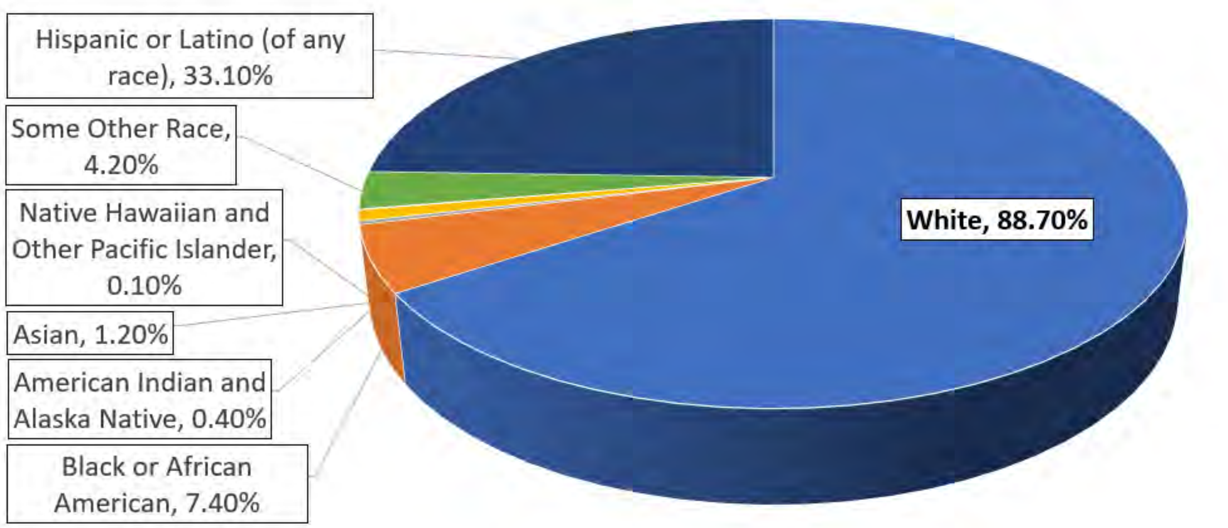
6.6.3 Disabled Populations

The 2019 U.S. Census estimated that 40.3 million non-institutionalized Americans with disabilities live in the U.S, approximately 12.6%. People with disabilities are more likely to have difficulty responding to a hazard event than the general population. Local government is the first level of response to assist these individuals, and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. It is important for emergency managers to distinguish between functional and medical needs in order to plan for incidents that require evacuation and sheltering. Knowing the percentage of the population with a disability will allow emergency management personnel and first responders to have personnel available who can provide services needed by those with access and functional needs. According to the 2010 U.S. Census, 17.8% of the population in the planning area lives with some form of disability.

6.6.4 Ethnic Populations

Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be less effective for ethnic populations and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. According to the 2019 U.S. Census, the ethnic composition of the planning area is predominantly white, at about 87.1%. The largest minority population is Hispanic or Latino at 33.1%. Figure 6-17 shows the population distribution by race and ethnicity in the planning area. The values shown in Figure 6-18 exceed 100% because according to the U.S. Census, Hispanic or Latino is listed as an ethnicity, not a race. Therefore, the Hispanic or Latino designation encompasses several races.

Figure 6-17. Jackson County Ethnic Distribution



Note: From U.S. Census Bureau

The planning area has a 9.7% foreign-born population. Other than English, the most commonly spoken language in the planning area is Spanish. The census estimates 4.5% of the residents 18 years and older speak English “less than very well.

6.7 ECONOMY

Select 2019 economic characteristics estimated for Jackson County and the participating communities by the U.S. Census Bureau are shown in Table 6-7.

TABLE 6-7.
JACKSON COUNTY ECONOMIC CHARACTERISTICS

	Jackson County	City of Edna	City of Ganado	City of La Ward
Individuals Below Poverty Level	1,924	1,058	273	40
Median Home Value (Owner Occupied)	$114,00	$95,800	$126,200	$58,700
Median Household Income	$62,806	$51,107	$52,321	$53,125
Per Capita Income	$27,051	$22,741	$25,651	$23,455
Population >16 Years Old in Labor Force	59.8	59.6	66.1	63.5
Population Employed	57.8	56.9	64.2	57.7

Note: From U.S. Census Bureau

6.7.2 Income

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

Based on U.S. Census Bureau estimates, per capita income in the planning area in 2019 was $27,051 and the median household income was $62,806. It is estimated that about 13.3% of households receive an income between $100,000 and $149,999 per year and 10.8% are above $150,000 annually. Families with incomes below the poverty level in 2013 made up 11.2% of all families and 13.4% of the total population in Jackson County.

6.7.3 Employment Trends

According to the U.S. Bureau of Labor Statistics, Jackson County's unemployment rate as of July 2021, was 5.5%, compared to a statewide rate of 6.2%. Figure 6-18 shows Jackson County's unemployment trends from 1990 through September 2021. Jackson County's unemployment rate was lowest in 1990 at 2.2% and peaked in 2009 at 8.9%.

Figure 6-18. Jackson County Unemployment Rate (1990-2021)

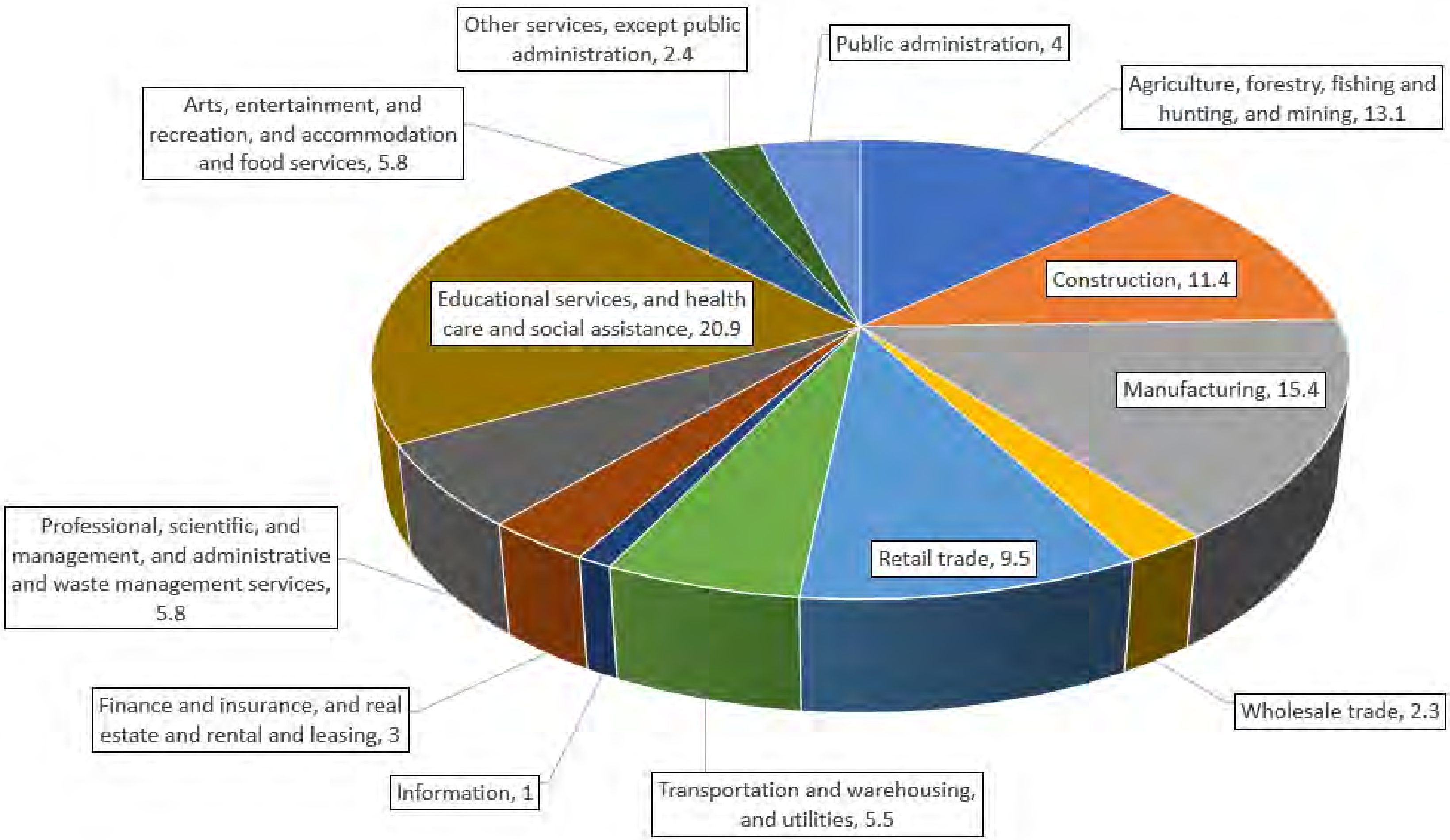
Notes: Shaded areas indicate U.S. recessions, From U.S. Bureau of Labor Statistics

According to the 2019 U.S. Census data, 59.8% of Jackson County's population 16 years and older are in the labor force, including 64.4% of women and 84.9% of men.

6.7.4 Occupations and Industries

According to 2019 U.S. Census data, the planning area's economy is strongly based in the education, health care and social assistance industries (20.9% of total employment), followed by manufacturing (15.4%), the agriculture, forestry, fishing and hunting, and mining sectors (13.1%), and construction (11.4%). Figure 6-19 shows the distribution of industry types in Jackson County, based on the share of total employment.

Figure 6-19. Percent of Total Employment by Industry in Jackson County



Note: From U.S. Census Bureau

6.8 FUTURE TRENDS IN DEVELOPMENT

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

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

6.8.1 Jackson County

Jackson County consists primarily of agricultural land. Developed land accounts for only 4.4% of the county. Table 6-8 lists the present land use in Jackson County.

TABLE 6-8.
PRESENT LAND USE IN PLANNING AREA

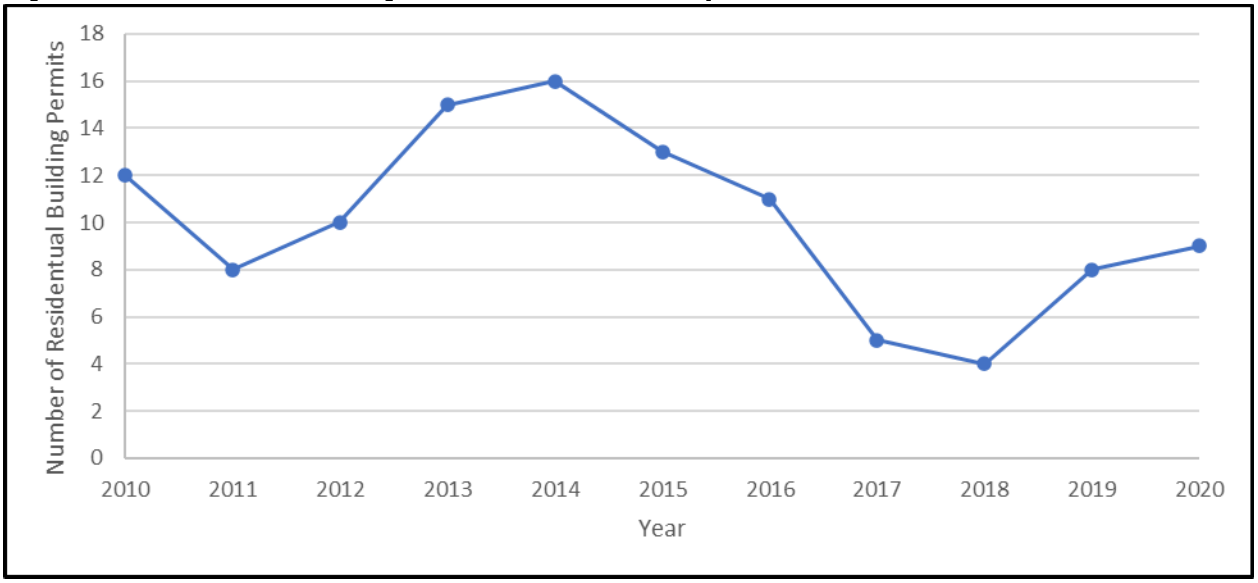
Present Use Classification	Area (acres)	% of Total Land Area
Agriculture	363,080	64.7
Developed, Open Space	19,501	3.5
Developed, High Intensity	283	<0.1
Developed, Medium Intensity	869	0.2
Developed, Low Intensity	3,118	0.6
Forest Land	65,915	11.7
Grassland/Prairie	60,200	10.7
Water/Wetland	47,511	8.5
Total	**560,477**	**100.0**

Note: From U.S. Geological Survey: National Land Cover Database

As described in Chapter 6.6.1 the population of Jackson County increased 10.4% from 1990 to 2000 but increased only a little over 4.9% from 2000 to 2019. Most of the population in the county lives in the City of Edna and unincorporated areas of Jackson County.

Housing units in Jackson County are mainly single-family detached homes; however, there are approximately 1,169 mobile homes in the county. According to the Texas Real Estate Research Center, the number of residential building permits reported in Jackson County dropped over the last 10 years from a high of 16 in 2014 and a low of 4 in 2018. With the residential building permits on the increase from 2018 to 2020. Figure 6-20 shows the reported residential building permits in Jackson County.

Figure 6-20. Residential Building Permits in Jackson County

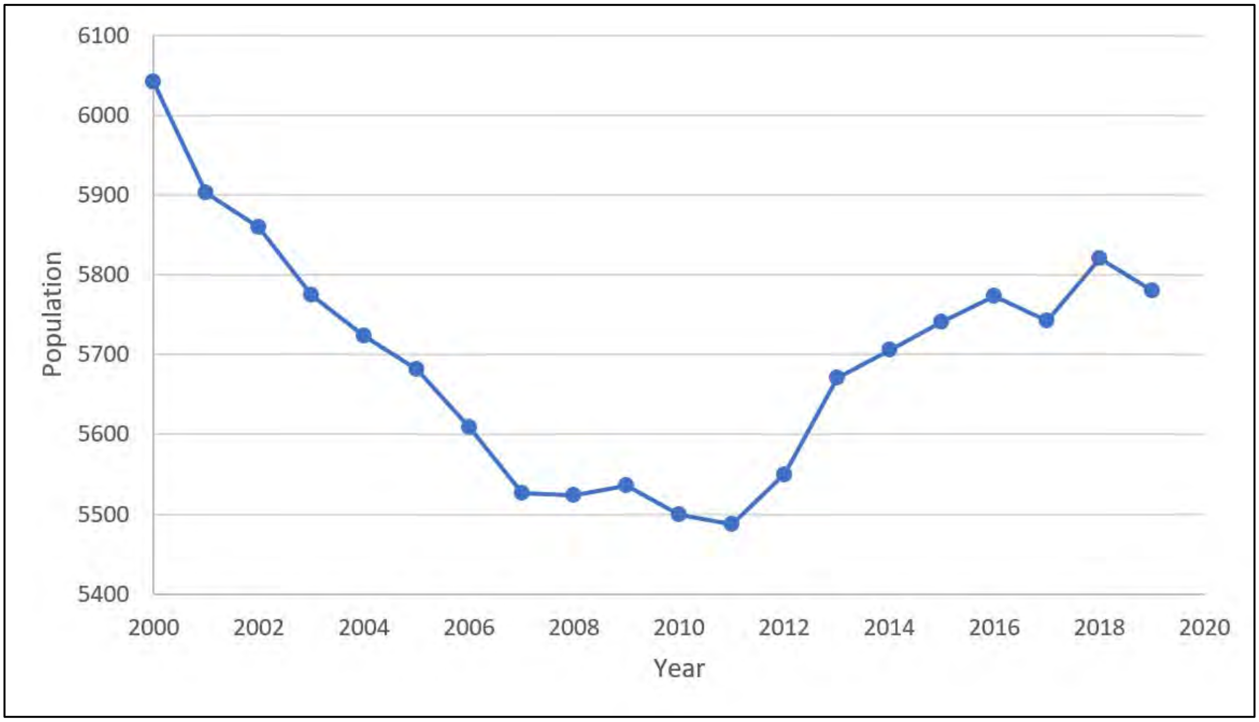


Note: From Texas Real Estate Research Center at Texas A&M University

6.8.2 City of Edna

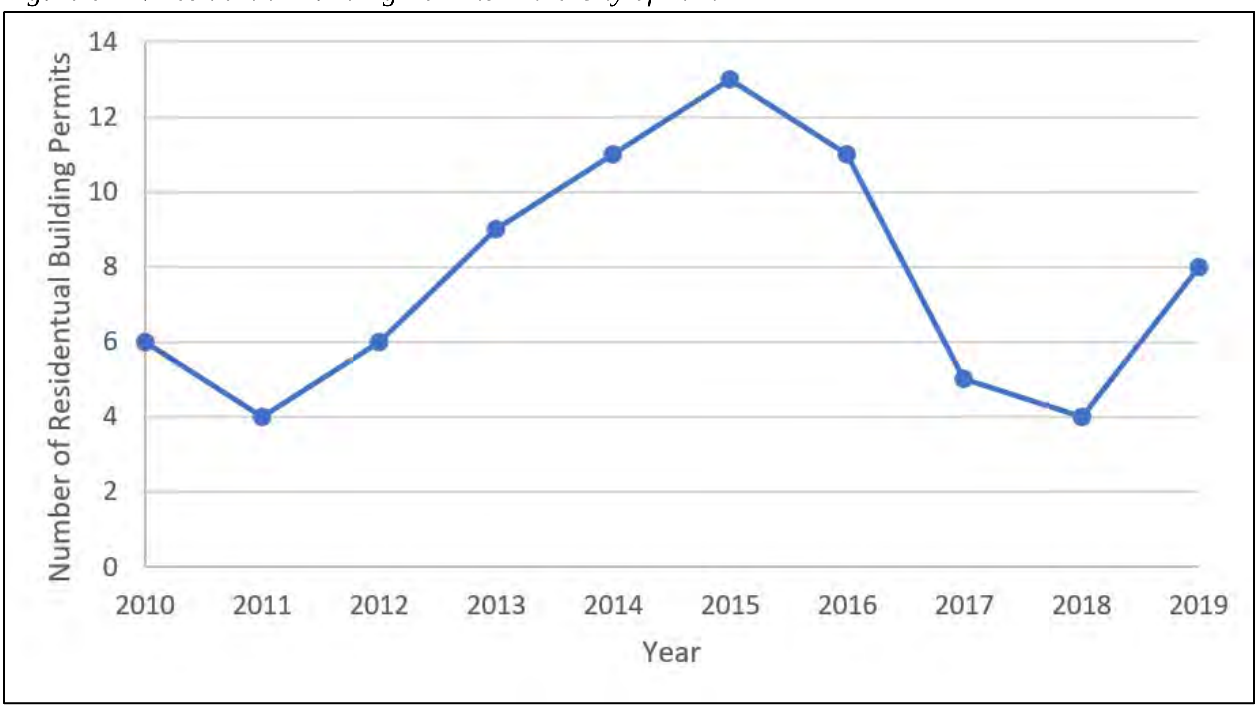
According to 2019 U.S. Census data estimates, the population of the City of Edna decreased 9.9% from 2000 to 2010 before rising by 4.9% from 2010 to 2019 as shown in Figure 6-21. The number of residential building permits reported in the City of Edna grew from 2011 to 2015 peaking at 13 permits before dropping to 4 in 2018 (See Figure 6-22). U.S. Census data estimates, there are 2,501 housing units in the City of Enda, 177 of which are classified as mobile homes. It is estimated only 1,789, or 71.5%, of the cities housing units, are occupied.

Figure 6-21. Population of City of Edna



Note: From U.S. Census Bureau

Figure 6-22. Residential Building Permits in the City of Edna

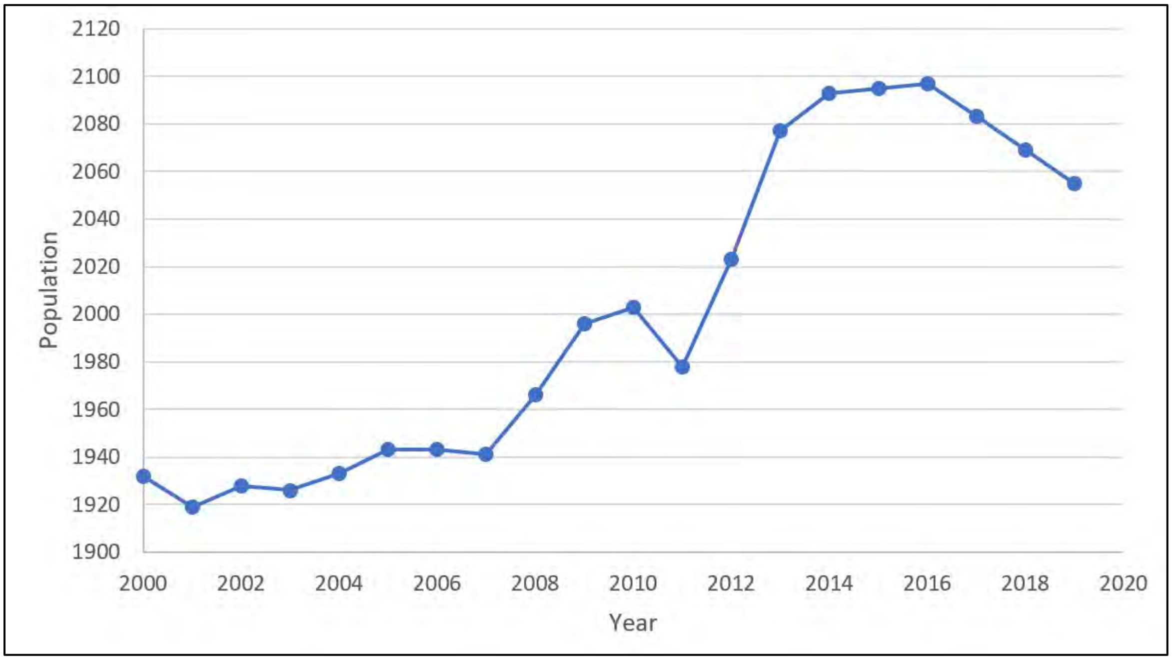


Note: From City-Data.Com: Edna

6.8.3 City of Ganado

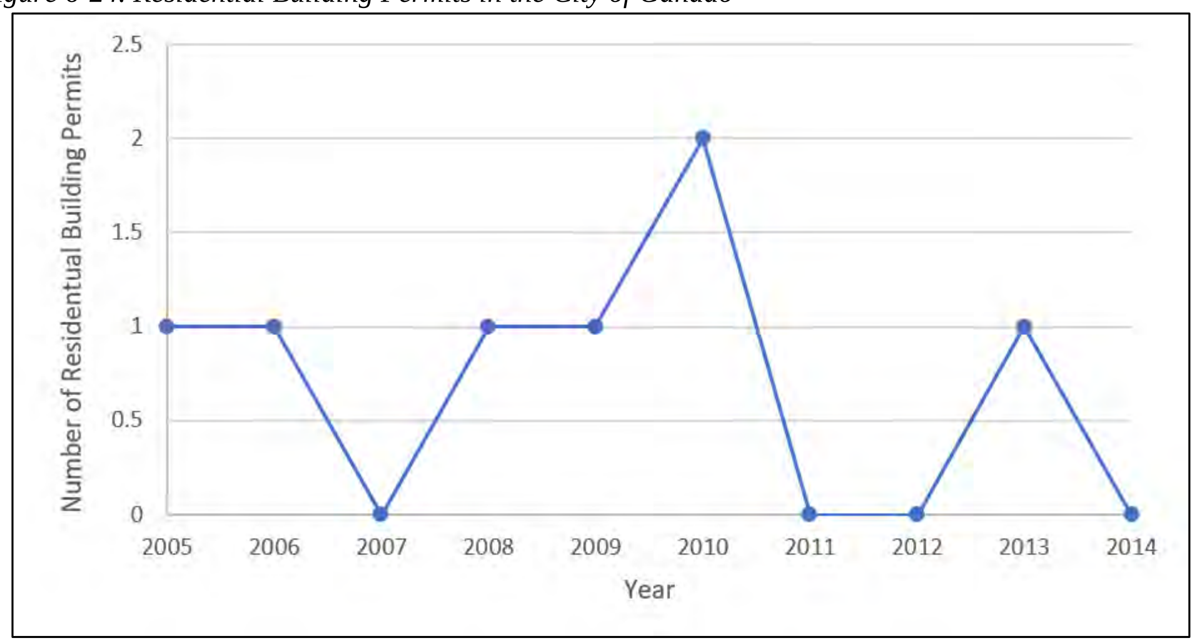
According to 2019 U.S. Census data estimates, the population of the City of Ganado increased approximately 6.0% from 2000 to 2019, as shown in Figure 6-23. The number of residential building permits reported in the City of Ganado between 2004 and 2015 can be seen in Figure 6-24. U.S. Census data estimates, there are 872 housing units in the City of Ganado, 185 of which are classified as mobile homes. It is estimated only 709, or 81.3%, of the cities housing units, are occupied.

Figure 6-23. Population of City of Ganado



Note: From U.S. Census Bureau

Figure 6-24. Residential Building Permits in the City of Ganado

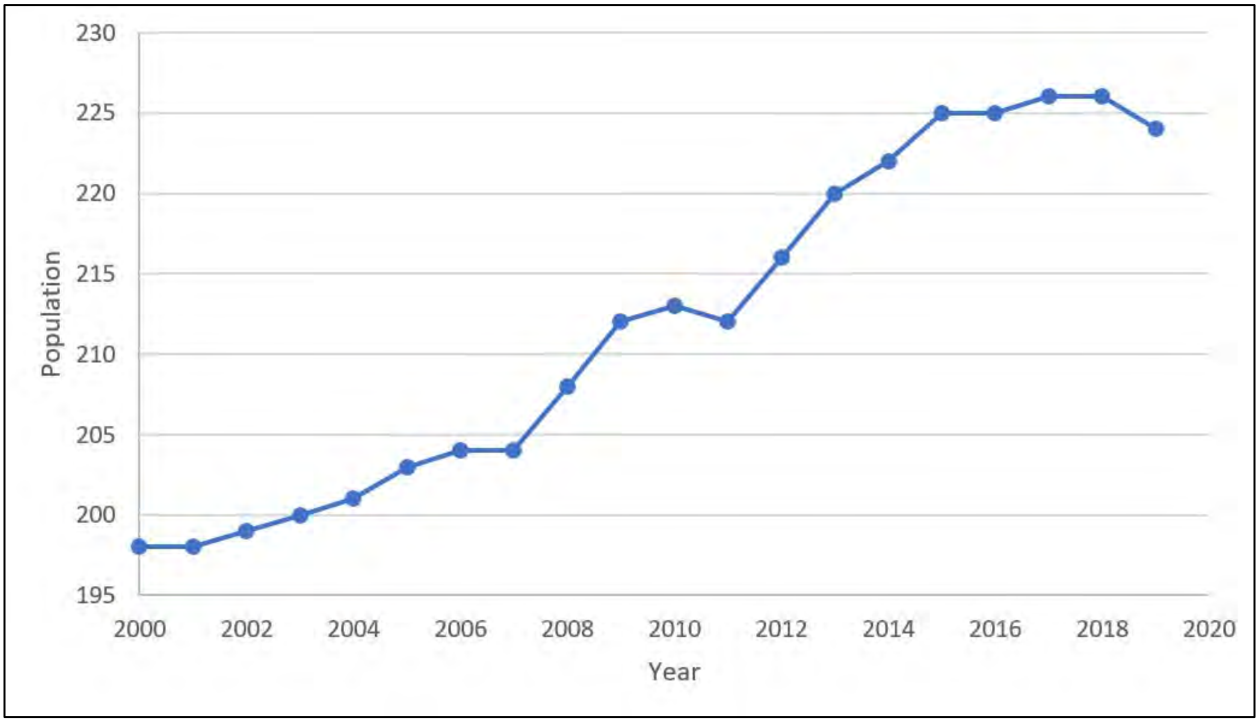


Note: From City-Data.Com: Ganado

6.8.4 City of La Ward

According to 2019 U.S. Census data estimates, the population of the City of La Ward increased approximately 11.6% from 2000 to 2019, as shown in Figure 6-25. During this same time, approximately 20 new housing units have been constructed. U.S. Census data estimates, there are 122 housing units in the City of La Ward, 41 of which are classified as mobile homes. It is estimated only 96, or 78.7%, of the city's housing units, are occupied.

Figure 6-25. Population of City of La Ward



Note: From U.S. Census Bureau

6.9 LAWS AND ORDINANCES

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

6.9.1 Federal

Disaster Mitigation Act

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

Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife, and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. It is the enabling legislation for the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Criminal and civil penalties are provided for violations of the ESA and the Convention.

Federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA's purposes. The ESA defines three fundamental terms:

- **Endangered** means that a species of fish, animal, or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)
- **Threatened** means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive for threatened species than for endangered species.
- **Critical habitat** means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

Five sections of the ESA are of critical importance to understanding the act:

- **Section 4: Listing of a Species**—NOAA's Fisheries Service is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comments and conduct further scientific reviews for 12 to 18 months, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections. Critical habitat for the species may be designated at the time of listing.
- **Section 7: Consultation**—Federal agencies must ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed or proposed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will "take" a species, it must propose mitigations or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.

- **Section 9: Prohibition of Take—**It is unlawful to “take” an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding, or sheltering.
- **Section 10: Permitted Take**—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a “Habitat Conservation Plan.”
- **Section 11: Citizen Lawsuits—**Civil actions initiated by any citizen can require the listing agency to enforce the ESA’s prohibition of taking or to meet the requirements of the consultation process.

Clean Water Act

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

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

National Flood Insurance Program

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

6.9.2 State and Regional

Texas Division of Emergency Management

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

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

Texas Water Development Board

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

TWDB financial assistance programs are funded through state-backed bonds, a combination of state bond proceeds and federal grant funds, or limited appropriated funds. Since 1957, the Texas State Legislature and voters approved constitutional amendments authorizing TWDB to issue up to $10.93 billion in Texas Water Development Bonds. To date, TWDB has sold nearly $3.95 billion of these bonds to finance the construction of water- and wastewater-related projects. In 1987, TWDB added the Clean Water State Revolving Fund (CWSRF) to its portfolio of financial assistance programs. Low-interest loans from the CWSRF finance costs associated with the planning, design, construction, expansion, or improvement of wastewater treatment facilities, wastewater recycling and reuse facilities, collection systems, stormwater pollution control projects, and nonpoint source pollution control projects. Funded in part by federal grant money, CWSRF provides loans at interest rates lower than the market can offer to any eligible applicant. CWSRF offers 20-year loans using either a traditional long-term, fixed-rate or a short-term, variable-rate construction period loan that converts to a long-term, fixed-rate loan on project completion.

Texas State Soil and Water Conservation Board

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

Texas Bureau of Economic Geology

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

Texas Forest Service

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

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

Goals:

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

Objectives:

- Complete wildfire risk assessments
- Identify strategic fuels reduction projects
- Address treatment of structural ignitability
- Identify local capacity building and training needs
- Promote wildfire awareness programs

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

Texas Department of State Health Services

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

Texas Colorado River Floodplain Coalition

The TCRFC is a partnership of cities and counties in the Colorado River Basin and surrounding areas seeking better ways to reduce and mitigate flood damage. The coalition was formed in response to a combination of rapid growth, a greatly expanded number of homes and businesses in the floodplain, and devastating floods that have reoccurred in the basin. TCRFC's mission statement is to "Encourage comprehensive consistent management of the floodplain along the Colorado River and its tributaries; provide a forum for data exchange; and facilitate a structured approach to managing the complex issues related to floodplain management."

Golden Crescent Regional Planning Commission

The Golden Crescent Regional Planning Commission (GCRPC) was created in 1968 in response to the Regional Planning Act of 1965, as amended and codified. GCRPC serves the counties of Calhoun, DeWitt, Goliad, Gonzales, Jackson, Lavaca, and Victoria. Historically, the primary functions of GCRPC were viewed as planning for the development of the region, assisting local governments, and providing technical assistance/services. However, since its inception, the role of GCRPC has grown to include comprehensive planning and service delivery in program areas such as aging, employment and training, criminal justice, solid waste management, community and economic development, and tourism. Staff and membership work closely together to develop opportunities that will enhance the economic outlook of the entire region.

The GCRPC 911 Department developed a Regional 911 Plan to include DeWitt, Goliad, Gonzales, Jackson, Lavaca, and Victoria counties. The plan, approved by the Commission on State Emergency Communications, includes Automatic Number Identification, Automatic Location Identification, Selective Routing, Wireless, and Voice Over Internet Protocol. These enhanced features allow for the display of the ten-digit telephone number of the caller and the address for that telephone to be displayed at the public safety answering point when 911 is dialed. The 911 department now provides a service that allows citizens to send a text message to 911 in the case of an emergency where the citizen is unable to make a voice call by dialing 911. When using this service, the exact location of the citizen and the nature of the emergency need to be known.

The Regional Environmental Resources Advisory Committee is charged with supporting and assisting the GCRPC and its Board of Directors in their efforts to address regional environmental issues. In turn, the RERAC and the Board of Directors provide an effective means to disseminate environmental information throughout the region. In the area of Environmental Resources, GCRPC's primary goals are the development and implementation of appropriate regional strategies and plans in solid waste management, water issues, air issues, and land use.

6.9.3 Jackson County

The Jackson County government is made up of the following offices and departments:

- County Auditor
- Airport
- Commissioners’ Court
- Constable
- Emergency Management
- Extension Office
- Health
- County Judge
- Justice of the Peace
- Juvenile Probation
- Sherriff
- Library
- Jackson County Transfer and Recycling
- Permitting and Inspections
- County Tax Assessor/Collector
- County Treasurer

Excerpts from applicable policies, regulations, plans, and program descriptions follow to provide more detail on existing mitigation capabilities.

Jackson County Subdivision Regulations and Recreational Vehicle Regulations, 2006 (as amended)

The 2006 Jackson County Subdivision Regulations established rules, regulations, and standards governing the subdivision of land within the unincorporated areas of Jackson County. It established standards and specifications for the construction of roads and drainage, private sewage facilities, and development within the floodplain. The Subdivision Regulations were designed and enacted for the purpose of promoting the health, safety, and general welfare of the public and to establish standards of subdivision design, which will encourage the development of sound, economical, stable neighborhoods and create a healthy environment for present and future inhabitants of Jackson County by:

1. Detailing platting requirements, lot sizes, and setbacks
2. Detailing requirements and design standards, for water, wastewater, streets, and utilities
3. Detailing acceptable impacts and drainage requirements
4. Detailing administrative responsibilities

Jackson County's Flood Damage Prevention Order

The Flood Damage Prevention Order signed on June 9, 2014, established the Jackson County Commissioners' Court as the governing body to administer the National Flood Insurance Act and Texas Flood Control and Insurance Act. The purpose of the order and attached regulations is "to promote the public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas by regulations designed to (1) protect human life and health; (2) minimize the expenditure of public money for costly flood control projects; (3) minimize the need for rescue and relief efforts associated with flooding and usually undertaken at public expense; (4) minimize prolonged business. interruptions; (5) minimize damage to public facilities and utilities such as water and gas mains, electric, telephone, and sewer lines, and streets and bridges located in or near floodplains; (6) help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and (7) insure that potential buyers are notified that property is in a flood area."

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

The responsibilities of the Commissioners' Court are to (1) fulfill an obligation mandated by federal and state law; (2) regulate construction in an area designated under law as a floodplain; (3) regulate sewer and on-site sewage/sewer facilities (OSSF); (4) prevent waste; (5) protect the rights of owners of interests in groundwater; (6) prevent subsidence; (7) provide a response to a real and substantial threat to public health and safety, said response being designed to significantly advance the public purposes herein described and not to impose a greater burden than is necessary to achieve said purposes; and (8) prevent the imminent destruction of property or injury to persons from flooding within a floodplain established by a federal flood control program and enacted to prevent the flooding of buildings intended for public occupancy."

Jackson County Floodplain Map

The floodplain maps from FEMA are in use for issuing permits and went into effect on September 17, 2014.

Jackson County Basic Emergency Operation Plan

The purpose of the Jackson County Emergency Operations Plan (EOP) is to:

- Identify the roles, responsibilities, and actions required of county departments and other agencies in preparing for and responding to major emergencies and disasters
- Ensure a coordinated response by local, state, and federal governments by the use of the National Incident Management System (NIMS) in managing emergencies or disasters; to save lives, prevent injuries, protect property and the environment, and return the affected area to a state of normalcy as quickly as possible
- Provide a framework for coordinating, integrating, and administering the emergency operations plans and related programs of local, state, and federal governments
- Provide for the integration and coordination of volunteer agencies and private organizations involved in emergency response and relief efforts

The EOP covers Jackson County and the Cities of Edna, Ganado, and La Ward. The EOP uses the all-hazard approach addressing a full range of complex and constantly changing requirements in anticipation of or in response to threats or acts of major disasters (natural or technological), terrorism, and other emergencies. It provides general guidance for emergency management activities and an overview of methods of mitigation, preparedness, response, and recovery. The EOP does not specifically address long-term reconstruction, redevelopment, and mitigation measures. The EOP details the specific incident management roles and responsibilities of departments and agencies involved in emergency management. This plan also helps establish coordination roles of the county departments and agencies and local jurisdictions. The EOP was designed to address hazards such as flooding, tornadoes, wildfires, severe weather, hurricane, drought, earthquake, dam failures, and hazardous materials. The EOP includes 22 functions annexes to provide functions and identify responsibilities for each time of incident and the necessary support elements that may be required.

Jackson County Office of Emergency Management

The Emergency Management Coordinators provide services countywide to prepare and plan for emergencies in Jackson County and the Cities of Edna, Ganado, and La Ward. In addition, communication is maintained with state and federal agencies for coordination in the event of large disasters, natural or manmade.

Jackson County Office of Permitting and Inspections

The Jackson County Office of Permitting and Inspections manages the building and septic permitting management in the unincorporated areas of Jackson County. The department also provides information regarding the flood hazard are development and permitting.

Jackson County Hospital District

Jackson County Emergency Medical Services is provided by Jackson County Hospital District (JCHD) EMS. JCHD EMS operates three Mobile Intensive Care Units (MICU) ambulances to serve the citizens of Jackson County. Working with other responders in the district, the mission of the JCHD EMS is to provide professional, state-of-the-art pre-hospital care with an emphasis on customer service.

Jackson County Commissioners Court

The Jackson County Commissioner's Court is responsible for the maintenance and construction of those roadway and drainage structure assets maintained through the direct and indirect efforts of Jackson County. It is also the responsibility of the Commissioner's Court to approve or disapprove plats for the development of subdivisions.

6.9.4 City of Edna

The city of Edna government is made up of the following offices and departments:

- Board of Commissioners
- City Administration
- Code Enforcement
- Fire and EMS Department
- Municipal Court
- Parks and Recreation
- Police Department
- Public Works Department
- Utility Services

The City of Edna has multiple plans and functions in place that guide growth and development within the community. The city also has a Building and Standards Commission and a Planning and Zoning Commission. Excerpts from applicable policies, regulations, plans, and program descriptions follow to provide more detail on existing mitigation capabilities.

City of Edna Code of Ordinances

Some of the chapters in the City of Edna Code of Ordinances have provisions related, directly or indirectly, to hazard mitigation. These provisions are discussed below:

- **Chapter 1 General Provisions**

Provisions under this chapter include:

- Establishes the roles, responsibilities, and authority of the City Planning Commission (1996 Code, sec. 2-48)
    - Adoption of the National Incident Management System, dated March 1, 2004 (Ordinance 2005-08 adopted 11/17/05)
    - Establishment of the City of Edna Emergency Management Organization (Ordinance 97-09, sec. 1, adopted 1/15/98)
    - Identification of the powers, duties, and responsibilities of the Emergency Management Director (Ordinance 97-09, sec. 1, adopted 1/15/98)
    - Requirement to develop and maintain an emergency operations plan (Ordinance 97-09, sec. 1, adopted 1/15/98)
    - Authorized to join with the county judge and mayors of the other cities in the county in the formation of an inter-jurisdictional emergency management program (Ordinance 97-09, sec. 4, adopted 1/15/98)

- Establishes rules, regulations, and procedures for city parks including land use and prohibiting fireworks (Ordinance 2006-07, art. IV, adopted 6/22/06)

- **Chapter 3 Building Regulations**

Provisions under this chapter include:

- Adoption of the International Building Code, 2009 edition (Ordinance 2010-07 adopted 11/18/10)
- Adoption of the International Residential Code, 2010 edition. (Ordinance 2010-09 adopted 12/2/10
- Description of enforcement, authorization, and purpose of the Standard for Floodplain Management in the City of Edna (1996 Code, sec. 9-2)
- Methods of reducing flood losses (1996 Code, sec. 9-2)
- Basis for establishing the areas of special flood hazard and permitting requirements (1996 Code, sec. 9-11)
- Designation, duties, and responsibilities of the floodplain administrator (1996 Code, sec. 9-11)
- Permit and variance procedures for a floodplain development permit (1996 Code, sec. 9- 11)
- Construction standards for new construction and substantial improvements to minimize flood damage (1996 Code, sec. 9-11)
- Standards for subdivision (1996 Code, sec. 9-19)

- **Chapter 5 Fire Protection and Prevention**

Provisions under this chapter include:

- Adoption of the International Fire Code, 2010 edition (Ordinance 2010-12 adopted 12/2/10)
- Establishment and staffing for the fire department (1996 Code, sec. 8-32)
- Regulations on the use, possession, and sale of fireworks (Ordinance 2005-02, art. I, adopted 3/3/05)
- Restrictions on burning (Ordinance 2006-17, art. II, adopted 1/4/07)\

- **Chapter 10 Subdivision**

Provisions under this chapter include:

- This chapter includes the purpose of the subdivision regulations and establishes rules, regulations, and standards governing the subdivision of land within the City of Edna. It establishes standards and specifications for the construction of roads and drainage, private sewage facilities, and development within the floodplain (1996 Code, sec. 19-1)

- **Chapter 14 Zoning**

Provisions under this chapter include:

- This chapter includes the purpose of the zoning regulations and establishes zoning districts within the City of Edna. This chapter also describes the regulations, plans and procedures, and review process for approval of construction projects within the city (Ordinance No. 74-04, as amended by Ordinance No. 2004-24)

City of Edna Emergency Management

The Jackson County Emergency Management Coordinator is the principal emergency operations agent for Jackson County and the City Manager is the principal emergency operations agent for the City of Edna. Emergency operations for both the county and the city will be coordinated and conducted primarily from the Jackson County Emergency Operation Center. In response to an emergency situation and pursuant to state law, the Mayor of Edna or the Jackson County Judge, as chief elected officials, or the City Council or the Commissioners' Court, as elected governing bodies, have the authority to request that the governor issue an Emergency Declaration or a Disaster Declaration for the city or a part thereof. The Mayor of Edna and/or the Jackson County Judge have the authority to issue evacuation orders for all or part of the City of Edna. On-site response operations to an emergency will be conducted in accordance with the provisions of NIMS.

City of Edna Building and Standard Commission

The Building and Standards Commission was established in accordance with provisions of the city's Land Use Ordinance and §211.008 of the Texas Local Government Code. The Commission is appointed by the City Council to make final judgment upon whether a building or structure conforms to the city's standards and regulations as promulgated in the city's Land Use Ordinance or other ordinances. Its duties are as follows:

- Conduct public hearings regarding dangerous buildings/structures as presented by Code Enforcement
- Conduct public hearings regarding deviation from Zoning Ordinances
- Based on information and justifications presented, decide for or against a zoning deviation. Note:A zoning deviation decision by the Building and Standards Commission can only be overruled bythe District Court
- Rules on the correctness of the Building Official's interpretation of the Zoning Ordinance (when questioned by the City Council or citizens)

City of Edna Planning and Zoning Commission

The Planning and Zoning Commission was established in accordance with Article VIII of the City Charter. The Planning and Zoning Commission (aka the City Planning Commission) has the following responsibilities:

- Conduct public hearings regarding zoning changes
- Make recommendations to City Council for or against zoning changes
- Review and approve preliminary and final plats for all subdivisions in accordance with subdivisionand other ordinances
- Work in conjunction with subdivision plat approvals and require necessary dedications for futureor planned street right-of-ways, alleys, sidewalks, easements, etc.
- Review and approve site plans submitted
- Keep Land Use Plan in mind when making decisions regarding zoning or subdivision plans

- Make recommendations to City Council regarding changes on amendments to Zoning Ordinancesand Subdivision Ordinances

City of Edna Land Use Management Ordinance

The City of Edna has adopted resolutions and ordinances that directly or indirectly mitigate hazards identified in this plan. The City of Edna Zoning Ordinances establishes a comprehensive plan to promote public health, safety, morals and general welfare, and aid to protect and preserve places and areas of historical, cultural and/or architectural importance and significance within the City of Edna. They have been designed to lessen the congestion in the streets; secure safety from fire, panic, and other dangers; ensure adequate light and air; prevent the overcrowding of land and thus avoid undue concentration of population; and facilitate the adequate provision of transportation, water, wastewater treatment, schools, parks, and other public infrastructure. The rules have been made with reasonable consideration, among other things, for the character of each zone and its particular suitability for the uses specified; and to conserve the value of buildings and attributes while encouragingthe most appropriate use of land throughout the city.

6.9.5 City of Ganado

The City of Ganado government is led by a mayor and five council members and is made up of the followingoffices and departments:

- City Secretary
- Municipal Court
- Animal Control
- Police Department
- Fire and EMS Department
- Water/Sewer Department
- City Attorney

The City of Ganado has multiple plans and functions in place that guide growth and development within the community. Excerpts from applicable policies, regulations, and plans, and program descriptions followto provide more detail on existing mitigation capabilities.

City of Ganado Code of Ordinances

Some of the chapters in the Ganado, Texas Code of Ordinances have provisions related, directly or indirectly, to hazard mitigation. These provisions are discussed below:

- **Chapter 1 General Provisions**

  Provisions under this chapter include:

    – Establishes the roles and responsibilities of the Volunteer Fire Department (Ordinance No.279 of February 10, 1998)

    – Establishes the roles and responsibilities of the Emergency Medical System (OrdinanceNo. 279 of February 10, 1998)

    – Establishment of the City of Ganado Emergency Management Organization (OrdinanceNo. 279 of February 10, 1998)

    – Identification of the powers, duties, and responsibilities of the Emergency Management Director (Ordinance No. 279 of February 10, 1998)

    – Requirement to develop and maintain an emergency operations plan

(Ordinance No. 279 of February 10, 1998)

- Authorized to join with the county judge and mayors of the other cities in the county in the formation of an inter-jurisdictional emergency management program (Ordinance No. 279of February 10, 1998)

- **Chapter 3 Building Regulations**

Provisions under this chapter include:

- Adoption of the International Building Code, 1991 edition (Ordinance No. 228 of June 1,1993)
- Identification of the powers, duties, and responsibilities of the Board of Code Enforcement/Office of Housing Building Enforcement Official (Ordinance No. 228 of June 1, 1993)
- Description of enforcement, authorization, and purpose of the Standard for FloodplainManagement in the City of Ganado (Ordinance No. 158 of December 8, 1987)
- Methods of reducing flood losses (Ordinance No. 158 of December 8, 1987)
- Basis for establishing the areas of special flood hazard and permitting requirements(Ordinance No. 158 of December 8, 1987)
- Designation, duties, and responsibilities of the floodplain administrator (Ordinance No.158 of December 8, 1987)
- Permit and variance procedures for a floodplain development permit (Ordinance No. 158of December 8, 1987)
- Construction standards for new construction and substantial improvements to minimizeflood damage (Ordinance No. 158 of December 8, 1987)
- Standards for subdivision (Ordinance No. 158 of December 8, 1987)

- **Chapter 5 Fire Protection**

Provisions under this chapter include:

- Adoption of the Standards Fire Prevention Code, 1991 edition (Ordinance No. 229 of June1, 1993)
- Regulations on the use, possession, and sale of fireworks (Ordinance of December 9, 1952)
- Restrictions on burning (Ordinance No. 159 of March 1, 1988)
- Identification of the powers, duties, and responsibilities of the Office of Fire Marshall(Ordinance of February 2, 1960

- **Chapter 8 Subdivision**

Provisions under this chapter include:

- Established rules, regulations, and standards governing the subdivision of land (OrdinanceNo. 222, Section V, of March 2, 1993)
- Defines the process and permits required (Ordinance No. 222, Section V, of March 2, 1993)

– Established standards and specifications for construction of roads and drainage (OrdinanceNo. 222, Section V, of March 2, 1993)

– Established use of the Board of Code Enforcement to serve as the Ganado City PlanningBoard. (Ordinance No. 222, Section V, of March 2, 1993)

– Adoption of Comprehensive Plan (Ordinance No. 222, Section V, of March 2, 1993)

City of Ganado Board of Code Enforcement

The Board of Code Enforcement was established in accordance with provisions of the city's Subdivision Ordinance (Chapter 8) and §211.008 of the Texas Local Government Code. The Commission is appointedby the mayor to make final judgment upon whether a building or structure conforms to the city's standards and regulations as promulgated in the city's ordinances. Its duties are as follows:

- Approval of Subdivision Plats
- Preparation of Comprehensive Plan
- Enforce the Building Regulations (Chapter 3) and Subdivision Regulations (Chapter 8)

6.9.6 City of La ward

The City of La Ward government is led by a mayor and five council members and is made up of the following offices and departments:

- Maintenance Department
- Office of the Mayor
- Water/Sewer Department

The City of La Ward often reviews and adopts Jackson County plans and policies which are applicable to the community.

City of La Ward Code of Ordinances – *City Manager indicated that it does exist but could not provide a copy as of the date of this document.*

City of La Ward Floodplain Map

The floodplain maps from FEMA are in use for issuing permits and went into effect on September 17, 2014.

City of La Ward Drainage Master Plan

The City of La Ward is in the process of creating a drainage master plan as of September 2021. This plan analyzes the existing drainage system and identifies improvements designed to relieve existing problem areas or potential future problem areas.

Chapter 7.
Hazard Mitigation Capabilities Assessment

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

7.1 JACKSON COUNTY

7.1.1 Legal and Regulatory Capabilities

Table 7-1 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Jackson County.

TABLE 7-1.
JACKSON COUNTY REGULATORY MITIGATION CAPABILITIES MATRIX

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General plan	No	
Zoning ordinance	No	
Subdivision ordinance	Yes	The Jackson County Subdivision Regulations (2008, as amended) established rules, regulations, and standards governing the subdivision of land within the unincorporated areas of Jackson County.
Growth management	Yes	Growth management is accomplished through compliance with the Jackson County Subdivision ordinance.
Floodplain ordinance	Yes	Jackson County Flood Damage Prevention Order, 2014, adopting Jackson County Flood Damage Prevention Regulations and Floodplain Ordinance administered by Permit and Inspection Department.
Other special-purpose ordinances (stormwater, steep slope, wildfire)	No	
Building code	No	
Erosion or sediment control program	No	LNRA administers the erosion and sediment control program.
Stormwater management	No	LNRA administers the stormwater management control program, Jackson County County Wide Drainage district.
Site plan review requirements	Yes	Permitting and Inspections
Capital improvement plan	No	
Economic development plan	No	

TABLE 7-1. JACKSON COUNTY REGULATORY MITIGATION CAPABILITIES MATRIX		
Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
Local emergency operations plan	Yes	Jackson County Emergency Operations - Basic Plan, 2018. Reverse 911 is a notification system that transmits a recorded message in the event of an emergency.
Other special plans	Yes	Drainage Master Plan/Coastal Resiliency Plan
Flood insurance study or other engineering study for streams	Yes / No	The Floodplain Management Office is the local repository for the FEMA FIRMs for the unincorporated areas of the county and makes the maps available for public review. The department maintains flood insurance rate maps in conjunction with the NFIP. JCCWDD SCS Study.
Elevation certificates	Yes	The Floodplain Managers Office of Jackson County keeps records of flood elevation certificates on file in its office.
Notes: FEMA Federal Emergency Management Agency JCCWDD Jackson County County Wide Drainage District NFIP National Flood Insurance Program SCS Soil Conservation Service		

7.1.2 Administrative and Technical Capabilities

Table 7-2 identifies the county personnel responsible for activities related to mitigation and loss prevention in Jackson County.

TABLE 7-2. JACKSON COUNTY ADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES MATRIX		
Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	Yes	Certified Floodplain Manager
Engineer/professional trained in construction practices related to buildings or infrastructure	No	Outsourced
Planner/engineer/scientist with an understanding of natural hazards	No	Outsourced
Personnel skilled in GIS	Yes	Certified Floodplain Manager/Outsourced
Full-time building official	No	
Floodplain manager	Yes	County Department Land Development and Permitting maintains a full-time flood permitting staff
Emergency manager	Yes	Department of Emergency Management
Grant writer	No	
Other personnel	No	
GIS data: Hazard areas	Yes	Floodplain Only
GIS data: Critical facilities	No	

TABLE 7-2. JACKSON COUNTY ADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES MATRIX		
Personnel Resources	Yes/No	Department/Position
GIS data: Building footprints	No	
GIS data: Land use	No	
GIS data: Links to Assessor's data	No	
Warning systems/services (Reverse 911 callback, cable override, outdoor warning signals)	Yes	Outdoor warning system consisting of two sirens and emergency notifications through all commercial radio and television stations, and cable television companies. 911 based emergency phone notifications contracted to Cassidian. App for push notifications.
Other	No	
Notes: GIS Geographic Information System		

7.1.3 Financial Capabilities

Table 7-3 identifies financial tools or resources that Jackson County could use to help fund mitigation activities.

TABLE 7-3. JACKSON COUNTY FINANCIAL MITIGATION CAPABILITIES MATRIX	
Financial Resources	Accessible/Eligible to Use (Yes/No)
Community Development Block Grants	Yes
Capital improvements project funding	Yes
Authority to levy taxes for specific purposes	Yes
Fees for water, sewer, gas, or electric services	Yes
Impact fees for new development	Yes
Incur debt through general obligation bonds	Yes
Incur debt through special tax bonds	Yes
Incur debt through private activities	No
Withhold spending in hazard-prone areas	No
Other	No

7.2 CITY OF EDNA

7.2.1 Legal and Regulatory Capabilities

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

TABLE 7-4.
CITY OF EDNA REGULATORY MITIGATION CAPABILITIES MATRIX

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General plan	Yes	1972 (Outdated)
Zoning ordinance	Yes	City of Edna Code of Ordinances
Subdivision ordinance	Yes	City of Edna Code of Ordinances (Article 10.02)
Growth management	No	
Floodplain ordinance	Yes	Adopted the Standard for Floodplain Management
Other special-purpose ordinances (stormwater, steep slope, wildfire)	No	
Building code	Yes	The City of Edna adopted the International Building Code and the International Residential Code. 2009 edition
Erosion or sediment control program	No	LNRA administers the erosion and sediment control program
Stormwater management	No	LNRA administers the stormwater management control program.
Site plan review requirements	Yes	Code Enforcement
Capital improvements plan	Yes	The plan was last updated in 1972
Economic development plan	No	
Local emergency operations plan	Yes	The City of Edna works in conjunction with Jackson County Emergency Management.
Other special plans	Yes	Drainage Master Plan (1970s)
Flood insurance study or other engineering study for streams	Yes	FEMA floodplain maps indicate insurance is necessary along the Dry Creek
Elevation certificates	Yes	Administrated by Director of Utilities

Notes:
FEMA Federal Emergency Management Agency
LNRA Lavaca-Navidad River Authority

7.2.2 Administrative and Technical Capabilities

Table 7-5 identifies the city personnel responsible for activities related to mitigation and loss prevention in the City of Edna.

TABLE 7-5.
CITY OF EDNA ADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES MATRIX

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	No	Outsourced
Engineer/professional trained in construction practices related to buildings or infrastructure	No	Outsourced
Planner/engineer/scientist with an understanding of natural hazards	No	Outsourced
Personnel skilled in GIS	No	Outsourced
Full-time building official	Yes	Building Official and Code Enforcement
Floodplain manager	Yes	Director of Utilities
Emergency manager	Yes	City Manager. The City of Edna also works in conjunction with the Jackson County Emergency Manager.
Grant writer	No	Outsourced
Other personnel	No	
GIS data: Hazard areas	No	
GIS data: Critical facilities	No	
GIS data: Building footprints	No	
GIS data: Land use	No	
GIS data: Links to Assessor’s data	No	
Warning systems/services (Reverse 911 callback, cable override, outdoor warning signals)	Yes	Included in county 911 based emergency phone notifications contracted to Cassidian, social media.
Other	No	

Notes:
GIS Geographic Information System

7.2.3 Financial Capabilities

Table 7-6 identifies financial tools or resources that the City of Edna could use to help fund mitigation activities.

TABLE 7-6. CITY OF EDNA FINANCIAL MITIGATION CAPABILITIES MATRIX	
Financial Resources	Accessible/Eligible to Use (Yes/No)
Community Development Block Grants	Yes
Capital improvements project funding	Yes
Authority to levy taxes for specific purposes	Yes
Fees for water, sewer, gas, or electric services	Yes (water, sewer, and garbage)
Impact fees for new development	No
Incur debt through general obligation bonds	Yes
Incur debt through special tax bonds	Yes
Incur debt through private activities	Yes
Withhold spending in hazard-prone areas	No
Other	No

7.3 CITY OF GANADO

7.3.1 Legal and Regulatory Capabilities

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

TABLE 7-7. CITY OF GANADO REGULATORY MITIGATION CAPABILITIES MATRIX		
Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General plan	Yes	Planning and Capacity Study/Plan
Zoning ordinance	No	
Subdivision ordinance	Yes	Subdivision regulations are included in the City of Ganado Subdivision Code (1993, as amended)
Growth management	Yes	Growth management is accomplished through compliance with the Subdivision Regulations.
Floodplain ordinance	Yes	Adopted the Standard for Floodplain Management (1987)
Other special-purpose ordinances (stormwater, steep slope, wildfire)	No	
Building code	Yes	The City of Ganado adopted the International Building Code and International Residential Code (1991 editions)
Erosion or sediment control program	No	LNRA administers the erosion and sediment control program
Stormwater management	No	LNRA administers the stormwater management control program

TABLE 7-7. CITY OF GANADO REGULATORY MITIGATION CAPABILITIES MATRIX		
Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
Site plan review requirements	Yes	Board of Code Enforcement
Capital improvements plan	Yes	Adopted under resolution 2020-09
Economic development plan	No	
Local emergency operations plan	No	The City of Ganado works in conjunction with the Jackson County Emergency Management
Other special plans	No	
Flood insurance study or other engineering study for streams	Yes	FEMA floodplain maps indicate flood insurance is necessary along the Devers Creek and Lake Texana
Elevation certificates	No	The Floodplain Managers Office of Jackson County keeps records of flood elevation certificates on file in its office
Notes: FEMA Federal Emergency Management Agency LNRA Lavaca-Navidad River Authority		

7.3.2 Administrative and Technical Capabilities

Table 7-8 identifies the City of Ganado personnel responsible for activities related to mitigation and loss prevention.

TABLE 7-8. CITY OF GANADO ADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES MATRIX		
Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	No	Outsourced
Engineer/professional trained in construction practices related to buildings or infrastructure	No	Outsourced
Planner/engineer/scientist with an understanding of natural hazards	No	Outsourced
Personnel skilled in GIS	No	Outsourced
Full-time building official	No	Board of Code Enforcement
Floodplain manager	Yes	Jackson County Floodplain Administrator
Emergency Management Coordinator	Yes	Mayor. The City of Ganado also works in conjunction with the Jackson County Emergency Manager.

TABLE 7-8. CITY OF GANADO ADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES MATRIX		
Personnel Resources	Yes/No	Department/Position
Grant writer	No	Outsourced to Grant works
Other personnel	No	Outsourced
GIS data: Hazard areas	No	Outsourced
GIS data: Critical facilities	No	Outsourced
GIS data: Building footprints	No	Outsourced
GIS data: Land use	No	Outsourced
GIS data: Links to Assessor's data	No	Outsourced
Warning systems/services (Reverse 911 callback, cable override, outdoor warning signals)	Yes	County 911 based emergency phone notifications and warning sirens within the city, social media, push notifications
Other	No	Outsourced

Notes:
GIS Geographical Information System

7.3.3 Financial Capabilities

Table 7-9 identifies financial tools or resources that the City of Ganado could use to help fund mitigation activities.

TABLE 7-9. CITY OF GANADO FINANCIAL MITIGATION CAPABILITIES MATRIX	
Financial Resources	Accessible/Eligible to Use (Yes/No)
Community Development Block Grants	Yes
Capital improvements project funding	Yes
Authority to levy taxes for specific purposes	Yes
Fees for water, sewer, gas, or electric services	Yes (water and sewer)
Impact fees for new development	Yes
Incur debt through general obligation bonds	Yes
Incur debt through special tax bonds	Yes
Incur debt through private activities	No
Withhold spending in hazard-prone areas	No
Other	No

7.4 CITY OF LA WARD

7.4.1 Legal and Regulatory Capabilities

Table 7-10 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the City of La Ward.

TABLE 7-10.
CITY OF LA WARD REGULATORY MITIGATION CAPABILITIES MATRIX

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General plan	No	
Zoning ordinance	No	
Subdivision ordinance	No	
Growth management	No	
Floodplain ordinance	Yes	Within the general ordinances and has adopted the county floodplain ordinance. Development must get approval through the county.
Other special-purpose ordinances (stormwater, steep slope, wildfire)	No	
Building code	Yes	Currently Inactive
Erosion or sediment control program	No	
Stormwater management	No	
Site plan review requirements	No	
Capital improvements plan	No	
Economic development plan	No	
Local emergency operations plan	Yes	Conducted in conjunction with the county.
Other special plans	No	
Flood insurance study or other engineering study for streams	No	
Elevation certificates	Yes	The Floodplain Managers Office of Jackson County keeps records of flood elevation certificates on file in its office.

Notes:
FEMA Federal Emergency Management Agency
LNRA Lavaca-Navidad River Authority

7.4.2 Administrative and Technical Capabilities

Table 7-11 identifies the City of La Ward personnel responsible for activities related to mitigation and loss prevention.

TABLE 7-11.
CITY OF LA WARD ADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES MATRIX

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	No	
Engineer/professional trained in construction practices related to buildings or infrastructure	No	
Planner/engineer/scientist with an understanding of natural hazards	No	
Personnel skilled in GIS	No	
Full-time building official	No	
Floodplain manager	No	The City of La Ward does not have an in-house floodplain administrator but does utilize the services of the Jackson County floodplain administrator via an interlocal agreement with Jackson Co.
Emergency Management Coordinator	No	
Grant writer	No	
Other personnel	No	
GIS data: Hazard areas	No	
GIS data: Critical facilities	No	
GIS data: Building footprints	No	
GIS data: Land use	No	
GIS data: Links to Assessor's data	No	
Warning systems/services (Reverse 911 callback, cable override, outdoor warning signals)	Yes	Conducted in conjunction with the county.
Other	No	

Notes:
GIS Geographical Information System

7.4.3 Financial Capabilities

Table 7-12 identifies financial tools or resources that the City of La Ward could use to help fund mitigation activities.

TABLE 7-12.
CITY OF LA WARD FINANCIAL MITIGATION CAPABILITIES MATRIX

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

PART 2
RISK ASSESSMENT

Chapter 8.

Expansive Soils

EXPANSIVE SOILS RANKING	
Jackson County	Low
City of Edna	Low
City of Ganado	Low
La Ward	Low

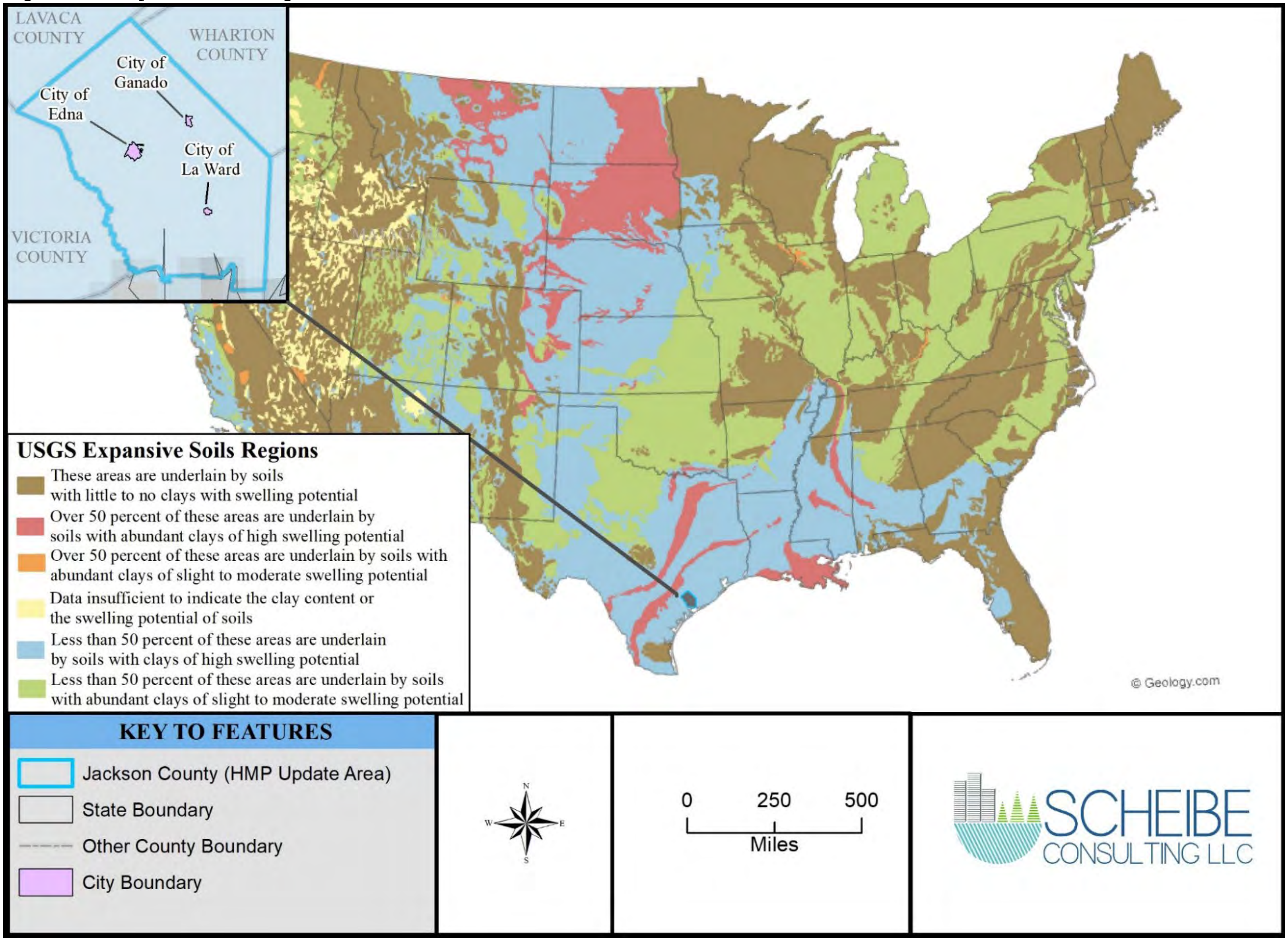
DEFINITIONS

Expansive Soils Expansive soils are soils that expand when water is added and shrink when they dry out. They usually undergo significant volume change with the addition of depletion of pore water. Generally, the result of the chemical structure of certain types of clay soils.

8.1 GENERAL BACKGROUND

Expansive and collapsible soils are some of the most widely distributed and costly geologic hazards. Collapsible soils are a group of soils that can rapidly settle or collapse the ground. They are also known as metastable soils and are unsaturated soils that undergo changes in volume and settlement in response to wetting and drying, often resulting in severe damage to structures. The sudden and usually large volume change can cause considerable structural damage. Expansive soil and rock are characterized by clayey material that shrinks as it dries or swells as it becomes wet. In addition, trees and shrubs placed close to a structure can lead to soil drying and subsequent shrinkage. The parent (source) rock most associated with expansive soils is shale. Figure 8-1 shows expansive soil distribution in the United States (U.S.) Collapsible soils consist of loose, dry, low-density materials that collapse and compact under the addition of water or excessive loading. Soil collapse occurs when the land surface is saturated at depths greater than those reached by typical rain events. This saturation eliminates the clay bonds holding the soil grains together. Similar to expansive soils, collapsible soils result in structural damage such as cracking of the foundation, floors, and walls in response to the settlement. Swelling soils cause cracked foundations, as well as damage to the upper floors of a building when the motion in the structure is significant. Shrinkage as a result of dried soils can remove support from buildings or other structures and result in damaging subsidence. Fissures in the soil can also develop. These fissures can facilitate the deep penetration of water when moist conditions or runoff occurs.

Figure 8-1. Expansive Soil Regions



From Olive et. al. (1989)

8.2 HAZARD PROFILE

8.2.1 Past Events

Jackson County is mostly underlain by soils with clay that have high shrink-swell properties (Figure 8-1). Expansive soils can cause structural damage, and even though structural foundation issues occur in the Hazard Mitigation Plan (HMP) update area, there is little documentation of site-specific past events from local, state, or national datasets.

Expansive soil is a condition that is native to Jackson County and participating communities because of the clay composition of the soils in this region. Expansive soils cannot be documented as a time-specific event, except when it leads to structural and infrastructure damage. There are no specific damage reports or historical records of events in Jackson County and participating communities; however, future events can occur. See Chapter 8.2.3 below for more information on future events.

8.2.2 Location

Structural foundation issues are a known occurrence through this region of South Texas including Jackson County and participating communities. The potential vertical rise of the clay soil in the area can be as high as several inches over a drought cycle. Structural foundations in the participating communities are thus subject to cyclical perimeter lifting and lowering from seasonal changes in soil moisture content because of the semi-arid conditions that persist in the area. Figure 8-1 shows the location of expansive soils areas for the participating communities. The *2018 State of Texas Hazard Mitigation Plan* has Jackson classified as a high potential swelling area.

8.2.3 Frequency

Expansive soil expansion and contraction is a condition that is native to Jackson County and participating communities. In Texas, it can take five or more years for an initial moisture dome to stabilize in a foundation. The establishment of the initial moisture dome usually causes the worst of the damage from foundation deflection. Afterward, the foundation is subject to cyclic perimeter lifting and lowering from seasonal changes in soil moisture content. For example, most homeowners with shifting foundations find that cracks widen in the summer and close in the winter. This is due to the area's normal weather consisting of a majority of annual rainfall in May and September, along with dry summers and less evapotranspiration in the winter.

Future Events

The large increase in development in the Texas Gulf Coast Region could lead to an increase in land subsidence events. More structures, residents, and people could cause a strain on previously undeveloped areas of land and resources. This could increase the probability of an event occurring in Jackson County and participating communities. Future events are considered likely (event possible in the next 10 years) for Jackson County and participating communities.

8.2.4 Severity

The severity of expansive soil is largely related to the extent and location of areas that are impacted. Such events can cause property damage as well as loss of life; however, events may also occur in remote areas of the HMP update area where there is little to no impact on people or property.

Expansive soil is the hidden force behind basement and foundation problems. The United States Department of Agriculture (USDA) claims that expansive soils are responsible for more home damage every year than floods, tornadoes, and hurricanes combined. The USDA estimates 50% of all homes in the U.S. are built on expansive soils. Each year in the U.S., expansive soils cause $2.3 billion in structural damage. Structures may be condemned as a result of this damage resulting in large losses. Shrink-swell problems are the second most likely problem a homeowner would encounter, after insects.

The *2013 State of Texas Hazard Mitigation Plan* defines soil expansion measurements in terms of its swelling potential or volumetric swell. The State uses the American Society for Testing and Materials (ASTM) soil expansion index adopted by ASTM in 1988. This expansion index has been determined to have a greater range and better sensitivity of expansion than other indexes. The following ratings define expansive soil extent ‘per the ASTM D4729-11 Expansive Soils Index:

0-20%	Very Low
21-50%	Low
51-90%	Medium
91-130%	High
130%+	Very High

As seen in Figure 8-1, Jackson County and participating communities are vulnerable to expansive soils as up to 50% of the area is underlain by soils with clays of high swelling potential. Therefore, they fall under the ‘Low’ extent per the ASTM D4729-11. The Uniform Building Code (UBC) mandates that special foundation design considerations be employed if the Expansion Index is 20 or greater. This applies to all participating communities.

8.2.5 Warning Time

Soil expansion generally occurs gradually over time; however, these processes may be intensified as a result of natural or human-induced activities.

8.3 SECONDARY HAZARDS

Events that cause damage to improved areas can result in secondary hazards, such as explosions from natural gas lines, loss of utilities such as water and sewer due to shifting infrastructure, and potential failures of reservoir dams. Additionally, these events may occur simultaneously with other natural hazards such as flooding.

8.4 CLIMATE CHANGE IMPACTS

Climate change is expected to have a considerable impact on the extent of damage caused by expansive soils in the future. Many areas are expected to transition to hotter summer conditions accompanied by a decrease in annual rainfall. This is predicted to cause changes in normal soil moisture content than that at present. The hotter and dryer weather will cause an increased demand for soil moisture from plants to supplement the change in annual rainfall. These conditions will create an environment with the potential to experience large amounts of soil expansion and contraction.

8.5 EXPOSURE

While all structures and foundations are exposed to expansive soils, Jackson County and participating communities' clay soil composition increases the likelihood and severity of the seasonal swelling and contraction of soils. Each participating community's structures and population are potentially exposed and equally at risk by expansive soils. Table 8-1 lists the exposed population and structure count for each participating jurisdiction.

8.5.1 Population

It can be assumed that the entire planning area is exposed equally to some extent to expansive soils events. Certain areas are more exposed due to geographic location and local weather patterns. Current growth trends could cause more area residents to be exposed to expansive soils. Increased population will increase demands on structure development, as well as surface and sub-surface soil activities, and may introduce new expansive soils in areas where soil expansion activities have not yet occurred.

8.5.2 Property

According to the Hazards United States Multi-Hazard (HAZUS-MH) system inventory data (updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs), there are 6,626 buildings within the census blocks that define the planning area with an asset replaceable value of $1.4 billion (excluding contents). About 93% of these buildings (and 79% of the building value) are associated with residential housing. The total building and content value are $2.4 billion. Other types of buildings in this report include agricultural, education, religious, and governmental structures. See Table 8-1 below.

TABLE 8-1
EXPOSED STRUCTURES AND POPULATION

Jurisdiction	Residential	Commercial	Other*	**Total Structures**	**Total Population**
City of Edna	2,143	133	100	**2,376**	**5,499**
City of Ganado	657	34	17	**708**	**2,003**
City of La Ward	88	6	6	**100**	**213**
Unincorporated Area	3,256	82	104	**3,442**	**6,360**
Jackson County Total	**6,144**	**255**	**227**	**6,626**	**14,075**

Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.

8.5.3 Critical Facilities and Infrastructure

Any critical facilities or infrastructure that are located in the participating communities on or near areas prone to expansive soils and are equally exposed to risk from this hazard. Bare ground or lack of tree cover may result in additional exposure.

8.5.4 Environment

Expansive soils are naturally occurring processes, but can still cause damage to the natural environment. These processes and events can alter the natural environment where they occur.

8.6 VULNERABILITY

Jackson County and participating communities are at risk from expansive soils because of the amounts of clay with swelling potential within the soils in these communities. For the specific rankings given for each entity see ranking tables in Chapter 22. Because expansive soils cannot be directly modeled in HAZUS-MH, annualized losses were estimated using geographic information system- (GIS) based analysis, historical data analysis, and statistical risk assessment methodology. Event frequency, severity indicators, expert opinions, and historical local knowledge of the region were used for this assessment.

8.6.1 Population

The risk of injury or fatalities as a result of this hazard is limited but possible. The most vulnerable demographics will be the economically disadvantaged population areas, children under 16 years of age, and the elderly. Economically disadvantaged families and those living on a fixed income may not have the financial means to adequately deal with the effects of an event and make the necessary structural improvements. The youth and elderly population may require further assistance as dependents if an event were to occur. Table 8-2 shows all vulnerable populations per participating community.

TABLE 8-2
MOST VULNERABLE POPULATION

Jurisdiction	Youth Population (< 16)	% of Total Population	Elderly Population (> 65)	% of Total Population	Economically Disadvantage (Income < $20,000)	% of Total Population
City of Edna	1,481	26.93	876	15.93	371	6.75
City of Ganado	502	25.06	270	13.48	100	4.99
City of La Ward	71	33.33	24	11.27	22	10.33
Unincorporated Area	1,525	23.98	1,143	17.97	448	7.04
Jackson County Total	**3,579**	**25.43**	**2,313**	**16.43**	**941**	**6.69**

8.6.2 Property

All properties are at some level of risk from expansive soils, but properties in poor condition or particularly vulnerable locations (economically disadvantaged communities and areas with low tree cover) may risk the most damage. Generally, the damage is minimal and goes unreported.

Loss estimations for expansive soil hazards are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing projected damages (annualized loss) on exposed values. Historical events, statistical analysis, and probability factors were applied to the counties and communities exposed values to create an annualized loss. Table 8-3 lists the property loss estimates for each participating community compared to the exposed value (excluding content). Annualized losses of 'negligible' are less than $50 annually. Negligible loss hazards are still included despite minimal annualized losses because of the potential for a high-value damaging event.

TABLE 8-3.
LOSS ESTIMATES FOR EXPANSIVE SOILS

Jurisdiction	Exposed Value	Annualized Loss	Annualized Loss Percentage
City of Edna	$531,363,874	$1,585	<0.01
City of Ganado	$157,942,407	$465	<0.01
City of La Ward	$17,368,908	$51	<0.01
Unincorporated Area	$735,585,812	$13,518	<0.01
Jackson County Total	$1,442,261,000	$15,619	<0.01

Vulnerability Narrative

All participating communities are at risk to expansive soils. Table 8-2 lists the vulnerable population per community. Table 8-3 lists the estimated annualized losses in dollars for each participating community.

- **City of Edna -** The effects of expansive soils are more likely to be felt in the more developed areas of the city, such as along US 59 or TX 111. Property owners face additional maintenance costs because of structure foundation issues caused by the swelling of soils. Owners unaware of the areas of higher risk at the time the property was purchased are more at risk of not being prepared for its effects. If an event were to occur near a critical facility, such as an area school, government building, or site containing hazardous materials, area residents would be increasingly impacted.
- **City of Ganado** – Weather events of greater disparity (such as short intense periods of rainfall to prolonged drought conditions) cause more stress on areas affected by expansive soils. As the soil expands, cracks in foundations can occur as well as other structural damages. This can cause damages to critical facilities (such as emergency response facilities, government buildings, and schools, as well as homes). If major area thoroughfares, such as TX FM 1157 or Loop 522, were to be closed or become impassable by an event, response times to the community and mobility into and out of the city would be limited. Structures built without the benefit of building requirements designed to

minimize the risk of property damage are more vulnerable as well. Residents unaware of the risks and hazards associated with expansive soils increase their risk of negative impacts.

- **City of La Ward** – Expansive soils could affect the community in the more developed area of the town, such as that along State Highway 172 causing damage to critical facilities. Other areas of the town, containing mostly residential structures, could also be affected. This shifting could damage critical infrastructure and residential structures resulting in the need for costly repairs.
- **Jackson County (Unincorporated Area)** – Less than 50% of the unincorporated areas within Jackson County are underlain by soils with abundant clays of high swelling potential. Critical facilities and structures that have not been inspected for expansive soils may have a greater risk. Residents and business owners who are unaware of the dangers of expansive soils are more vulnerable as well. Communities who monitor the structural integrity of critical facility structures and conduct the improvements needed to major thoroughfares or crossings help to mitigate these risks.

Community Perception of Vulnerability

See the front page of the current chapter for a summary of hazard rankings for Jackson County and participating communities in this HMP update. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

8.6.3 Critical Facilities and Infrastructure

Even though expansive soils cause extensive damage, the effects can occur slowly and may not be attributed to a specific event. The damage done by expansive soils is then attributed to poor construction practices or a misconception that all buildings experience this type of damage as they age. Cracked foundations, floors, and basement walls, as well as damage to the upper floors of the building when the motion in the structure is significant, are typical types of damage done by swelling soils. Shrinkage can remove support from buildings or other structures and result in damaging subsidence.

When critical facilities and infrastructure are affected and closed down for maintenance due to structure foundation problems as a result of soil expansion, critical response times and services to the affected communities will become limited.

8.6.4 Environment

Expansive soils are a naturally occurring process. The swelling and contraction of soil is necessary to maintain a healthy ecosystem. However, excessive swelling and contraction can be damaging to the natural environment. Ecosystems that are already exposed to other pressures, such as encroaching development, may be more vulnerable to impacts from these hazards.

8.7 FUTURE TRENDS IN DEVELOPMENT

Jurisdictions in the planning area should ensure that known hazard areas are regulated under their planning and zoning programs. In areas where hazards may be present, permitting processes should require geotechnical investigations to access risk and vulnerability to hazards. Soil expansion issues generally do impact land use and structure development. Issues pertaining to land use in these areas are likely addressed through jurisdictional building codes, ordinances, and regulations.

8.8 SCENARIO

A worst-case scenario would occur if a rapidly occurring soil swelling and contraction caused severe structure deformation or the subsurface soil to crack and open up beneath a structure where many individuals lived or worked. This situation could result in a number of injuries or fatalities and would cause extensive damage to the area directly impacted.

8.9 ISSUES

The major issues for soil expansion are the following:

- The onset of actual or observed soil expansion in many cases is related to changes in land use. Land uses permitted in known hazard areas should be carefully evaluated.
- Knowledge of hydrologic factors is critical for evaluating most types of soil swelling.
- Some land use and housing developments have had soil site investigations completed before development. This practice should be reviewed and expanded as needed.
- A more detailed analysis should be conducted for critical facilities and infrastructure exposed to hazard areas. This analysis should address how potential structural were addressed in facility design and construction.

Chapter 9.
Dam/Levee Failure

DAM/LEVEE FAILURE RANKING	
Jackson County	Low
City of Edna	Low
City of Ganado	N/A
City of La Ward	N/A

DEFINITIONS

Breach	An opening through which floodwaters may pass after part of a levee has given way.
Dam Failure	An uncontrolled release of impounded water due to structural deficiencies in a dam.
Emergency Action Plan	A document that identifies potential emergency conditions at a dam and specifies actions to be followed to minimize property damage and loss of life. The plan specifies actions the dam owner should take to alleviate problems at a dam. It contains procedures and information to assist the dam owner in issuing an early warning and notification messages to responsible downstream emergency management authorities of the emergency situation. It also contains inundation maps to show emergency management authorities the critical areas for action in case of an emergency. (FEMA 64)
High Hazard Dam	Dams where failure or operational error will probably cause loss of human life. (FEMA 333)
Significant hazard Dam	Dams where failure or operational error will result in no probable loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities, or can impact other concerns. Significant hazard dams are often located in rural or agricultural areas but could be located in areas with population and significant infrastructure. (FEMA 333)
Accredited Levee	A levee that is shown on a Flood Insurance Rate Map (FIRM) as providing protection from the 1% annual chance or greater flood. A **non-accredited or de-accredited levee** is a levee that is not shown on a FIRM as providing protection from the 1% annual chance or greater flood. A **provisionally accredited levee** is a previously accredited levee that has been de-accredited for which data and/or documentation is pending that will show the levee is compliant with National Flood Insurance Program (NFIP) regulations.

9.1 GENERAL BACKGROUND

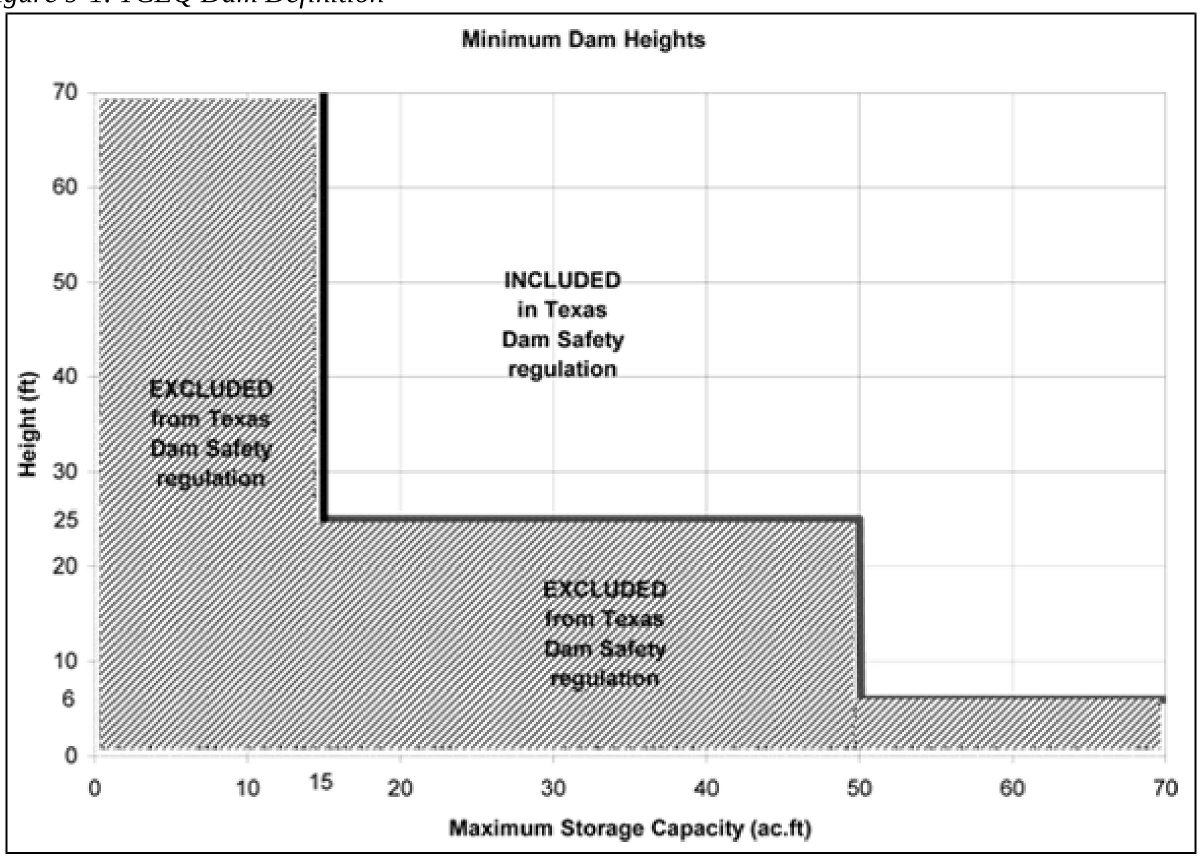
9.1.1 Dams

Water is an essential natural resource and one of the most efficient ways to manage and control water resources is through dam construction. A dam is defined in the Texas Water Code as “any barrier, or barriers with an appurtenant structure, constructed for the purpose of either permanently or temporarily impounding water” (Texas Administrative Code, Title 30, Part 1, Ch. 299, 2005).

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

According to the TCEQ, a dam in Texas is a barrier with any of the following: “height greater than or equal to 25 feet and a maximum storage capacity greater than or equal to 15 acre-feet; a height greater than 6 feet and a maximum storage capacity greater than or equal to 50 acre-feet; are a high- or significant-hazard dam as defined in n §299.14 (relating to Hazard Classification Criteria), regardless of height or maximum storage capacity; or are used as a pumped storage or terminal storage facility” (TCEQ, Ch 1, 2009). Figure 9-1 shows the specifications required for a dam to be regulated by TCEQ.

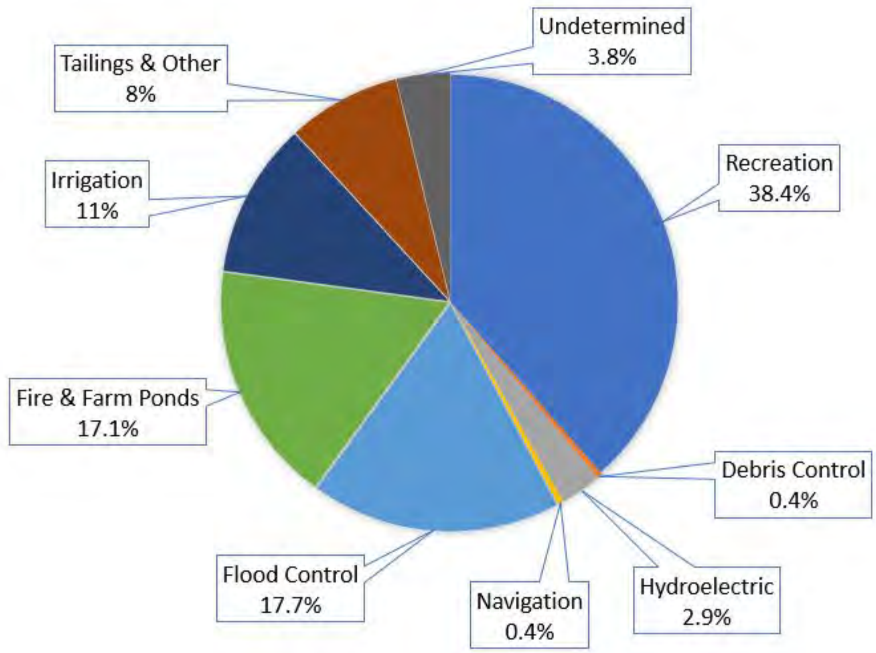
Figure 9-1. TCEQ Dam Definition



Note: From TCEQ, Ch 1, 2009

The majority of dams and lakes in Texas are used for water supply. Dams also provide benefits such as irrigation for agriculture, hydropower, flood control, maintenance of lake levels, and recreation. The primary purposes and benefits of dams are shown in Figure 9-2. However, despite the benefits and importance of dams to our public works infrastructure, many safety issues exist for dams as with any complex infrastructure; the most serious threat is dam failure. Almost all the dams in Jackson County are privately owned.

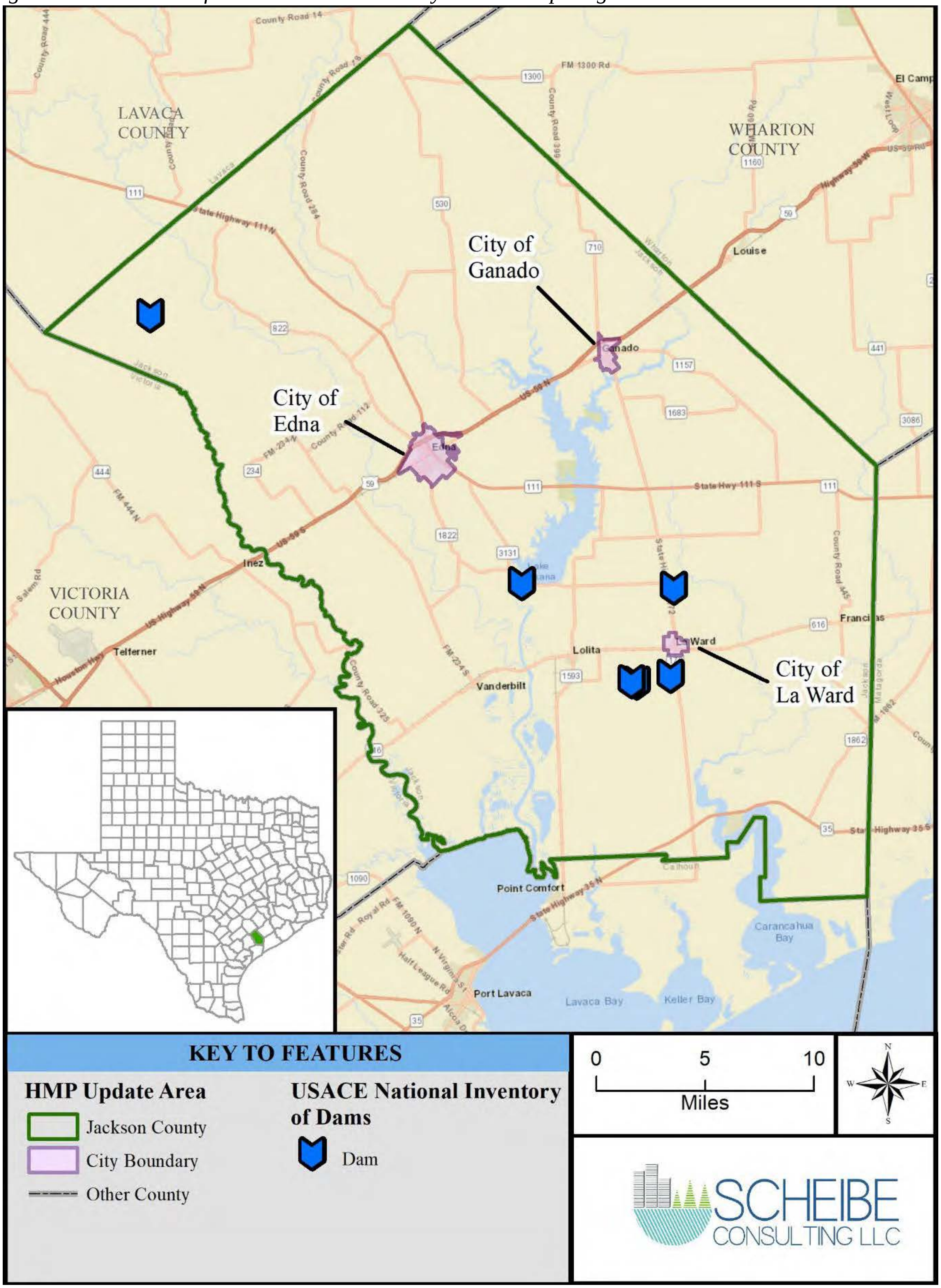
Figure 9-2. Primary Purpose/Benefit of U.S. Dams



Note: From FEMA, Living With Dams

Approximately 17% of the dams in all of Jackson County and participating communities are owned by either the local government or local government agencies. The remaining 83% are privately owned. See Figure 9-3 for the location of dams in the participating communities.

Figure 9-3. Locations of Dams in Jackson County and Participating Communities



Note: From USACE National Inventory of Dams

9.1.2 Levees

The Federal Emergency Management Agency (FEMA) defines a levee as a "man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." The terms dike and levee are sometimes used interchangeably. A few examples of levee systems are the Texas City Hurricane Protection Structure, Freeport Hurricane Protection Structure, the Port Arthur Hurricane Protection Structure in the Houston area, and the Trinity Floodway Levees in the Dallas area. Levees reduce the risk of flooding but no levee system can eliminate all flood risks. There is always a chance that a flood will exceed the capacity of a levee, no matter how well built. Levees can work to provide critical time for local emergency management officials to safely evacuate residents during flooding events. The possibility exists that levees can be overtopped or breached by large floods; however, levees sometimes fail even when a flood is small.

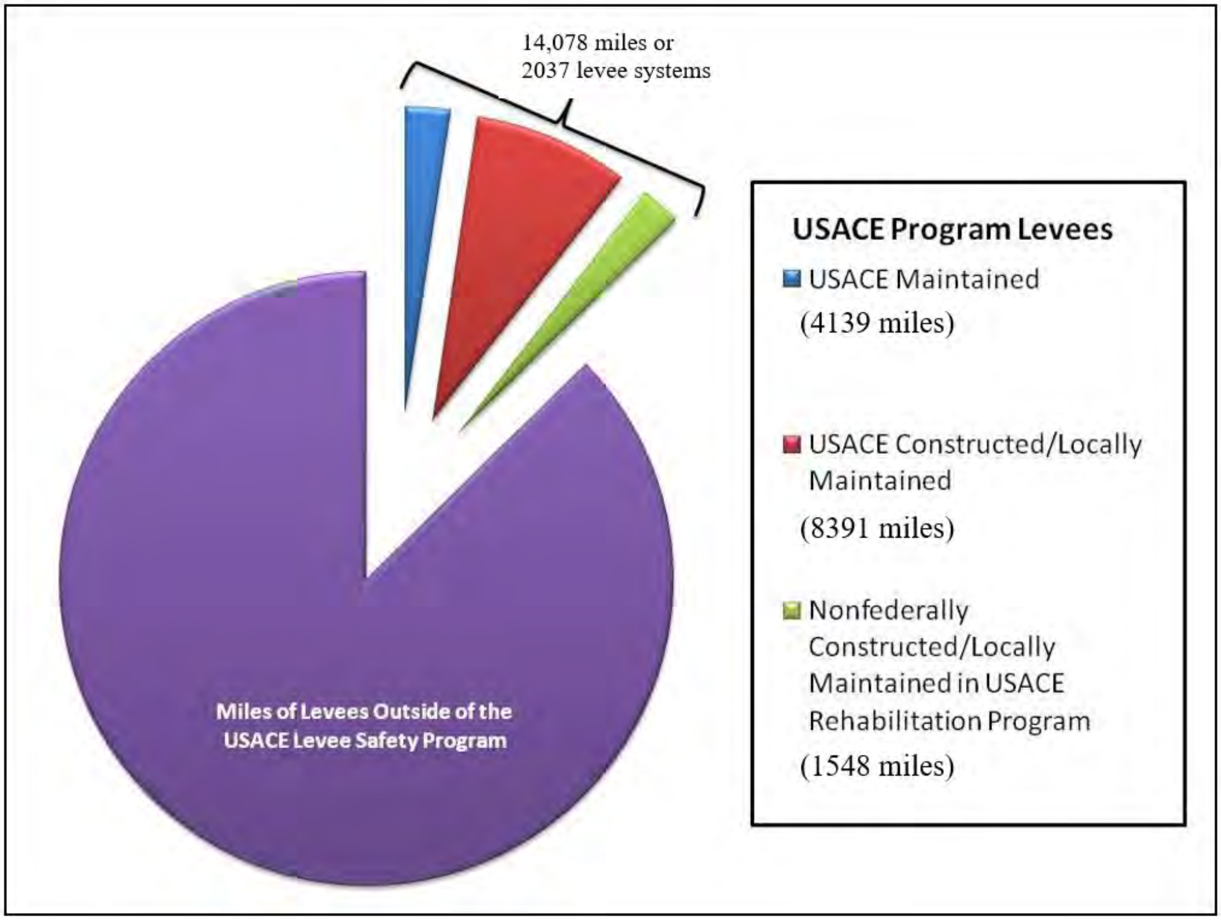
Although there are levees in all 50 states, there is no single agency responsible for levee construction and maintenance. It is a common misperception that the United States Army Corps of Engineers (USACE) manages all levees in the nation. In reality, the levees included in the USACE Levee Safety Program represent only about 10% of the nation's levees (as estimated by the National Committee on Levee Safety). Some estimates indicate that over 100,000 miles of levees exist across the nation. Of that number, the USACE designed and constructed over 14,000 miles of levees with another 14,000 to 16,000 miles operated by other federal agencies, such as the U.S. Bureau of Reclamation. The majority of the nation's levees were constructed by private and non-federal interests and are not federally operated or maintained. However, more than 10 million people live or work behind USACE program levees. For this reason, USACE considers its role in assessing, communicating, and managing risk to be a top priority. Figure 9-4 shows USACE program levees versus other levee programs. Jackson County and participating communities do not contain known levees (See Figure 9-5) based on the National Levee Database and local knowledge. Additional small private levees may exist which are unaccounted for.

Flooding can happen anywhere, but certain areas are especially prone to serious flooding. To help communities understand their risk behind levee structures, FEMA uses levee accreditation on flood insurance rate maps (FIRM) to show the locations with reduced risks from the base flood. Conditions in, near, or under levees can change due to environmental factors. The FIRMs take these factors into consideration. If the risk level for a property changes, so may the requirement to carry flood insurance.

Levee accreditation is FEMA's recognition that a levee is reasonably certain to contain the base (1% annual chance exceedance, sometimes referred to as the 100-year flood) regulatory flood. In order to be accredited, levee owners must certify to FEMA that the levee will provide protection from the base flood. Certification is a technical finding by a professional engineer based on data, drawings, and analyses that the levee system meets the minimum acceptable standards. FEMA's accreditation is not a guarantee of performance; it is intended to provide updated information for insurance and floodplain development.

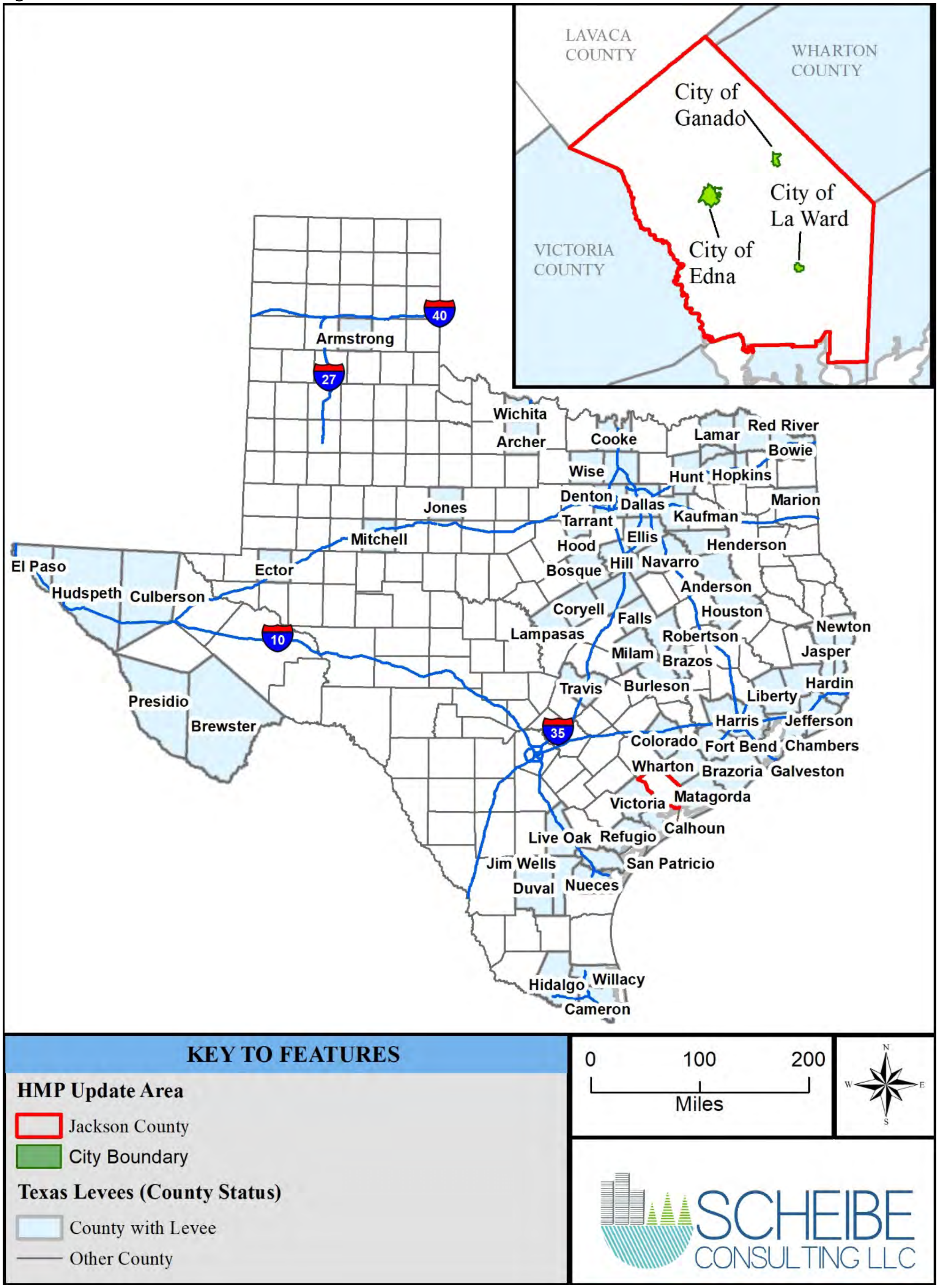
While there are no known certified levees in Jackson County and participating communities, small private levees may exist. Therefore, a general description of levees is provided.

Figure 9-4. U.S. Levee Systems



Note: From USACE

Figure 9-5. Counties in Texas with Levees



9.1.3 Causes of Dam Failure

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

- Overtopping of the primary dam structure, which accounts for 34% of all dam failures, can occur due to inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors.
- Foundation defects due to differential settlement, slides, slope instability, uplift pressures, and foundation seepage can also cause dam failure. These account for 30% of all dam failures.
- Failure due to piping and seepage accounts for 20% of all failures. These are caused by internal erosion due to piping and seepage, erosion along hydraulic structures such as spillways, erosion due to animal burrows, and cracks in the dam structure.
- Failure due to problems with conduits and valves, typically caused by the piping of embankment material into conduits through joints or cracks, constitutes 10% of all failures.

The remaining 6% of U.S. dam failures are due to miscellaneous causes. Many dam failures in the United States have been secondary results of other disasters. The prominent causes are earthquakes, landslides, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, and sabotage.

Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

9.1.4 Causes of Levee Failure

Levee data used in this report is from the FEMA Mid-term Levee Inventory (MLI). The FEMA MLI captures all levee data (USACE and non- USACE), with a primary focus on levees that provide protection from the base (1% annual chance) flood. Levees providing less than base flood protection will also be included, but only for those levees with data readily available. The HAZUS-MH database did not list any levees in Jackson County. The National Levee Database and the FEMA MLI database did not list any levees for Jackson County. However, there may be private levees located within the county and participating cities that are not listed in these databases.

A levee breach occurs when part of a levee gives way, creating an opening through which floodwaters may pass. A breach may occur gradually or suddenly. The most dangerous breaches happen quickly during periods of high water. The resulting torrent can quickly swamp a large area behind the failed levee with little or no warning.

Earthen levees can be damaged in several ways. For instance, strong river currents and waves can erode the surface. Debris and ice carried by floodwaters—and even large objects such as boats or barges—can collide with and gouge the levee. Trees growing on a levee can blow over, leaving a hole where the root wad and soil used to be. Burrowing animals can create holes that enable water to pass through a levee. If severe enough, any of these situations can lead to a zone of weakness that could cause a levee breach. In seismically active areas, earthquakes and ground shaking can cause a loss of soil strength, weakening a levee and possibly resulting in failure. Seismic activity can also cause levees to slide or slump, both of which can lead to failure. Unfortunately, in the rare occurrence when a levee system fails or is overtopped, severe flooding can occur due to increased elevation differences associated with levees and the increased water velocity that is created.

It is also important to remember that no levee provides protection from events for which it was not designed, and proper operation and maintenance are necessary to reduce the probability of failure. In some cases, flooding may not be directly attributable to a river, stream, or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations—areas that are often not in a floodplain. This type of flooding, often referred to as sheet flooding, is becoming increasingly prevalent as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow. Flooding also occurs due to combined storm and sanitary sewers that cannot handle the amount of water.

The complicated nature of levee protection was made evident by events such as Hurricane Katrina. Flooding can be exacerbated by levees that are breached or overtopped. As a result, FEMA and USACE are reevaluating their policies regarding enforcement of levee maintenance and post-flood rebuilding. Both agencies are also conducting stricter inspections to determine how much protection individual levees actually provide. The Texas Water Development Board's (TWDB) mission is to provide leadership, information, education, and support for planning, financial assistance, and outreach for the conservation and responsible development of water for Texas. TWDB will assist qualifying entities who are in good standing with the National Flood Insurance Program (NFIP) through technical and financial assistance. TWDB assistance may include grant funding, participation in levee inspections, assistance in developing Maintenance Deficiency Correction Plans, site visits, and participation in public hearings. In addition, the TWDB will also discourage the construction of new levees to protect new developments, and instead encourage other types of flood mitigation projects.

9.1.5 Regulatory Oversight

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

Texas Rules and Regulations for Dam Safety and Dam Construction

Effective September 1, 2013, dams are exempt from safety requirements if they are located on private property, have a maximum impoundment capacity of less than 500 acre-feet, are classified as low or significant hazard, are located in a county with a population of less than 350,000 (as per 2010 U.S. Census), and are not located within the corporate limits of a municipality. Dam owners will still have to comply with maintenance and operation requirements. There is no exemption expiration date. Figure 9-6 shows counties in Texas that fall under this exemption criteria. Three of the dams in Jackson County are non-exempt while the others are exempt per 30 Texas Administrative Code (TAC) 299.

To help the State Dam Safety Program achieve its goal, the state's dam safety regulations now include the requirement for emergency action plans on all non-exempt Significant-Hazard and High-Hazard Potential dams (Title 30, TAC, Ch. 299, 299.61b). Dam count and exemptions 30 TAC 299 are detailed below by jurisdiction in Table 9-1.

TABLE 9-1. DAM COUNTS AND EXEMPTIONS		
Jurisdiction	Dam Count	Exemptions
City of Edna	0	0
City of Ganado	0	0
City of La Ward	0	0
Unincorporated Areas	6	3
Jackson County Total	6	3

Note: Dam data provided by the USACE National Inventory of Dams (NID) in 2018

U.S. Army Corps of Engineers Dam Safety Program

USACE is responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act. USACE has inventoried dams; surveyed each state and federal agency's capabilities, practices, and regulations regarding design, construction, operation, and maintenance of the dams; and developed guidelines for inspection and evaluation of dam safety.

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) cooperates with a large number of federal and state agencies to ensure and promote dam safety. More than 3,000 dams are part of regulated hydroelectric projects in the FERC program. Two-thirds of these are more than 50 years old. As dams age, concern about their safety and integrity grows, so oversight and regular inspection are important. FERC inspects hydroelectric projects on an unscheduled basis to investigate the following:

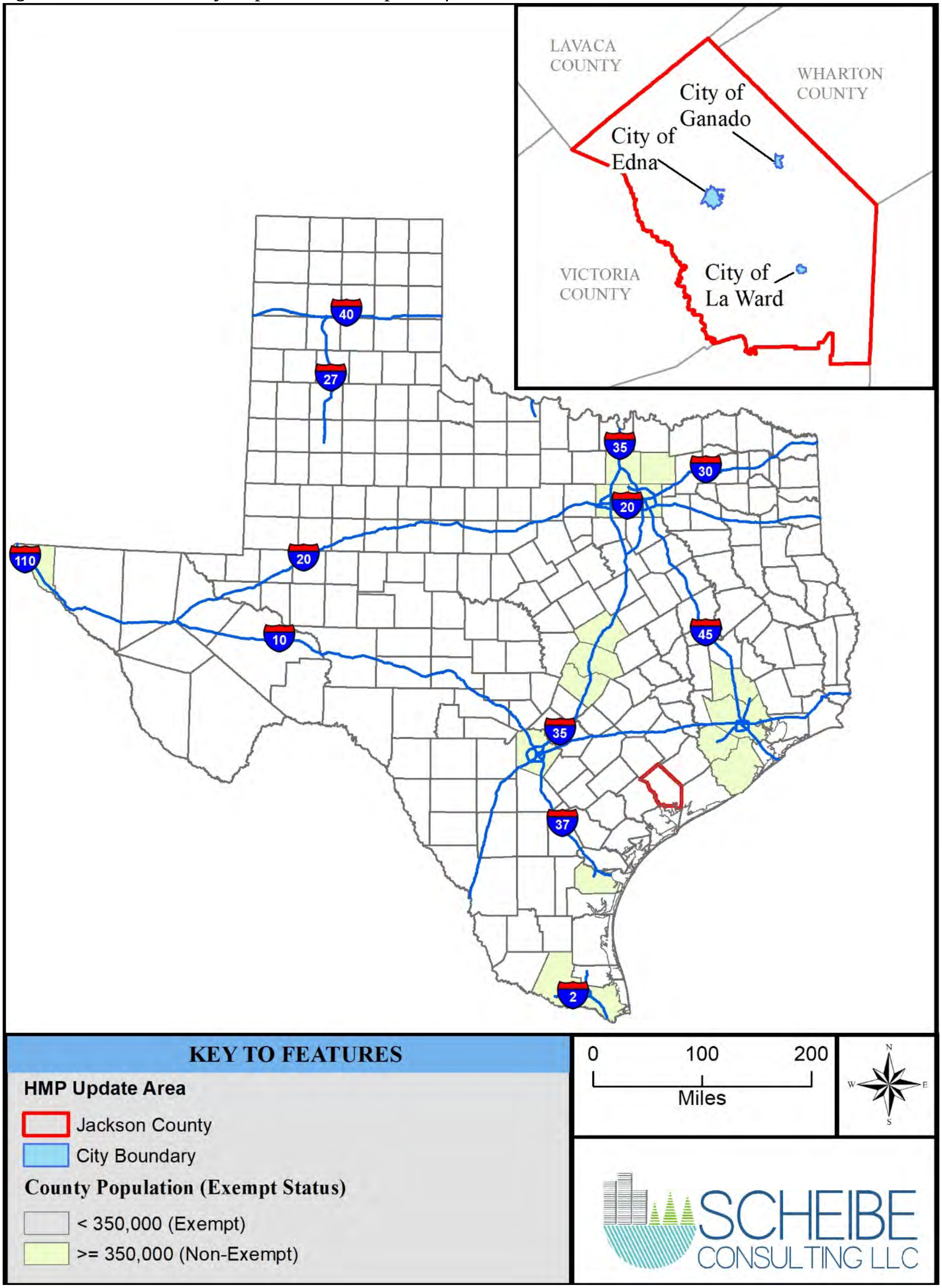
- Potential dam safety problems
- Complaints about constructing and operating a project
- Safety concerns related to natural disasters
- Issues concerning compliance with the terms and conditions of a license

Every 5 years, an independent engineer approved by the FERC must inspect and evaluate projects with dams higher than 32.8 feet (10 meters) or with a total storage capacity of more than 2,000 acre-feet.

FERC monitors and evaluates seismic research and applies it in investigating and performing structural analyses of hydroelectric projects. FERC also evaluates the effects of potential and actual large floods on the safety of dams. During and following floods, FERC visits dams and licensed projects, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must undertake. The FERC publication *Engineering Guidelines for the Evaluation of Hydropower Projects* guides the FERC engineering staff and licensees in evaluating dam safety. The publication is frequently revised to reflect current information and methodologies.

FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans outline an early warning system if there is an actual or potential sudden release of water from a dam due to failure. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that everyone knows what to do in emergency situations.

Figure 9-6. Texas County Population Exemptions for Dams



9.2 HAZARD PROFILE

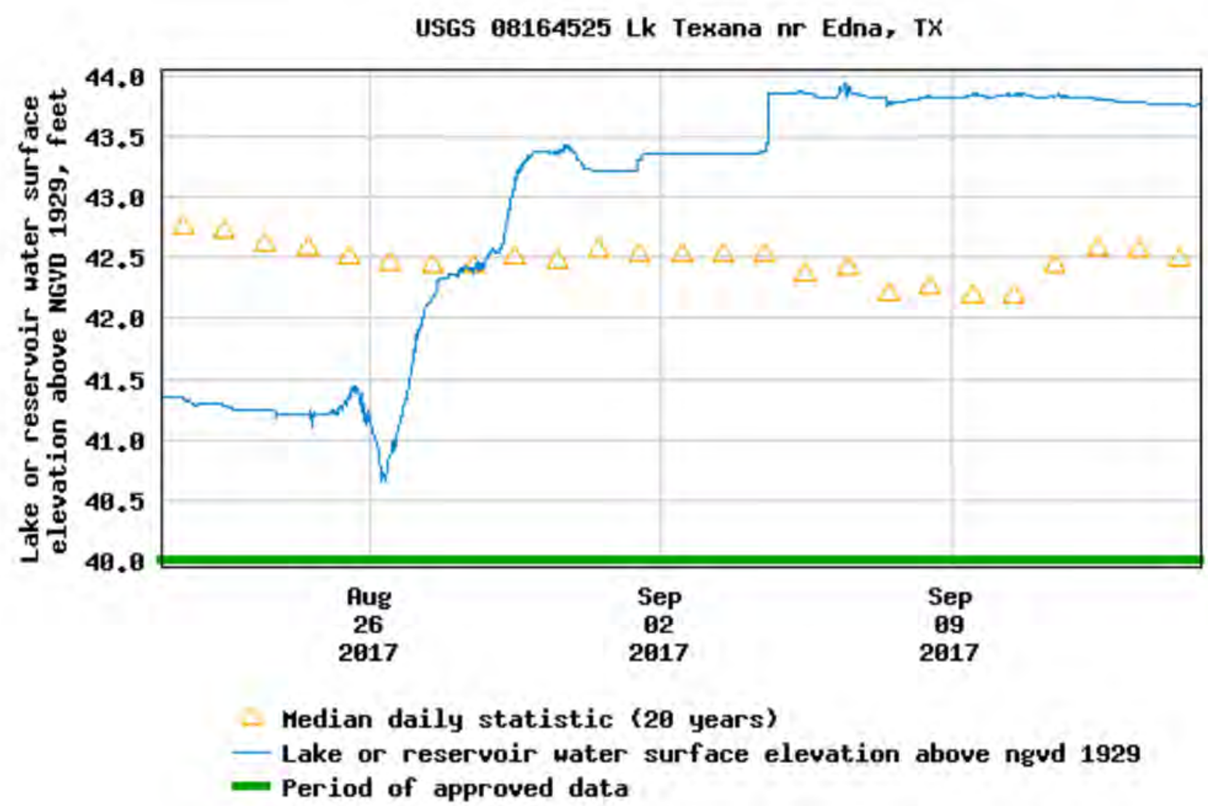
9.2.1 Past Events

There are approximately 7,324 dams in the inventory of dams in Texas. Only two major dam failures have occurred in the entire Texas Colorado River Floodplain Coalition (TCRFC) region. Both occurred in the City of Austin. The last failure for the city was in 1915. There have been no previous dam failure events in Jackson County and the participating communities.

After a series of high-profile failures throughout the United States during the 1960s and early 1970s, the U.S. Congress enacted legislation mandating inspections and strict safety requirements for all governmental and privately operated dams. Stricter state and federal dam safety regulations were adopted in the 1970s and 1980s as a direct response to numerous dam failures across the country. These standards require that dams be able to withstand the most severe flood imaginable, the Probable Maximum Flood (PMF). This flood is so severe and statistically remote that its probability of occurrence in any given year cannot be measured. Since that time the number of failures and deaths has dramatically decreased.

Hurricane Harvey resulted in an extreme precipitation event from August 23, 2017, through August 27, 2017 (this event is further outlined in Chapter 12, Flood) causing a rise along the Lavaca River. The elevation of water in Lake Texana near the City of Edna is shown in Figure 9-7.

Figure 9-7. Reservoir Elevation of Lake Texana Near the City of Edna



Note: From USGS

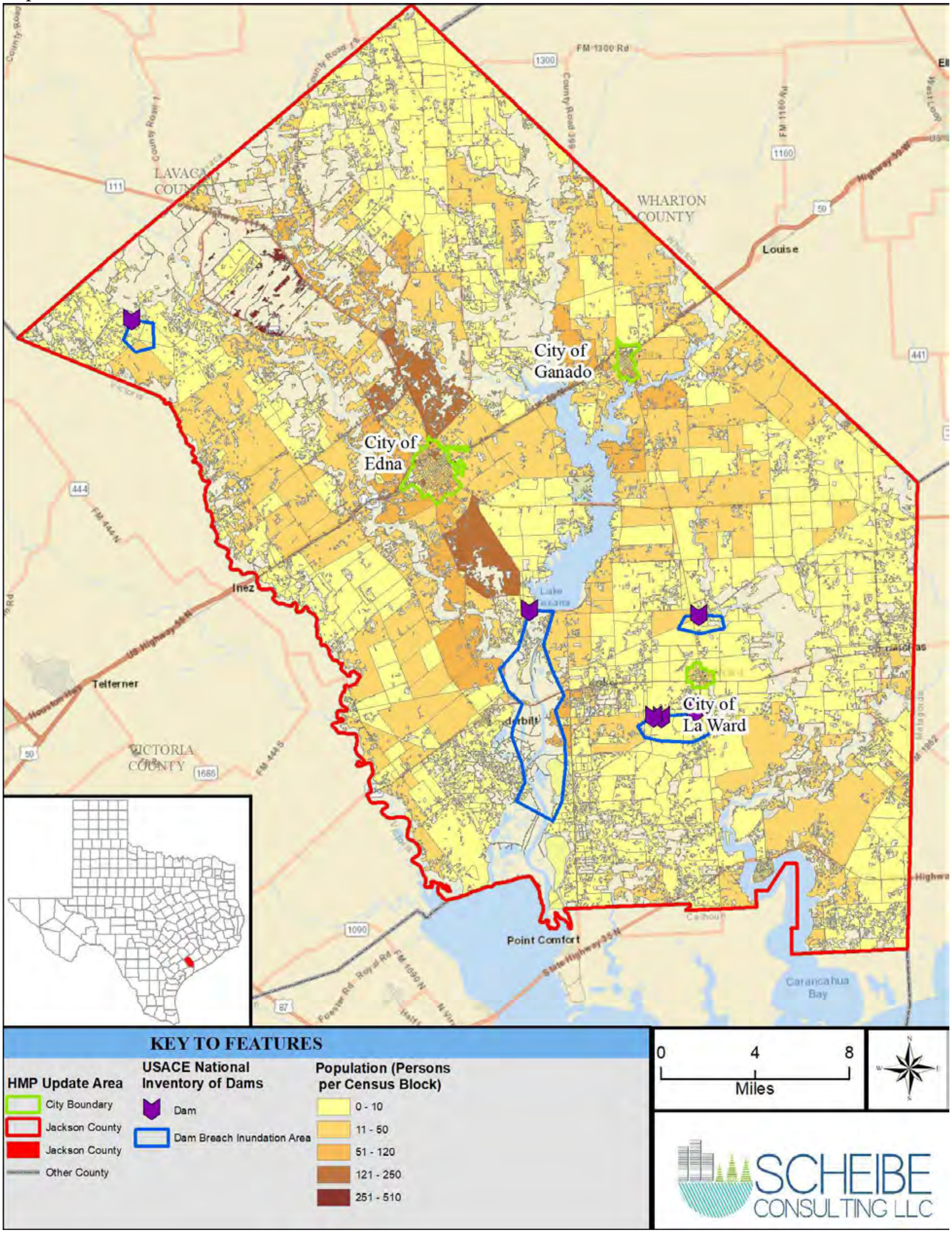
9.2.2 Location

Location is based on information provided by the USAC National Inventory of Dams (NID). This database lists 6 dams in Jackson County and participating communities and classifies dams based on the potential hazard to the downstream area resulting from failure or misoperation of the dam or facilities:

- High-Hazard Potential—Probable loss of life (one or more persons)
- Significant-Hazard Potential—No probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns; often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure
- Low-Hazard Potential—No probable loss of human life and low economic or environmental losses; losses are principally limited to the owner’s property

Based on these classifications, five dams in Jackson County are classified as Low-Hazard Potential and one dam in Jackson County is classified as High-Hazard Potential. Figure 9-8 shows locations of the dams in the county and participating cities. Estimated potential dam inundation extents are included with comparison to population densities by census block.

Figure 9-8. Jackson County and Participating Communities Dam Potential Inundation Areas and Population



Note: From NDI and HAZUS-MH (Blue polygon represents approx. area of inundation in the event of a dam breach)

There is an uncounted number of non-jurisdictional dams on public and private lands in the planning area. These are small dams that normally do not store water but may impound water during heavy precipitation events. Because they are not monitored or maintained, there is potential for them to overtop or fail and cause flooding and property damage during a significant rainfall event. The extent and risk associated with these dams is not known.

The risks of a dam failure are spread throughout the county. The planning area could be impacted by several high-hazard dams that are located outside of the county. If a failure of the high-hazard dam occurred, it could result in loss of life. Other high-hazard dams are located outside of the county and their drainages enter Jackson County and participating communities either by direct drainage through parts of the planning area or by inflow into the Lavaca or Navidad Rivers upstream of Jackson County. However there have not been any dam breaches immediately upstream of or within the participating communities, thus the overall chance of this occurring is minimal. Additionally, major dams located outside of the planning area that could affect the participating communities, including Eg Goff dam, Hutchins Lake Dam, and Banes Lake Dam are located approximately 5, 7, and 25 miles, respectively, upstream of Jackson County. Eg Goff and Hutchins Lake Dam are located in Wharton County along Goldenrod Creek and Sandy Creek, respectively. Barnes Lake Dam is located in Lavaca County along Grafe Branch Creek. Because of these dam's upstream location and size, any major dam breach will minimally affect the planning area. A detailed description of exposure and vulnerability per jurisdiction is described in Chapter 9.5 and Chapter 9.6.

9.2.3 Frequency

There has been no occurrence of dam failure in the past 100 years in the HMP update area. Overall, the probability of a dam failure somewhere in Jackson County and the City of La Ward are considered rare or unlikely (event not probable in the next 100 years). This same probability applies to future events (event not probable in the next 100 years). The Cities of Ganado and Edna are not exposed to dam/levee failure due to their location outside of inundation areas.

9.2.4 Severity

USACE and TCEQ developed the classification system shown in Table 9-2 and Table 9-3 for the hazard potential of dam failures. The hazard rating systems are both based only on the potential consequences of a dam failure; neither system takes into account the probability of such failures.

TABLE 9-2.
USACE HAZARD POTENTIAL CLASSIFICATION

Hazard Category	Direct Loss of Life [b]	Lifeline Losses [c]	Property Losses [d]	Environmental Losses [e]
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Possible (rural location, only transient or day-use facilities)	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more persons; extensive residential, commercial, or industrial development)	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

Notes:

a. Categories are assigned to overall projects, not individual structures at a project.

b. Loss of life potential based on inundation mapping of the area downstream of the project. Analyses of loss of life potential should take into account the population at risk, time of flood wave travel, and warning time.

c. Indirect threats to life caused by the interruption of lifeline services due to project failure or operational disruption; for example, loss of critical medical facilities or access to them.

d. Damage to project facilities and downstream property and indirect impact due to loss of project services, such as impact due to loss of a dam and navigation pool, or impact due to loss of water or power supply.

e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

From 7 CFR Appendix A-Subpart E-Part 1724

TABLE 9-3.
TCEQ HAZARD POTENTIAL CLASSIFICATION

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

Note: From Title 30 Texas Administrative Code, Ch 299, Subchapter B, Rule §299.14

9.2.5 Warning Time

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

Emergency action plans for all high-hazard dams that would affect Jackson County are on file with TCEQ. Additionally, possible evacuation routes in the event of a failure have been identified.

9.3 SECONDARY HAZARDS

Dam failure can cause severe downstream flooding, depending on the magnitude of the failure. Other potential secondary hazards of dam failure are landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat.

9.4 CLIMATE CHANGE IMPACTS

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

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

9.5 EXPOSURE

Dam data records and exposures are described in general in this section. Figure 9-8 shows potential estimated areas of impact by a dam breach and population vulnerability by census block. While some communities have property and population that may be affected by an upstream event, due to the lack of previous events, local knowledge, and no high hazard dams or levees in the area, the overall probability of occurrence is minimal. Jackson County and the City of La Ward are therefore classified as "Low" probability and the Cities of Edna and Ganado are classified as "Not Exposure" due to their location outside of inundation areas.

Table 9-4 below lists the dams in each jurisdiction, as well as dam height, maximum discharge, and storage. A higher discharge and storage area corresponds with a greater extent of damage from a dam failure. High-hazard dams can impact human, economic, and environmental aspects in their inundation and around areas if a failure occurs. This table includes major upstream dams outside of the planning area that may affect Jackson County's participating communities. Due to their distant location from the planning area, the effects of a dam breach are minimized, and would not significantly contribute to damages. The maximum inundation depth for a dam breach would be in line with the height of the dam, as listed in the table below. Small dams in the rural parts of the unincorporated area of the county do not have the data available to predict breach analysis inundation effects on local road crossings. Existing road closure policies and emergency management practices would be used during a failure event. The Lavaca River at Edna has an action stage of 20 feet and a Flood Stage of 21 feet. West Mustang Creek at Ganado has an action stage of 9 feet, and a flood stage of 20 feet. Navidad River at Strane Park has an action stage of 13 feet and a flood stage of 24 feet. Sandy Creek near Cordele has an action stage of 13 feet and a flood stage of 18 feet. Participating communities use gauges for measurements, monitoring of conditions, road closures, and emergency conditions during events. Overall, dam failure impacts would likely be rare and limited in Jackson County, largely affecting the downstream areas during a failure event.

TABLE 9-4.
JACKSON COUNTY AND PARTICIPATING COMMUNITIES DAM EXTENTS

Dam Name	Community	Dam Height (feet)	Max Discharge (cubic feet/second)	Max Storage (acre feet)
HAL KOOP RESERVOIR DAM	Jackson County Unincorporated Area	10	NA	640
PALMETTO BEND DAM	Jackson County Unincorporated Area	93	NA	365,000
BONNOT RESERVOIR NO 1	Jackson County Unincorporated Area	8	NA	72
PRUDENTIAL RESERVOIR NO 1	Jackson County Unincorporated Area	8	NA	536
PRUDENTIAL RESERVOIR NO 2	Jackson County Unincorporated Area	10	NA	140
PRUDENTIAL RESERVOIR NO 3	Jackson County Unincorporated Area	10	NA	140
Outside of Planning Area				
EG GOFF DAM*	Wharton County	9	NA	63
HUTCHINS LAKE DAM*	Wharton County	9	NA	108
BARNES LAKE DAM*	Lavaca County	24	4200	278

Notes:
No Dams within participating community's city limits
*Major Dams upstream of participating Communities (Located outside all planning areas)
Dam data from NID

9.5.1 Population

Exposed populations are all populations downstream from dam failures or behind levees that are incapable of escaping the area within the allowable time frame. This population includes the elderly and young who may be unable to get themselves out of the inundation area. The vulnerable population also includes those who would not have an adequate warning from a television or radio emergency warning system. Table 9-5 lists the exposed structures and population for the participating communities based on the estimated inundation areas.

9.5.2 Property

Exposed properties are those closest to the dam inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since they are where the dam waters would collect. Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues. This includes all roads, railroads, and bridges in the path of the dam inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power, cable, and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

According to HAZUS-MH data analysis, within the participating communities in the HMP update area, there are an estimated 8 buildings (residential, commercial, and other) within the possible risk area. Other types of buildings in this report include agricultural, education, religious, and governmental structures.

TABLE 9-5.
EXPOSED STRUCTURES AND POPULATION

Jurisdiction	Residential	Commercial	Other *	**Total Structures**	**Total Population**
City of Edna	0	0	0	**0**	**0**
City of Ganado	0	0	0	**0**	**0**
City of La Ward	0	0	0	**0**	**0**
Unincorporated Area	8	0	0	**8**	**15**
Jackson County Total	**8**	**0**	**0**	**8**	**15**

Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.

9.5.3 Critical Facilities and Infrastructure

Any critical facilities or infrastructure that are located within a dam inundation area are exposed to risk from the hazard. Dam or levee failure can result in serious structural damage to critical facilities and infrastructure, in particular roads, bridges, underground utilities, and pipelines.

9.5.4 Environment

Reservoirs held behind dams affect many ecological aspects of a river. River topography and dynamics depend on a wide range of flows, but rivers below dams often experience long periods of very stable flow conditions or saw-tooth flow patterns caused by releases followed by no releases. Water releases from dams usually contain very little suspended sediment; this can lead to scouring of river beds and banks.

The environment would be vulnerable to several risks in the event of dam failure. The inundation could introduce many foreign elements into local waterways. This could result in the destruction of downstream habitat and could have detrimental effects on many species of animals.

9.6 VULNERABILITY

Dam failure inundation mapping for the planning area was not available to allow HAZUS-MH loss estimations to be modeled. Due to this data deficiency for dams, annualized losses were estimated using GIS-based analysis, historical data analysis, and statistical risk assessment methodology. Event frequency, severity indicators, expert opinions, and historical local knowledge of the region were used for this assessment. Overall, dam failure impacts would likely be rare and limited in Jackson County and the participating communities, with approximately 10 to 25% of the planning area affected during a failure event. While parts of the county could be affected, the likelihood of this occurring (based on historical events, and local knowledge) is minimal. Roads closed due to dam failure floods could result in serious transportation disruptions due to the limited number of roads in the county.

After profiling and analyzing the dam and levee information (including general background, historical occurrences, extent, exposure, and vulnerability). While some communities have property and population that may be affected by an event due to the local knowledge, lack of previous events, no high hazard dams in the immediate or upstream area, no certified levees affected 100-year floodplain requirements, and the overall probability of a minimal occurrence, the unincorporated area and the City of La Ward were classified as ‘Low’ impact and the cities of Gando and Edna were classified as ‘No Exposure’.

9.6.1 Population

The risk of injury or fatalities as a result of this hazard is limited but possible. The most vulnerable demographics will be the economically disadvantaged population areas, children under 16 years of age, and the elderly. See Table 9-6 for vulnerable populations per participating community in the inundation area.

TABLE 9-6. VULNERABLE POPULATION						
Jurisdiction	Youth Population (< 16)	% of Total Population	Elderly Population (> 65)	% of Total Population	Economically Disadvantage (Income <$20,000)	% of Total Population
City of Edna	0	0	0	0	0	0
City of Ganado	0	0	0	0	0	0
City of La Ward	0	0	0	0	0	0
Unincorporated Area	3	0.05	1	0.02	1	0.02
Jackson County Total	**27**	**0.02**	**13**	**0.01**	**10**	**0.01**

9.6.2 Property

All downstream properties in the inundation area are equally at risk from a dam breach. Loss estimations for dam hazards are not based on HAZUS-MH modeled damage functions, because detailed dam inundation mapping from hydrology and hydraulic modeling was unavailable. Annualized losses were estimated using GIS-based analysis, historical data analysis, and statistical risk assessment methodology. Event frequency, severity indicators, expert opinions, and historical local knowledge of the region were used for this assessment. Table 9-7 lists the property loss estimates for each participating community given exposed building value (including content). Annualized losses of ‘negligible’ are less than $50 annually. Negligible loss hazards are still included despite minimal annualized losses because of the potential for a high-value damaging event.

TABLE 9-7. LOSS ESTIMATES FOR DAM EVENT			
Jurisdiction	Exposed Value	Annualized Loss	Annualized Loss Percentage
City of Edna	$0	Negligible	Negligible
City of Ganado	$0	Negligible	Negligible
City of La Ward	$0	Negligible	Negligible
Unincorporated Area	$1,703,984	Negligible	<0.01
Jackson County Total	**$1,703,984**	**Negligible**	**<0.01**

Vulnerability Narrative

Communities with dams within and/or upstream of their jurisdictions are the most vulnerable. Table 9-6 lists the vulnerable population per community. Table 9-7 lists the estimated annualized losses in dollars for each participating community. The previous tables list the minimally exposed structures to an unlikely event. Based on previous occurrences (0), local knowledge and no high hazard dams in the area, the overall probability of occurrence is minimal and therefore classified as 'Low' for the unincorporated Jackson County and the City of La Ward and 'No Exposure' for the cities of Edna and Ganado.

- **City of Edna -** The City of Edna does not have any documented dams or levees within the city limits. With no known significant or high hazard dams upstream of the City, no known previous events, and local knowledge, the City of Edna is classified as 'No Exposure'.
- **City of Ganado -** The City of Ganado does not have any documented dams or levees within the city limits. With no known significant or high hazard dams upstream of the City, no known previous events, and local knowledge, the City of Ganado is classified as 'No Exposure'.
- **City of La Ward –** The City of La Ward does not have any documented dams or levees within the city limit and one dam, Bonnot Reservoir No. 1, is located upstream of the town. No previous incidents have occurred with this dam and it is unlikely a future event will occur. However, if a breach were to occur, the community could be heavily impacted. Based on a rare possibility of occurrence and local knowledge, the City of Law Ward is classified as 'Low'.
- **Jackson County (Unincorporated Area) –** There are 6 dams in the unincorporated parts of the County; 1 is classified as a high hazard. An event at this dam location would affect those downstream, especially those closest to the creeks. If a major thoroughfare such as US 59 or TX 111 were eroded and caved in as a result of flooding, many residents will be affected and emergency response times would increase. Dam breach events could impact critical facilities and infrastructure further increasing risk to residents. Critical facilities that are not equipped with generators or alternate sources of power increase the risk of these effects. Communities that are unaware of the areas of greater risk are unable to effectively plan appropriate emergency response actions. Areas of the impacted community that only have one evacuation route are more vulnerable if an event were to eliminate their primary means of escape. Community leaders who are not adequately trained or informed in emergency management processes and procedures increase vulnerability as well.

Community Perception of Vulnerability

See the front page of the current chapter for a summary of hazard rankings for Jackson County and participating communities in this plan update. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

9.7 FUTURE TRENDS IN DEVELOPMENT

Land use in the planning area will be directed by general plans. The safety elements of the general plans establish standards and plans for the protection of the community from hazards. Dam or levee failure is not typically addressed as a standalone hazard in the safety elements, but flooding is. The planning partners have established plans and policies regarding sound land use in identified flood hazard areas. Most of the areas vulnerable to the more severe impacts from dam failure are likely to intersect the mapped flood hazard areas. Flood-related policies in the general plans will help to reduce the risk associated with the dam failure hazard for all future development in the planning area.

9.8 SCENARIO

An earthquake in the region (although rare) could lead to liquefaction of soils around a dam or levee. This could occur without warning during any time of the day. A human-caused failure such as a terrorist attack also could trigger a catastrophic failure of a dam or levee that impacts the planning area. While the probability of dam or levee failure is very low, the probability of flooding associated with changes to dam operational parameters in response to climate change is higher. Dam and levee designs and operations are developed based on hydrographs with historical records. If these hydrographs experience significant changes over time due to the impacts of climate change, the design and operations may no longer be valid for the changed condition. This could have significant impacts on dams and levees that provide flood control. Specified release rates and impound thresholds may have to be changed. This would result in increased discharges downstream of these facilities, thus increasing the probability and severity of flooding.

9.9 ISSUES

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

- Federally regulated dams have an adequate level of oversight and sophistication in the development of emergency action plans for public notification in the unlikely event of failure. However, the protocol for notification of downstream citizens of imminent failure needs to be tied to local emergency response planning.
- Mapping for federally regulated dams is already required and available; however, mapping for non-federally regulated dams that estimates inundation depths is needed to better assess the risk associated with dam failure from these facilities.
- Most dam failure mapping required at federal levels requires determination of the PMF. While the PMF represents a worst-case scenario, it is generally the event with the lowest probability of occurrence. For non-federally regulated dams, mapping of dam failure scenarios that are less extreme than the PMF but have a higher probability of occurrence can be valuable to emergency managers and community officials downstream of these facilities. This type of mapping can illustrate areas potentially impacted by more frequent events to support emergency response and preparedness.
- The concept of residual risk associated with structural flood control projects should be considered in the design of capital projects and the application of land use regulations.
- Security concerns should be addressed and the need to inform the public of the risk associated with dam failure is a challenge for public officials.

Chapter 10.
Drought and Extreme Heat

DROUGHT AND EXTREME HEAT RANKING		
Jurisdiction	**Drought**	**Extreme Heat**
Jackson County	High	Medium
City of Edna	High	Medium
City of Ganado	High	High
City of La Ward	High	High

DEFINITIONS	
Drought	The cumulative impacts of several dry years on water users. It can include deficiencies in surface and subsurface water supplies and generally impacts health, well-being, and quality of life.
Extreme Heat	Summertime weather that is substantially hotter or more humid than average for a location at that time of year.

10.1 GENERAL BACKGROUND

10.1.1 Drought

Drought is a normal phase in the climatic cycle of most geographical areas. According to the National Drought Mitigation Center, drought originates from a deficiency of precipitation over an extended period, usually a season or more. This results in a water shortage for some activity, group, or environmental sector. Drought is the result of a significant decrease in water supply relative to what is "normal" in a given location. Unlike most disasters, droughts normally occur slowly but last a long time. There are four generally accepted operational definitions of drought (Wilhite and Glantz, 1985):

- **Meteorological drought** is an expression of precipitation's departure from normal over some period of time. Meteorological measurements are the first indicators of drought. Definitions are usually region-specific and based on an understanding of regional climatology. A definition of drought developed in one part of the world may not apply to another, given the wide range of meteorological definitions.
- **Agricultural drought** occurs when there is not enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought happens after a meteorological drought but before a hydrological drought. Agriculture is usually the first economic sector to be affected by drought.
- **Hydrological drought** refers to deficiencies in surface and subsurface water supplies. It is measured as stream flow and as lake, reservoir, and groundwater levels. There is a time lag between the lack of rain and the volume of water in streams, rivers, lakes, and reservoirs, so hydrological measurements are not the earliest indicators of drought. After precipitation has been reduced or deficient over an extended period of time, this shortage is reflected in declining surface and subsurface water levels.

Water supply is controlled not only by precipitation, but also by other factors, including evaporation (which is increased by higher-than-normal heat and winds), transpiration (the use of water by plants), and human use.

- **Socioeconomic drought** occurs when a physical water shortage starts to affect people, individually and collectively. Most socioeconomic definitions of drought associate it with the supply and demand of an economic good.

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

10.1.2 Extreme Heat

Excessive heat events are defined by the Environmental Protection Agency (EPA) as “summertime weather that is substantially hotter or more humid than average for a location at that time of year” (EPA, 2016). Criteria that define an excessive heat event may differ among jurisdictions and in the same jurisdiction depending on the time of year. Excessive heat events are often a result of more than just ambient air temperature. Heat index tables, such as that defined by the National Oceanic and Atmospheric Administration (NOAA) in Figure 10-1, are commonly used to provide information about how hot it feels, which is based on the interactions between several meteorological conditions. Since heat index values were devised for shady, light wind conditions, exposure to full sunshine can increase heat index values by up to 15 degrees Fahrenheit (°F). Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

Figure 10-1. Heat Index Table

NWS Heat Index — Temperature (°F)

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

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

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

Note: From NOAA National Weather Service

10.2 HAZARD PROFILE

Droughts originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (a few weeks or a couple of months), the drought is considered short-term. If the weather pattern becomes entrenched and the precipitation deficits last for several months or years, the drought is considered to be long-term. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that result in short-term wet spells. Likewise, a long-term wet circulation pattern can be interrupted by short-term weather spells that result in short-term drought.

Precipitation into area lakes and dams is the main source of Texas' water supply. Precipitation is the only naturally reoccurring/renewable water supply for Jackson County. Annual precipitation in the populated areas of the planning area is approximately 42 inches per year. Various streams and tributaries contribute to the water supply in the area. This supply is stored in four forms throughout the state: streamflow, reservoir water, soil moisture, and groundwater.

The summer months in Texas are frequently affected by severe heat hazards. Persistent domes of high pressure establish themselves, which set up hot and dry conditions. This high pressure prevents other weather features such as cool fronts or rain events from moving into the area and providing necessary relief. Daily high temperatures range into the upper 90s and low 100s. When combined with moderate to high relative humidity levels, the heat index moves into dangerous levels, and a heat index of 105°F is considered the level where many people begin to experience extreme discomfort or physical distress.

10.2.1 Past Events

Drought

Texas officially experienced the driest nine-month period in the state's history between October 2010 and June 2011 according to the National Weather Service (NWS) in Fort Worth. This beat the previous record of June 1917 to February 1918. The substantial dry period led to widespread extreme to exceptional drought conditions throughout the state. The 2010-2011 drought neared record levels, ranking as the third-worst in Texas history. The worst of the 2010-2011 drought was in central and western Texas where precipitation deficits during the 10 months exceeded 20 inches in some areas.

Based on previous occurrences, drought conditions in South Texas counties, such as Jackson County (and participating communities), are usually limited; typically with periods of dryness and moderate drought. Figure 10-2 and Figure 10-3 show the severity of drought conditions in Texas in spring 2012 and spring 2015. In March 2015, portions of Jackson County (and participating communities) were still experiencing D0 and D1 drought conditions. However, the drought conditions changed in May 2015 with heavy spring rains falling over the Texas region. Texas received a statewide average of 8.81 inches of rain in May 2015, exceeding the previous record wet month of June 2004 during which a statewide average of 6.66 inches of rain fell, according to the Office of the State Climatologist at Texas A&M University. The Texas region received more rain in the first 5 months of 2015 than in all of 2011.

Figure 10-4 shows the drought conditions in June of 2015. This was the first time in 5 years that none of the state fell within the U.S. Drought Monitor's most severe classification. Almost all of Jackson County (and participating communities) had no longer experienced drought and area reservoirs were 100% full or experienced large capacity gains during the spring and early summer of 2015.

Figure 10-5 shows the state's drought conditions for March 2020. This was the first time in 8 years that Jackson County experienced a level D3 extreme drought. Figure 10-6 shows the state's drought conditions as of April 2021. Jackson County has shown abnormally dry to moderate drought conditions since the previous year.

The National Drought Mitigation Center developed the Drought Impact Reporter in response to the need for a national drought impact database for the United States. Information comes from a variety of sources: online drought-related news stories and scientific publications, members of the public who visit the website and submit a drought-related impact for their region, members of the media, and members of relevant government agencies. The database is being populated beginning with the most recent impacts and working backward in time. Since drought impacts affect large areas across multiple counties, the impacts affect Jackson County and participating communities equally.

Figure 10-2. U.S. Drought Monitor, March 27, 2012

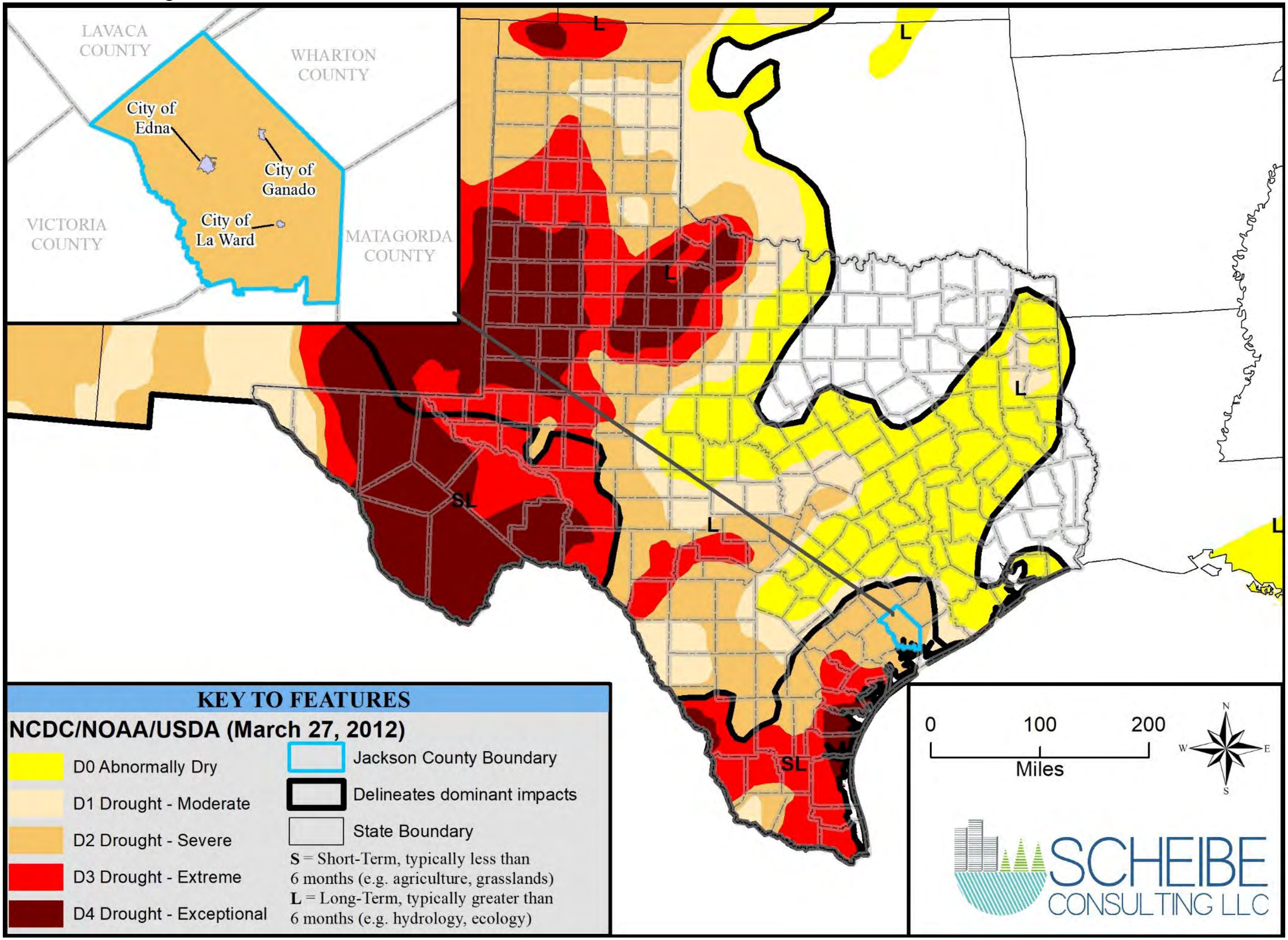


Figure 10-3. U.S. Drought Monitor, March 17, 2015

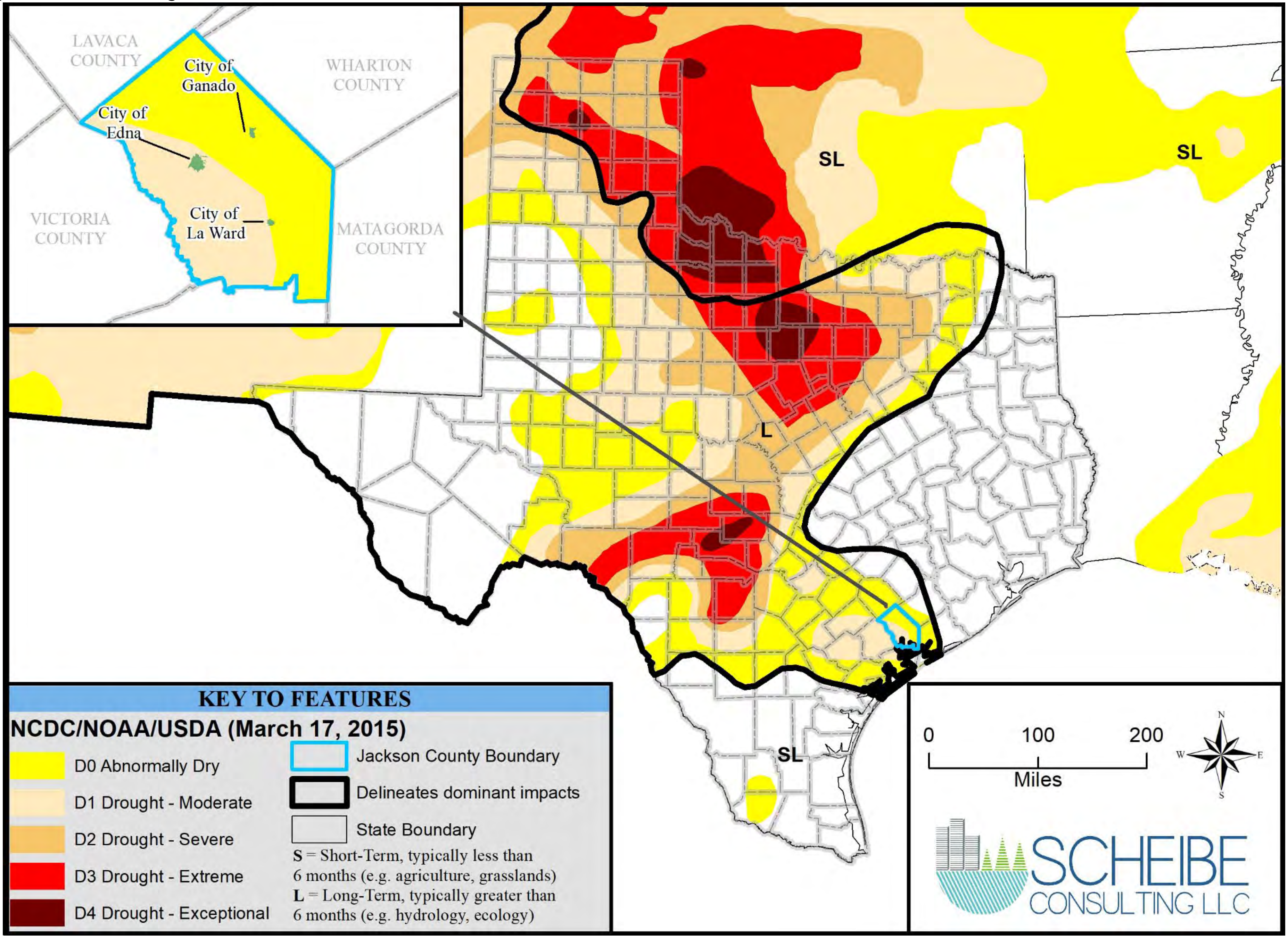


Figure 10-4. U.S. Drought Monitor, June 16, 2015

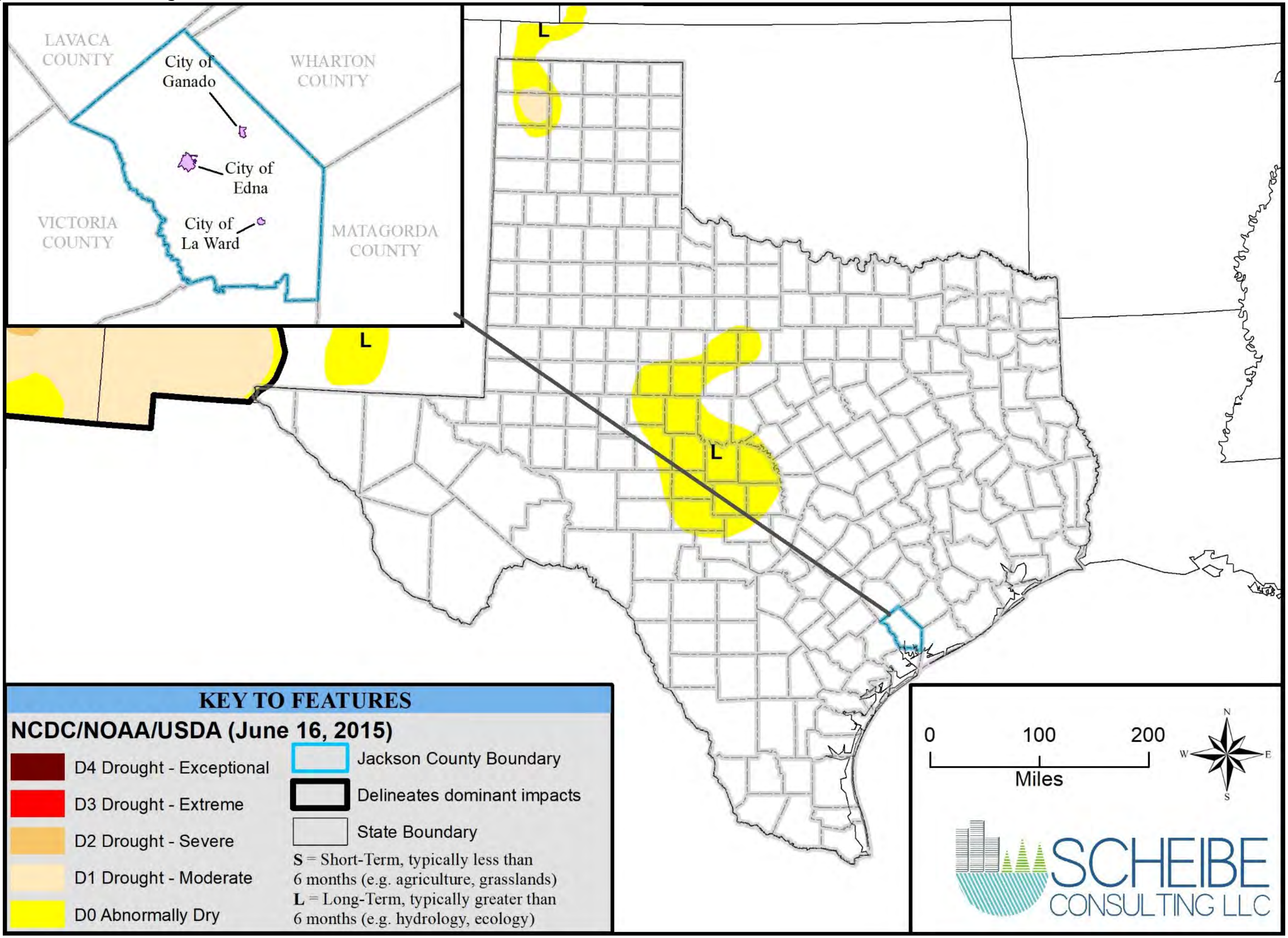


Figure 10-5. U.S. Drought Monitor, March 17, 2020

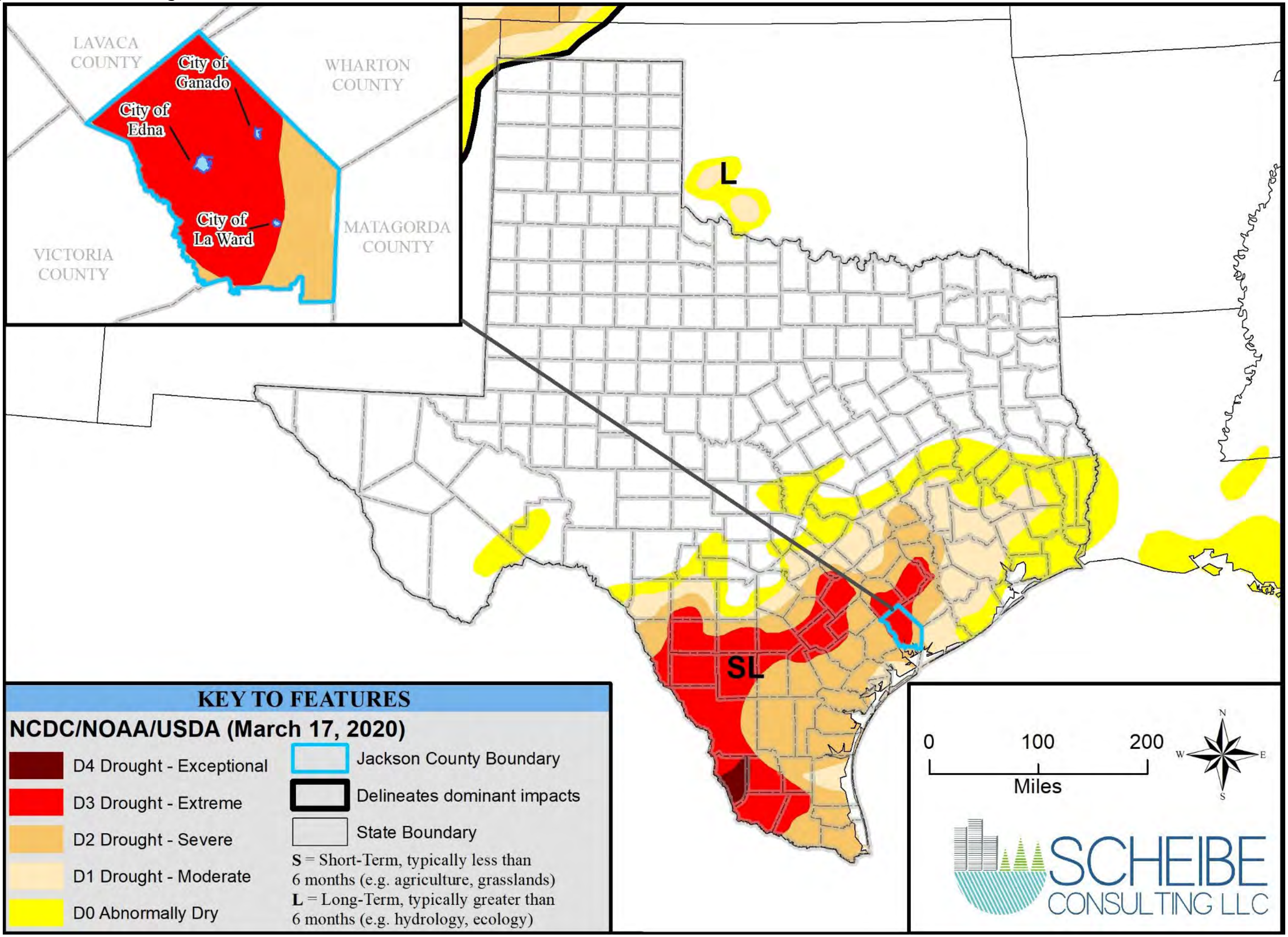
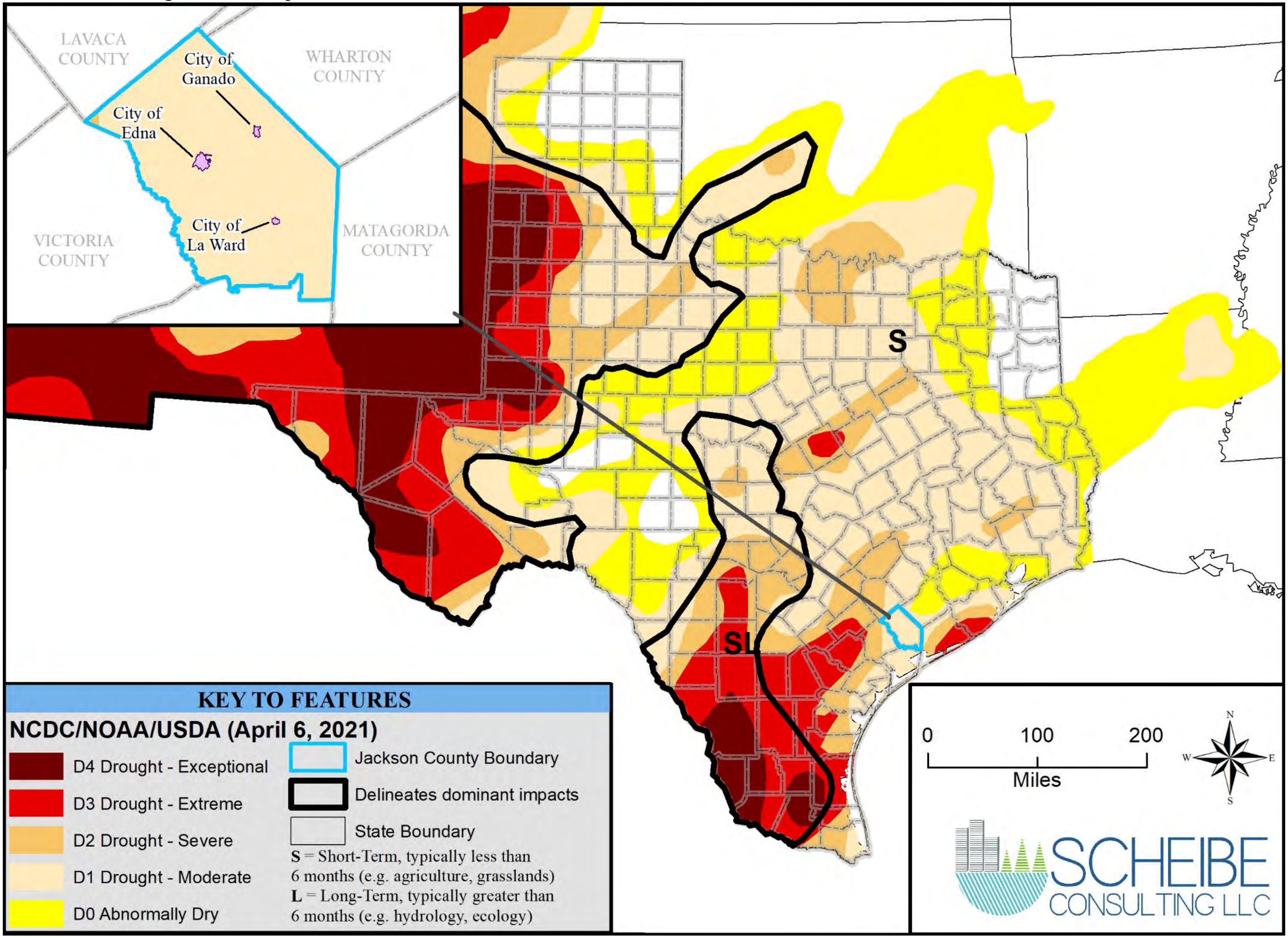


Figure 10-6. U.S. Drought Monitor, April 6, 2021



The Drought Impact Reporter

The Drought Impact Reporter contains information on impacts from droughts that affected Jackson County and participating communities between January 2005 and April 2021. Most of the impacts were classified as "agriculture" (1,506). Other impacts include "society and public health" (242), "fire" (911), "tourism and recreation" (89), "water supply and quality" (903), "energy" (18), "business and industry" (62), "plants and wildlife" (894), and "relief, response, and restrictions" (699). These categories are described as follows:

- **Agriculture** – Drought effects associated with agriculture, farming, aquaculture, horticulture, forestry, or ranching. Examples of drought-induced agricultural impacts include damage to crop quality; income loss for farmers due to reduced crop yields; reduced productivity of cropland; insect infestation; plant disease; increased irrigation costs; cost of new or supplemental water resource development (wells, dams, pipelines) for agriculture; reduced productivity of rangeland; forced reduction of foundation stock; closure/limitation of public lands to grazing; high cost or unavailability of water for livestock, Christmas tree farms, forestry, raising domesticated horses, bees, fish, shellfish, or horticulture.
- **Society and Public Health** – Drought effects associated with human, public, and social health include health-related problems related to reduced water quantity or quality, such as increased concentration of contaminants; loss of human life (e.g., from heat stress, suicide); increased respiratory ailments; increased disease caused by wildlife concentrations; increased human disease caused by changes in insect carrier populations; population migration (rural to urban areas, migrants into the United States); loss of aesthetic values; change in daily activities (non-recreational, like putting a bucket in the shower to catch water); elevated stress levels; meetings to discuss drought; communities creating drought plans; lawmakers altering penalties for violation of water restrictions; demand for higher water rates; cultural/historical discoveries from low water levels; cancellation of fundraising events; cancellation/alteration of festivals or holiday traditions; stockpiling water; public service announcements and drought information websites; protests; and conflicts within the community due to competition for water.
- **Fire** – Drought often contributes to forest, range, rural, or urban fires, fire danger, and burning restrictions. Specific impacts include enacting or increasing burning restrictions; fireworks bans; increased fire risk; occurrence of fire (number of acres burned, number of wildfires compared to average, people displaced, etc.); state of emergency during periods of high fire danger; closure of roads or land due to fire occurrence or risk; and expenses to state and county governments of paying firefighters overtime and paying equipment (helicopter) costs.
- **Tourism and Recreation –** Drought effects associated with recreational activities and tourism include the closure of state hiking trails and hunting areas due to fire danger; water access or navigation problems for recreation; bans on recreational activities; reduced license, permit, or ticket sales (e.g., hunting, fishing, ski lifts, etc.); losses related to curtailed activities (e.g., bird watching, hunting and fishing, boating, etc.); reduced park visitation; and cancellation or postponement of sporting events.
- **Water Supply and Quality** – Drought effects associated with water supply and water quality include dry wells; voluntary and mandatory water restrictions; changes in water rates; increasing water restrictions; increases in requests for new well permits; changes in water use due to water restrictions; greater water demand; decreases in water allocation or allotments; installation or alteration of water pumps or water intakes; changes to allowable water contaminants; water line damage or repairs due to

drought stress; drinking water turbidity; change in water color or odor; declaration of drought watches or warnings; and mitigation activities.

- **Energy** – Drought effects on power production, rates, and revenue include production changes for both hydropower and non-hydro power providers; changes in electricity rates; revenue shortfalls and/or windfall profits; and purchase of electricity when hydropower generation is down.
- **Business and Industry** – Drought effects on non-agriculture and non-tourism businesses, such as lawn care; recreational vehicles or gear dealers; and plant nurseries. Typical impacts include reduction or loss of demand for goods or services; reduction in employment; variation in the number of calls for service; late opening or early closure for the season; bankruptcy; permanent store closure; and other economic impacts.
- **Plants and Wildlife** – Drought effects associated with unmanaged plants and wildlife, both aquatic and terrestrial, include loss of biodiversity of plants or wildlife; loss of trees from rural or urban landscapes, shelterbelts, or wooded conservation areas; reduction and degradation of fish and wildlife habitat; lack of feed and drinking water; greater mortality due to increased contact with agricultural producers as animals seek food from farms and producers are less tolerant of the intrusion; disease; increased vulnerability to predation (from species concentrated near water); migration and concentration (loss of wildlife in some areas and too much wildlife in others); increased stress on endangered species; salinity levels affecting wildlife; wildlife encroaching into urban areas; and loss of wetlands.
- **Relief, Response, and Restrictions** – Drought effects associated with disaster declarations, aid programs, requests for disaster declaration or aid, water restrictions, or fire restrictions. Examples include disaster declarations; aid programs; USDA Secretarial disaster declarations; Small Business Association disaster declarations; government relief and response programs; state-level water shortage or water emergency declarations; county-level declarations; a declared "state of emergency;" requests for declarations or aid; non-profit organization-based relief; water restrictions; fire restrictions; NWS Red Flag warnings; and declaration of drought watches or warnings.

Extreme Heat

According to a 2016 EPA study, a total of more than 9,000 Americans suffered heat-related deaths between 1979 and 2010. The 2012 Natural Resource Defense Council study of 40 major U.S. cities showed that the historic average mortality per summer was 1,332 between 1975 and 2004. This reveals that annually more people in the U.S. die from severe summer heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.

According to the National Climatic Data Center (NCDC), a strong heatwave affected Texas in the summers of 1999, 2000, and 2011. During these heatwaves, multiple counties suffered in terms of injuries and deaths, mostly to the elderly. During these periods, some Texas counties also experienced extreme heat events. Table 10-1 contains temperature summaries related to extreme heat for Jackson County recorded by the Palacios Municipal Airport weather station. Jackson County does not contain a weather station with continuous data, so the nearest weather station was chosen as the source for climate data for the planning area. NOAA weather station climate data consists of information collected from February 1943 to August 2021. These temperatures are experienced throughout the entire planning area (City of Edna, City of Ganado, City of La Ward, and Jackson County Unincorporated Areas).

TABLE 10-1. MAXIMUM TEMPERATURE DATA SUMMARIES													
Statistic	**Years**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Highest Recorded Maximum	1943-2021	82	88	88	96	98	104	101	101	107	95	92	84
Highest Recorded Minimum	1943-2021	70	70	74	78	84	86	86	87	87	83	77	73
Average Maximum	1943-2021	63.4	66.4	72.2	78.3	83.9	88.8	90.6	91.4	88.5	82.1	73.1	66.0
Average Days with a Maximum Above 90	1943-2021	0.0	0.0	0.0	0.2	0.5	7.7	17.1	21.4	10.2	1.0	0.0	0.0

Notes:
Temperatures are in degrees Fahrenheit
From NOAA Weather Station Climate Data (February 1943– August 2021)

10.2.2 Location

Drought

NOAA has developed several indices to measure drought impacts and severity and to map their extent and locations:

- The Palmer Crop Moisture Index measures short-term (up to 4 weeks) and is used to quantify drought's impacts on agriculture during the growing season. The index can vary significantly from week to week and indicates normal conditions at the beginning and end of the growing season. Figure 10-7 shows this index for the week ending on April 17, 2021.
- The Palmer Z Index measures short-term drought on a monthly scale. Figure 10-8 shows this index for March 2021.
- The Palmer Drought Index (PDI) measures the duration and intensity of long-term drought-inducing circulation patterns. Long-term drought is cumulative, so the intensity of drought during a given month is dependent on the current weather patterns plus the cumulative patterns of previous months. Weather patterns can change quickly from a long-term drought pattern to a long-term wet pattern, and the PDI can respond fairly rapidly. Figure 10-9 and Figure 10-10 show the PDI for March 2014 and May 2015 showing the change in PDI after the substantial rainfall in May 2015. Figure 10-11 shows the most current index of March 2021.
- The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop and it takes longer to recover from them. The Palmer Hydrological Drought Index (PHDI), another long-term index, was developed to quantify hydrological effects. The PHDI responds more slowly to changing conditions than the PDI. Figure 10-12 shows this index for March 2021.
- While the Palmer indices consider precipitation, evapotranspiration, and runoff, the Standardized Precipitation Index (SPI) considers only precipitation. In the SPI, an index of zero indicates the median precipitation amount; the index is negative for drought and positive for wet conditions. The SPI is computed for time scales ranging from 1 month to 24 months. Figure 10-13 shows the 24-month SPI map from April 2019 through March 2021.

Figure 10-7. Crop Moisture Index (Week Ending April 17, 2021)

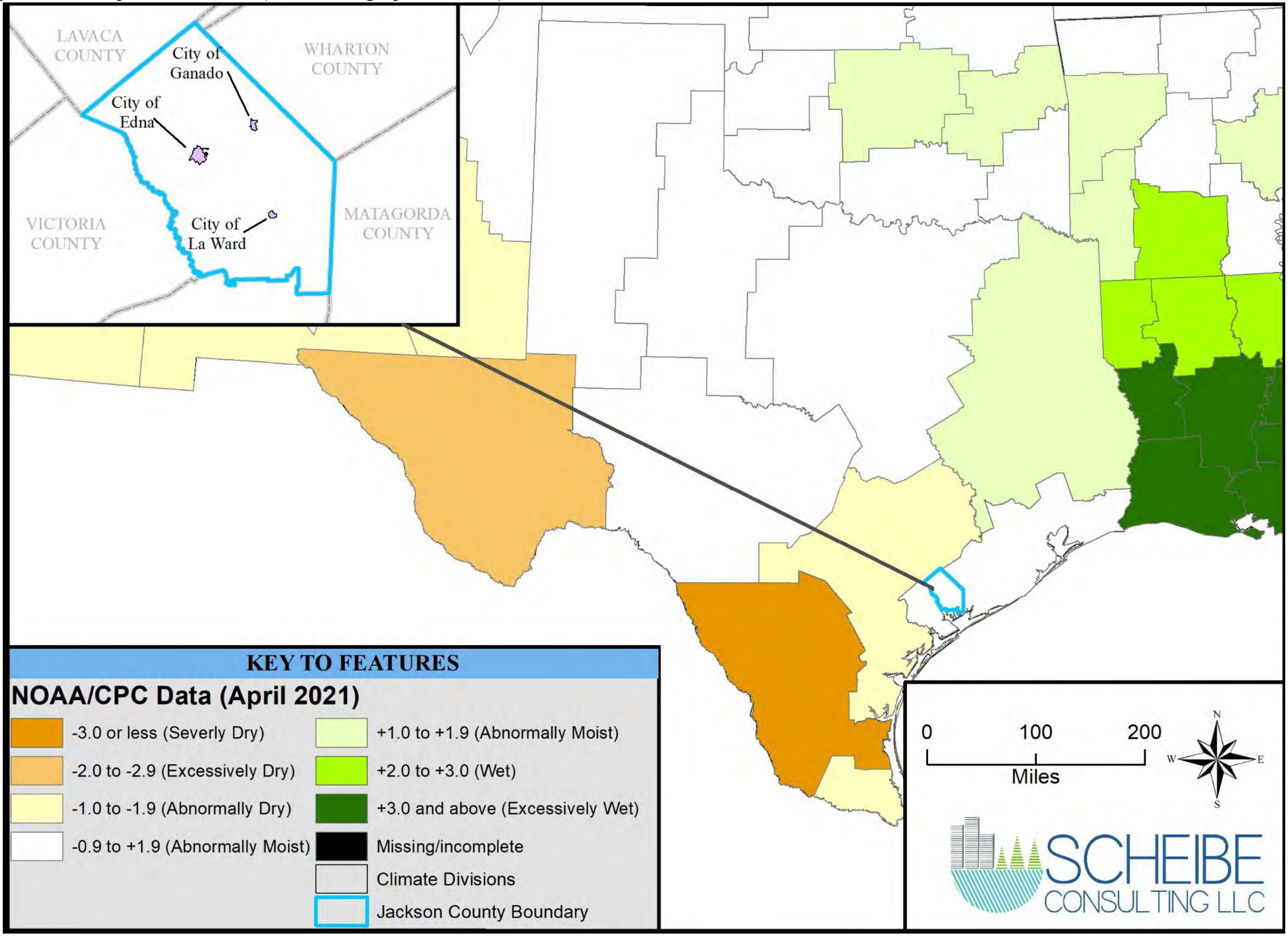


Figure 10-8. Palmer Z Index Short-Term Drought Conditions (March 2021)

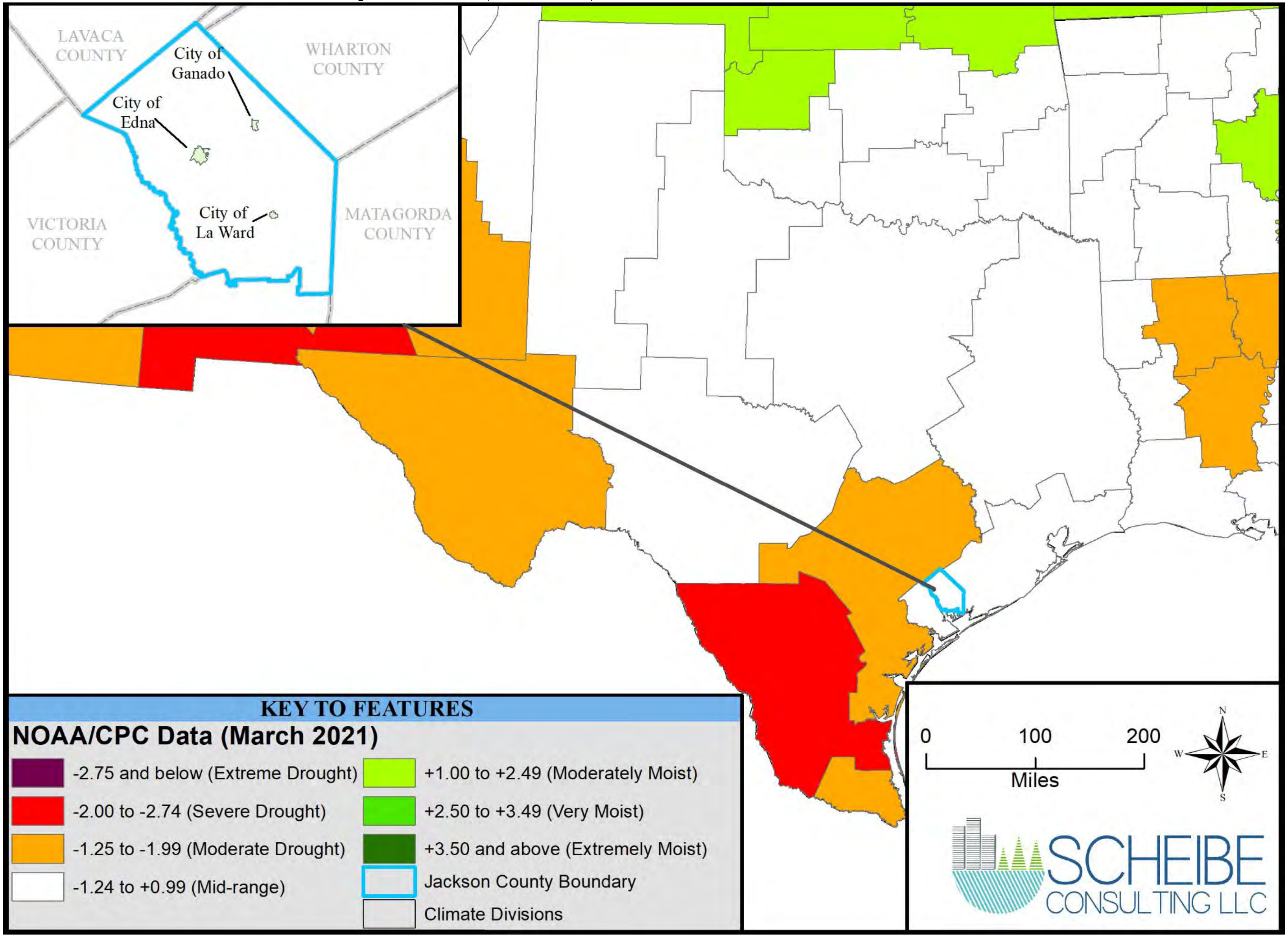


Figure 10-9. Palmer Drought Severity Index (March 2014)

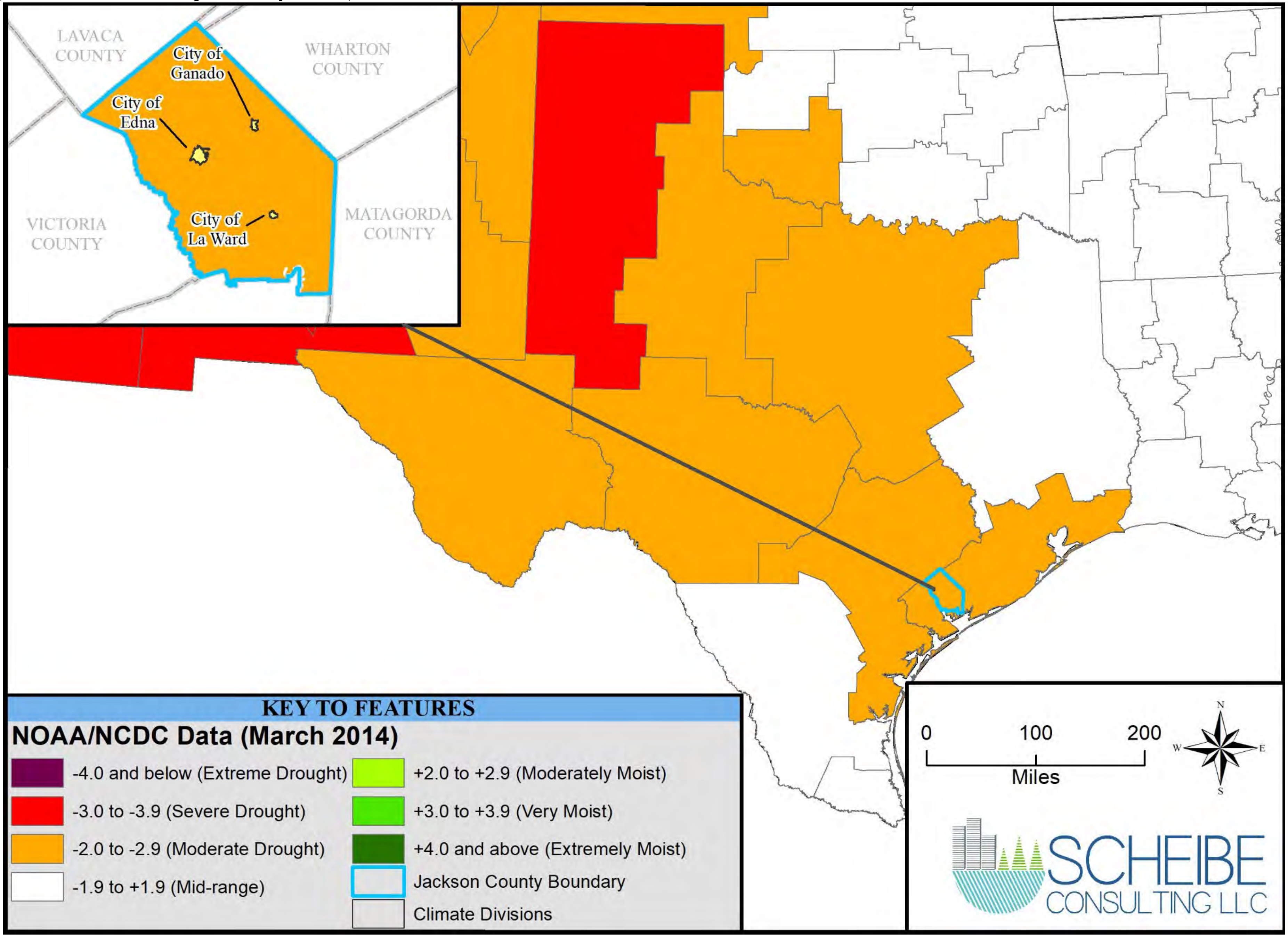


Figure 10-10. Palmer Drought Severity Index (May 2015)

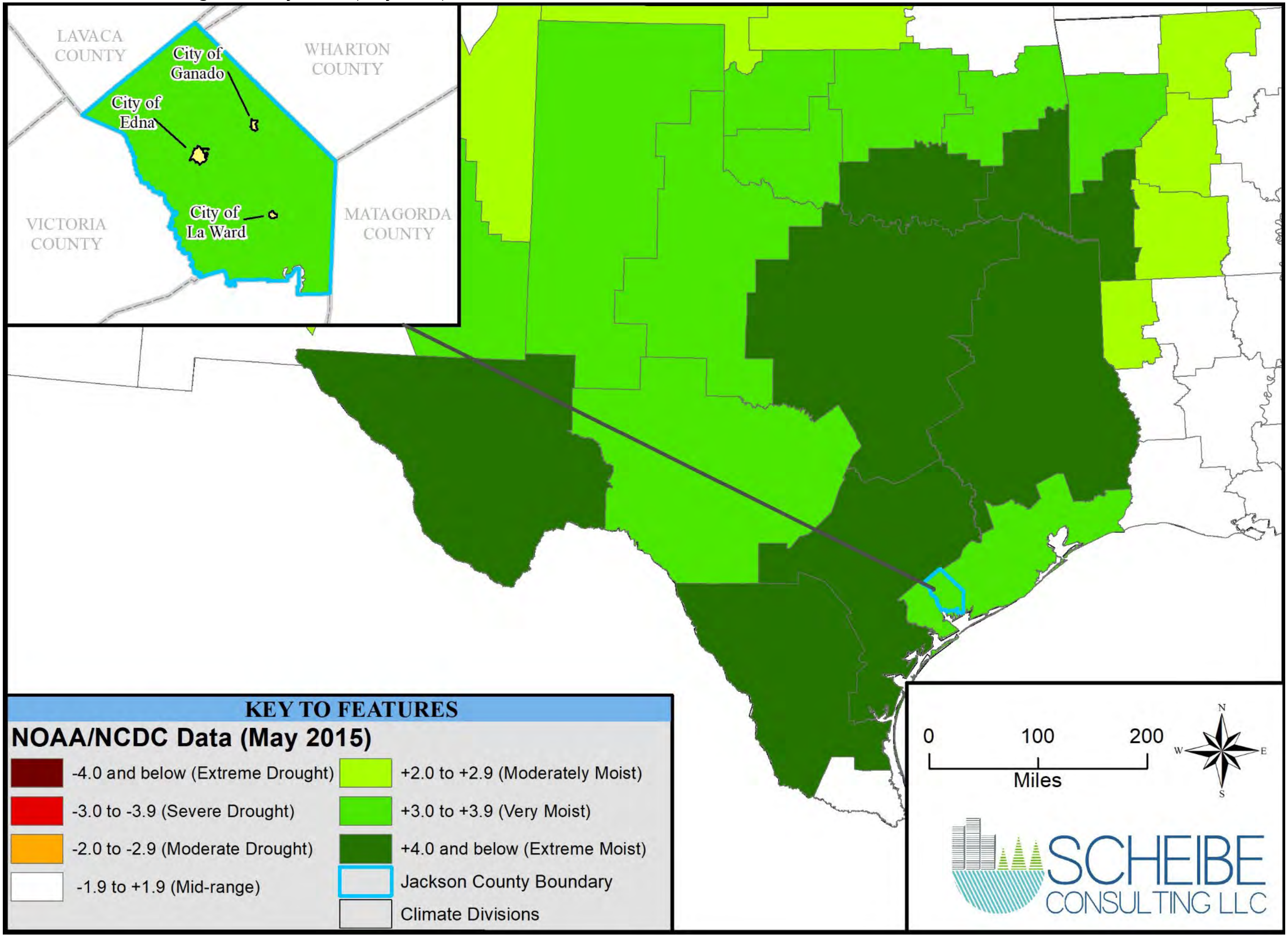


Figure 10-11. Palmer Drought Severity Index (March 2021)

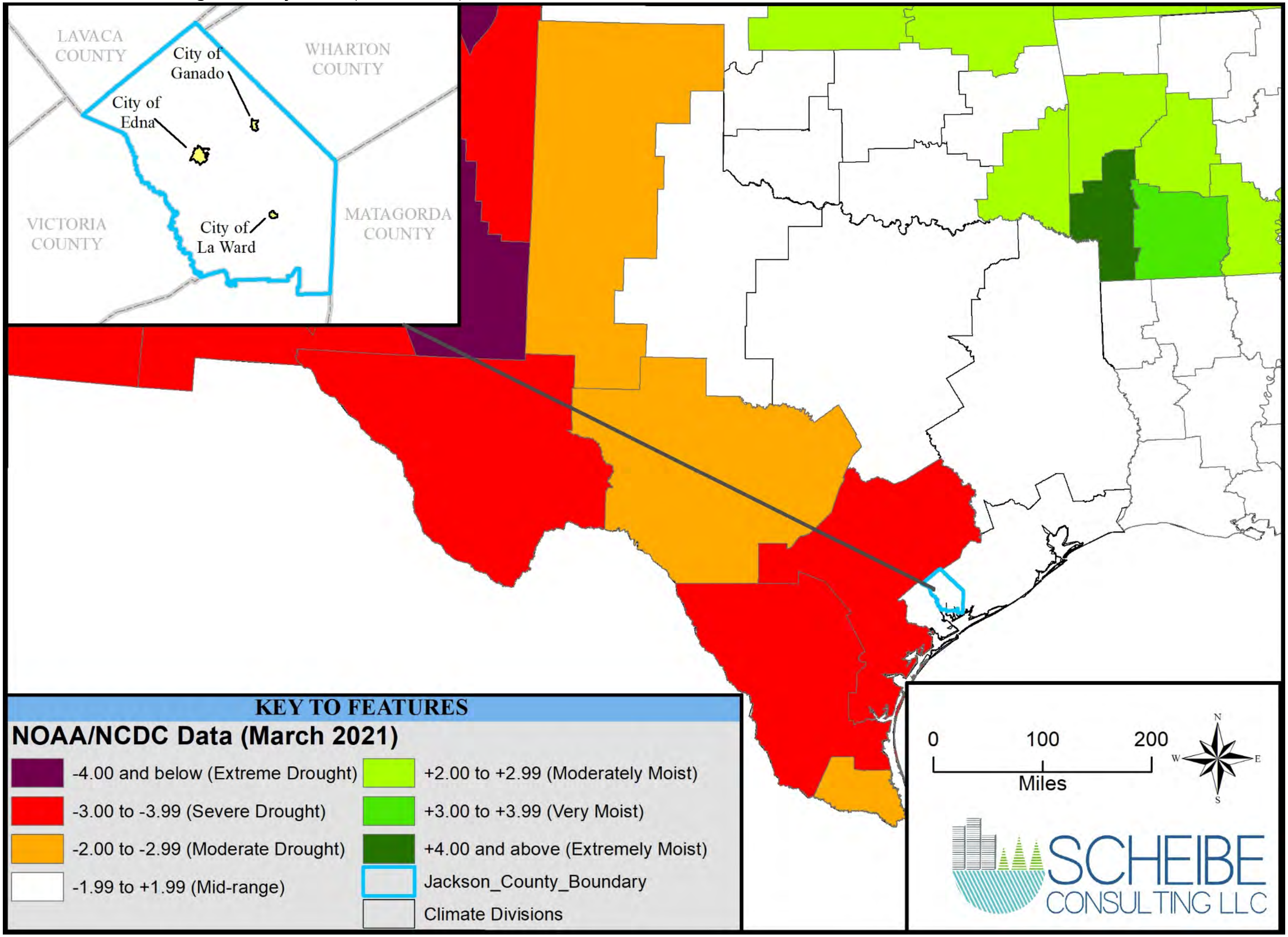


Figure 10-12. Palmer Hydrological Drought Index Long-Term Hydrologic Conditions (March 2021)

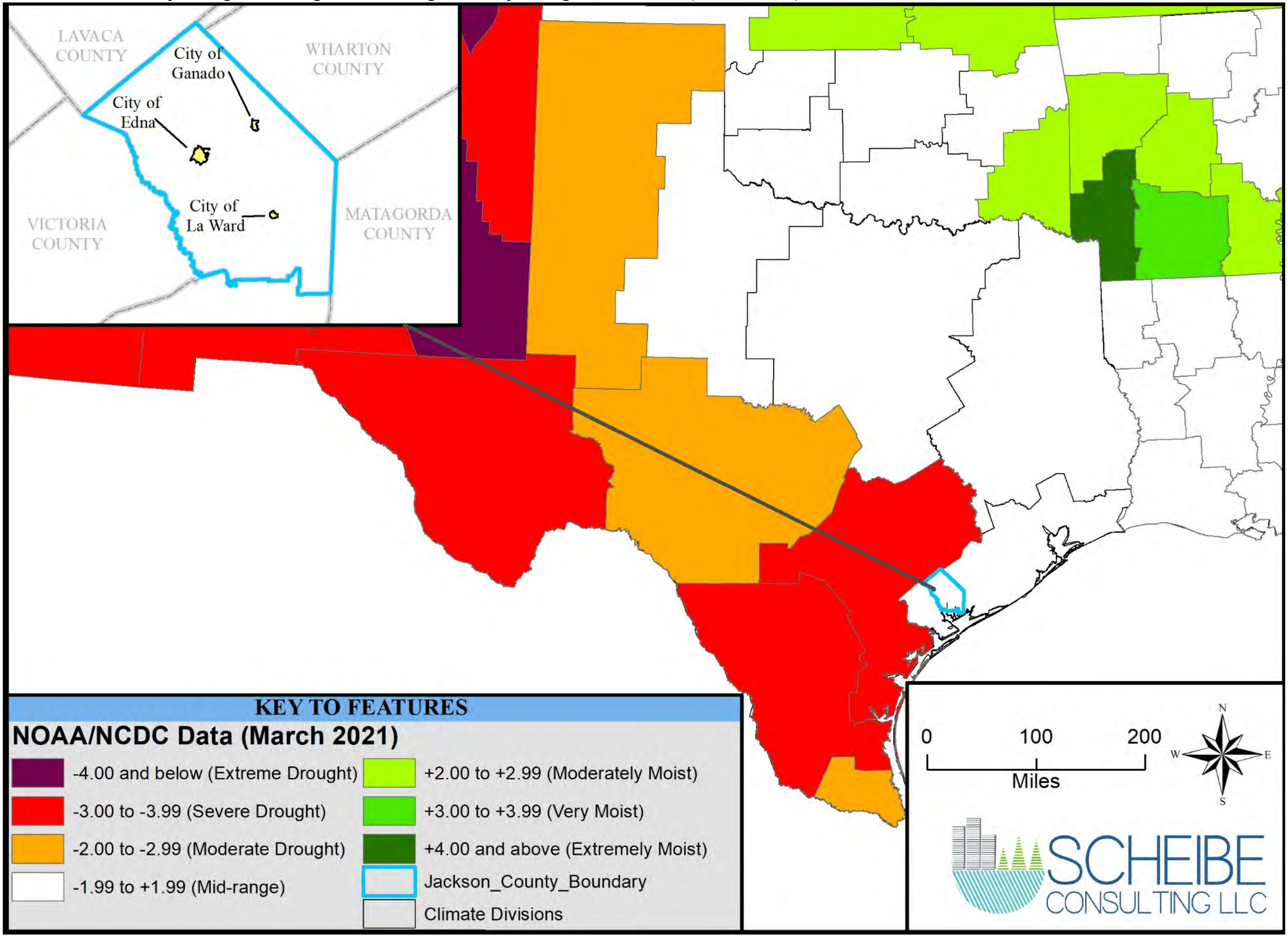
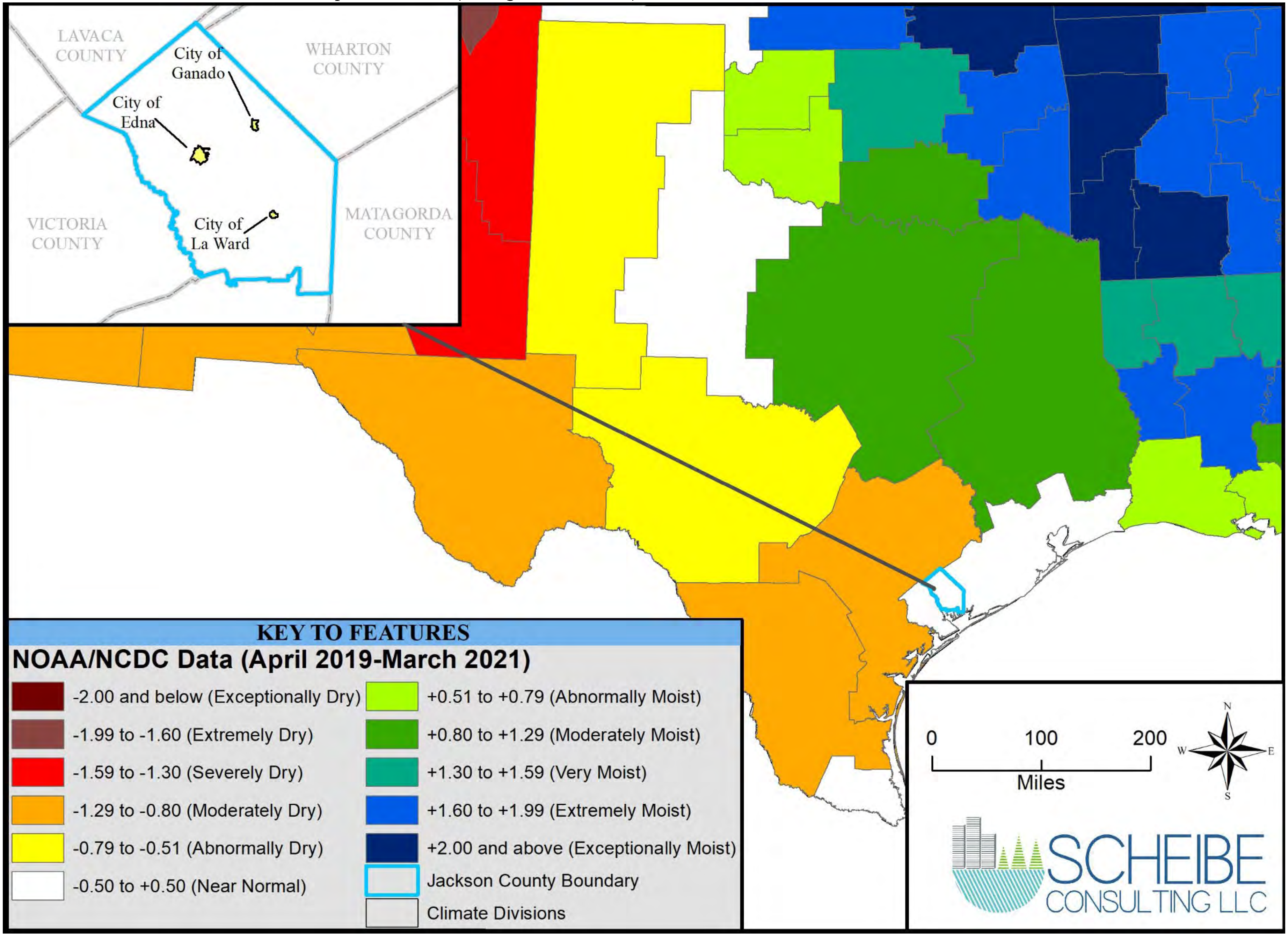


Figure 10-13. 24-Month Standardized Precipitation Index (through March 2021)



Because of Texas's humid, subtropical to semiarid conditions, drought is a regular but unpredictable occurrence in the state. However, because of natural variations in climate and precipitation sources, it is rare for all of Texas to be deficient in moisture at the same time. Single-season droughts over some portions of the state are quite common. From 1950 to 1957, Texas experienced the most severe drought in recorded history. By the time the drought ended, 244 of Texas' 254 counties had been declared federal disaster areas. In 2011, Texas experienced its most intense single-year drought in recorded history.

Droughts occur regularly in South Texas and are a normal condition. However, they can vary greatly in their intensity and duration. The entire HMP update area is at risk of drought conditions. Drought is one of the few hazards that have the potential to directly or indirectly impact every person in the participating communities as well as adversely affect the local economy. Table 10-2 lists past drought events for Jackson County and the participating communities in this HMP update.

TABLE 10-2.
HISTORIC DROUGHT EVENTS IN JACKSON COUNTY (1996-2021)

Date	Estimated Damage Cost		Injuries	Deaths
	Property	Crops		
April 1996	$0	$0	0	0
May 1996	$0	$0	0	0
June 1996	$0	$0	0	0
May 1998	$0	$0	0	0
June 1998	$0	$0	0	0
July 1998	$0	$0	0	0
August 1998	$910,722	$6,648,273	0	0
August 2000	$0	$0	0	0
September 2000	$0	$0	0	0

Extreme Heat

The entire planning area is at risk of extreme heat events. However, these events may be exacerbated in urban areas, where reduced airflow, reduced vegetation, and increased generation of waste heat can contribute to temperatures that are several degrees higher than that experienced in surrounding rural areas (Jackson County Unincorporated Areas) or less urbanized areas. This phenomenon is known as the urban heat island effect. This can happen in the City of Edna, the City of Ganado, and the City of La Ward as well as other more densely populated areas in unincorporated Jackson County.

The record highs for Texas occur from May through October. Jackson County (and participating communities) area experiences an average of seven days with temperatures 100°F and above during these months, according to data recorded by the NWS between 2000 and 2014. In June of 2021, Texas experienced the hottest summer in U.S. history with an average temperature of 86.8°F. The planning area experienced more than 40 days with temperatures 100°F and above in 2011. Figure 6-3 shows the annual average maximum temperature distribution in Texas.

Even though the NCDC storm events database doesn't list any documented specific past events for extreme heat, the local participating communities in this HMP update report that extreme heat days do occur a few days in the year during the summer months.

10.2.3 Frequency

Drought

The probability of future drought in Jackson and participating communities is likely, with an event possible in the next 8 years or less. According to information from the NCDC, Jackson County had 3 documented drought years between 1996 and 2021. Based on this historical information, the probability of a drought occurring in any given year is 12% (About 1 in 8 years). The same frequency (1 in 8 years) applies to the future probability. The level of probability for the entire community is therefore classified as 'High'.

Short-duration droughts occur much more frequently. Various studies indicate that drought occurrence in Texas is expected to increase in frequency and will continue to be an inevitable factor in the climate of Texas. Furthermore, since drought affects a large area (more regional than city-specific) historical analyses are applied to all participating communities equally.

Extreme Heat

On average, Jackson County and participating communities have experienced an average of 78 days per year where temperatures exceed 90°F, so the frequency of extreme heat events is expected to be very likely in any given year (per weather station data). This level of heat is considered an extreme danger for the area due to the moderate to high humidity levels combined with 90°F dry bulb temperature to resulting in a heat index above 105°F. Jackson County and participating communities can expect similar numbers in the future (78 days per year is highly likely). Due to the high number of days expected to be above 90°F, the probability for extreme heat is classified as 'High' for the entire planning area.

10.2.4 Severity

Drought

Drought impacts are wide-reaching and may be economic, environmental, or societal. The most significant impacts associated with drought in Texas are those related to water-intensive activities such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. An ongoing drought may leave an area more prone to wildfires. Drought conditions can also cause soil to compact, increasing an area's susceptibility to flooding, and reduce vegetation cover, which exposes soil to wind and erosion. A reduction of electric power generation and water quality deterioration are also potential problems. Drought impacts increase with the length of a drought, as carry-over supplies in reservoirs are depleted and water levels in streams and groundwater decline.

According to the information in this hazard profile, drought impacts on Jackson County could be considered moderate. Moderate drought typically means less than 25% to 50% of property (mainly agricultural) is severely damaged; injuries/illnesses are treatable or do not result in permanent disability; crop fields become withered; cattle herds are thinned; and for coastal communities, fishermen net light loads. Due to the low probability of severe drought, the overall significance is considered moderate with significant potential impact. Drought can have a widespread impact on the environment and the economy, depending upon its severity, although it typically does not result in loss of life or damage to property, as do other natural disasters. The National Drought Mitigation Center uses three categories to describe likely drought impacts:

- **Agricultural** – Drought threatens crops that rely on natural precipitation.
- **Water supply** – Drought threatens supplies of water for irrigated crops and communities.
- **Fire hazard** – Drought increases the threat of wildfires from dry conditions in forests and rangelands.

On average, the nationwide annual impacts of drought are greater than the impacts of any other natural hazard. They are estimated to be between $6 billion and $8 billion annually in the United States and occur primarily in the agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts.

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts are not usually associated with direct impacts on people or property, but they can have significant impacts on agriculture, which can impact people indirectly.

When measuring the severity of droughts, analysts typically look at economic impacts on a planning area. A drought directly or indirectly impacts all people in the affected areas. All people could pay more for water if utilities increase their rates due to shortages. Agricultural impacts can result in loss of work for farm workers and those in related food processing jobs. Other water- or electricity-dependent industries are commonly forced to shut down all or a portion of their facilities, resulting in further layoffs. A drought can harm recreational companies that use water (e.g., swimming pools, water parks, and river rafting companies) as well as landscape and nursery businesses because people will not invest in new plants if water is not available to sustain them.

Drought generally does not affect groundwater sources as quickly as surface water supplies, but groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. Reduced replenishment of groundwater affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when stream flows are lowest.

Additionally, there is an increased danger of wildfires associated with most droughts. Millions of board feet of timber have been lost due to drought, and in many cases, erosion has occurred, which caused serious damage to aquatic life, irrigation, and power production by heavy silting of streams, reservoirs, and rivers.

Extreme Heat

Drought is often accompanied by extreme heat. When temperatures reach 90ºF and above, people are vulnerable to heat cramps, heat exhaustion, and heatstroke. Pets and livestock are also vulnerable to heat-related injuries. Crops can be vulnerable as well.

Based on the information in this hazard profile, the magnitude/severity of extreme temperatures is considered moderate. This is defined as less than 25% to 50% of property (mainly agricultural) is severely damaged, or injuries/illnesses are treatable or do not result in permanent disability. Due to the expansive nature of soils in this area, extreme heat could pose foundation issues. Overall significance is considered minimal: moderate potential impact.

10.2.5 Warning Time

Drought

Droughts are climatic patterns that occur over long periods of time. Only generalized warnings can take place due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions. Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature.

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

Texas is semiarid to humid subtropical; thus, drought is a regular and natural occurrence in the state. The main source of water supply in the state is precipitation and much of this occurs in the spring and fall. Although drought conditions are difficult to predict, low levels of spring precipitation may act as an indicator that drought conditions are occurring.

Extreme Heat

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

10.3 SECONDARY HAZARDS

Drought

The secondary hazard most commonly associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. According to the TWDB Emergency Management Plan (updated 2016) (Drought Annex), economic impacts may also occur for industries that are water-intensive such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildfire preservation. Additionally, a reduction of electric power generation and water quality deterioration are also potential effects. Drought conditions can also cause soil to compact, decreasing its ability to absorb water, making an area more susceptible to flash flooding and erosion. Drought may also increase the speed at which dead and fallen trees dry out and become more potent fuel sources for wildfires. Drought may also weaken trees in areas already affected by insect infestations, causing more extensive damage to trees and increasing wildfire risk, at least temporarily. An ongoing drought that severely inhibits natural plant growth cycles may impact critical wildlife habitats. Drought impacts increase with the length of a drought, as carry-over supplies in reservoirs are depleted and water levels in groundwater basins decline.

Extreme Heat

Excessive heat events can cause the failure of motorized systems such as ventilation systems used to control temperatures inside buildings. The lack of air conditioning in businesses and homes can exacerbate existing health conditions, particularly in senior citizens.

10.4 CLIMATE CHANGE IMPACTS

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

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

With a warmer climate, droughts could become more frequent, more severe, and longer-lasting. From 1987 to 1989, losses from drought in the U.S. totaled $39 billion (Congressional Office of Technology Assessment, 1993). More frequent extreme events such as droughts could end up being more cause for concern than the long-term change in temperature and precipitation averages. Although climatic changes may occur, it is not anticipated that a significant or noticeable change will occur over the next 5 year planning cycle and therefore the historic extent of drought and extreme heat as presented in the figures within the section are assumed to apply to future anticipated trends over the next 5 years.

The best advice to water resource managers regarding climate change is to start addressing current stresses on water supplies and build flexibility and robustness into any system. Flexibility helps to ensure a quick response to changing conditions, and robustness helps people prepare for and survive the worst conditions. With this approach to planning, water system managers will be better able to adapt to the impacts of climate change.

10.5 EXPOSURE

Because droughts cannot be directly modeled in HAZUS-MH, annualized losses were estimated using GIS-based analysis, historical data (frequency and damage) analysis, and statistical risk assessment methodology. Event frequency, severity indicators, expert opinions, and historical knowledge of the region was used for this assessment. The primary data source was the HAZUS-MH data inventory (updated 2010 U.S. Census data and 2018 RS Means Square Foot Costs), and the 2017 Census of Agriculture augmented with state and federal datasets as well as the National Drought Mitigation Center reports.

All people, property, and environments in the planning area would be exposed to some degree to the impacts of moderate to extreme drought conditions and extreme heat. Populations living in densely populated urban areas are likely to be more exposed to extreme heat events. Furthermore, farms and agriculture will be greatly impacted by drought and extreme temperatures. For drought Figure 10-14

(USDA's 2017 Census of Agriculture) profiles the county and participating cities' agriculture use, which could all be potentially impacted by drought. The exposure rate for the entire HMP update area is approximately $84,989,000 based on the USDA's 2017 Census of Agriculture. This number is for the entire planning area. Even though most farmlands are usually outside the city limits, droughts still impact local communities economically.

Table 10-3 lists structures and populations exposed to drought and extreme heat. This is considered all structures and populations for the planning area.

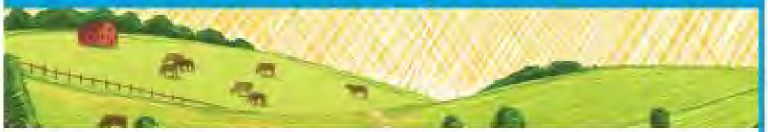
TABLE 10-3
EXPOSED STRUCTURES AND POPULATION

Jurisdiction	Residential	Commercial	Other*	**Total Structures**	**Total Population**
City of Edna	2,143	133	100	**2,376**	**5,499**
City of Ganado	657	34	17	**708**	**2,003**
City of La Ward	88	6	6	**100**	**213**
Unincorporated Area	3,256	82	104	**3,442**	**6,360**
Jackson County Total	**6,144**	**255**	**227**	**6,626**	**14,075**

Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.

Figure 10-14. USDA Census of Agriculture Jackson County Profile 2017

2017 CENSUS OF AGRICULTURE *County Profile*



Jackson County
Texas

Total and Per Farm Overview, 2017 and change since 2012

	2017	% change since 2012
Number of farms	788	-3
Land in farms (acres)	382,387	-13
Average size of farm (acres)	485	-11
Total	($)	
Market value of products sold	84,989,000	-17
Government payments	7,988,000	+22
Farm-related income	4,800,000	-7
Total farm production expenses	74,882,000	-2
Net cash farm income	22,894,000	-38
Per farm average	($)	
Market value of products sold	107,854	-14
Government payments (average per farm receiving)	42,263	+92
Farm-related income	17,777	-4
Total farm production expenses	95,028	+1
Net cash farm income	29,054	-36

(Z) Percent of state agriculture sales

Share of Sales by Type (%)

Crops	79
Livestock, poultry, and products	21

Land in Farms by Use (%) ª

Cropland	46
Pastureland	44
Woodland	9
Other	1

Acres irrigated: 6,405
2% of land in farms

Land Use Practices (% of farms)

No till	2
Reduced till	4
Intensive till	10
Cover crop	1

Farms by Value of Sales

	Number	Percent of Total ª
Less than $2,500	260	33
$2,500 to $4,999	81	10
$5,000 to $9,999	105	13
$10,000 to $24,999	116	15
$25,000 to $49,999	102	13
$50,000 to $99,999	38	5
$100,000 or more	86	11

Farms by Size

	Number	Percent of Total ª
1 to 9 acres	32	4
10 to 49 acres	210	27
50 to 179 acres	222	28
180 to 499 acres	146	19
500 to 999 acres	79	10
1,000 + acres	99	13

USDA United States Department of Agriculture
National Agricultural Statistics Service
www.nass.usda.gov/AgCensus

2017 CENSUS OF AGRICULTURE County Profile

Market Value of Agricultural Products Sold

	Sales ($1,000)	Rank in State [b]	Counties Producing Item	Rank in U.S. [b]	Counties Producing Item
Total	**84,989**	**71**	**254**	**1,306**	**3,077**
Crops	**67,159**	**35**	**253**	**878**	**3,073**
Grains, oilseeds, dry beans, dry peas	41,495	14	232	843	2,916
Tobacco	-	-	-	-	323
Cotton and cottonseed	24,422	31	174	67	647
Vegetables, melons, potatoes, sweet potatoes	-	-	188	-	2,821
Fruits, tree nuts, berries	244	103	225	927	2,748
Nursery, greenhouse, floriculture, sod	17	126	155	1,587	2,601
Cultivated Christmas trees, short rotation woody crops	-	-	43	-	1,384
Other crops and hay	981	141	251	1,890	3,040
Livestock, poultry, and products	**17,830**	**137**	**254**	**1,742**	**3,073**
Poultry and eggs	9	147	235	1,807	3,007
Cattle and calves	(D)	(D)	254	(D)	3,055
Milk from cows	(D)	74	94	(D)	1,892
Hogs and pigs	8	131	216	1,604	2,856
Sheep, goats, wool, mohair, milk	25	184	247	2,101	2,984
Horses, ponies, mules, burros, donkeys	66	180	254	1,662	2,970
Aquaculture	(D)	6	79	(D)	1,251
Other animals and animal products	80	100	229	827	2,878

Total Producers [c] 1,278

Sex	
Male	820
Female	458
Age	
<35	121
35 – 64	741
65 and older	416
Race	
American Indian/Alaska Native	13
Asian	6
Black or African American	25
Native Hawaiian/Pacific Islander	-
White	1,229
More than one race	5
Other characteristics	
Hispanic, Latino, Spanish origin	96
With military service	133
New and beginning farmers	337

Percent of farms that:

Have internet access	67
Farm organically	-
Sell directly to consumers	(Z)
Hire farm labor	28
Are family farms	95

Top Crops in Acres [d]

Corn for grain	89,140
Cotton, all	39,488
Forage (hay/haylage), all	10,831
Sorghum for grain	6,330
Soybeans for beans	2,412

Livestock Inventory (Dec 31, 2017)

Broilers and other meat-type chickens	91
Cattle and calves	36,372
Goats	175
Hogs and pigs	99
Horses and ponies	446
Layers	971
Pullets	105
Sheep and lambs	67
Turkeys	72

See 2017 Census of Agriculture, U.S. Summary and State Data, for complete footnotes, explanations, definitions, commodity descriptions, and methodology.
[a] May not add to 100% due to rounding. [b] Among counties whose rank can be displayed. [c] Data collected for a maximum of four producers per farm.
[d] Crop commodity names may be shortened; see full names at www.nass.usda.gov/go/cropnames.pdf. [e] Position below the line does not indicate rank.
(D) Withheld to avoid disclosing data for individual operations. (NA) Not available. (Z) Less than half of the unit shown. (-) Represents zero.

10.6 VULNERABILITY

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services. Drought can affect a wide range of economic, environmental, and social activities. The vulnerability of an activity to the effects of drought usually depends on its water demand, how the demand is met, and what water supplies are available to meet the demand. Extreme heat can exacerbate the effects of drought.

Because droughts cannot be directly modeled in HAZUS-MH, annualized losses were estimated using GIS-based analysis, historical data (frequency and damage) analysis, and statistical risk assessment methodology. Event frequency, severity indicators, expert opinions, and historical knowledge of the region were used for this assessment. The primary data source was the HAZUS-MH inventory data (updated with 2010 Census Data and 2018 RS Means Square Foot Costs), and the 2017 Census of Agriculture augmented with state and federal data sets as well as the National Drought Mitigation Center reports and local knowledge.

10.6.1 Population

Drought

The planning partnership has the ability to minimize any impacts on residents and water consumers in the county and participating cities should several consecutive dry years occur. No significant life or health impacts are anticipated as a result of drought within the planning area

Extreme Heat

According to the EPA, the individuals with the following characteristics are typically at greater risk to the adverse effects of excessive heat events: individuals with physical or mobility constraints, cognitive impairments, economic constraints, and social isolation. See Table 10-4 for populations most vulnerable to extreme heat and drought per jurisdiction

TABLE 10-4
MOST VULNERABLE POPULATION

Jurisdiction	Youth Population (< 16)	% of Total Population	Elderly Population (> 65)	% of Total Population	Economically Disadvantage (Income< $20,000)	% of Total Population
City of Edna	1,481	26.93	876	15.93	371	6.75
City of Ganado	502	25.06	270	13.48	100	4.99
City of La Ward	71	33.33	24	11.27	22	10.33
Unincorporated Area	1,525	23.98	1,143	17.97	448	7.04
Jackson County Total	**3,579**	**25.43**	**2,313**	**16.43**	**941**	**6.69**

10.6.2 Property

Drought

No structures will be directly affected by drought conditions, though some structures may become vulnerable to wildfires, which are more likely following years of drought. Droughts can also have significant impacts on landscapes, structure foundation issues (because of soil expansion and contraction) which could cause a financial burden to property owners. However, these impacts are not considered critical in planning for impacts from the drought hazard.

Loss estimations for drought are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing projected damages (annualized loss) on historical events, statistical analysis, and probability factors. These were applied to the exposed agriculture values of participating communities to create an annualized loss (Table 10-5).

TABLE 10-5.
LOSS ESTIMATES FOR DROUGHT EVENTS

Jurisdiction	Exposed Value ($)	Annualized Loss ($)	Annualized Loss (%)
Jackson County Total	**84,989,000**	**109,286**	**0.13**

Extreme Heat

Typically, the only impact extreme heat has on general building stock is increased demand for air conditioning equipment, which in turn may cause strain on electrical systems. Due to the expansive nature of soils in this area, extreme heat also could pose foundation issues. It costs an average homeowner at least $5,000 to fix or repair structure foundation issues.

Vulnerability Narrative

All participating communities are at risk to drought and extreme heat events. In addition to the documented impacts from the Drought Impact Reporter listed in Chapter 10.2.1, the participating communities also experience the following for both drought and extreme heat events:

- **City of Edna -** The City will be at a greater risk of rolling blackouts during an extreme heat event due to high usage. This would have a greater effect on the young, elderly, and economically disadvantaged that may not have the means to respond to such an event. Lawn watering and other outdoor water activities will have to be scheduled and rationed. Communities that have not developed or implemented a Drought Contingency Plan or Emergency Response Plan are more vulnerable to the effects of drought. Residents who are uninformed of the benefits of water conservation or how to effectively apply it are at an increased risk as well.
- **City of Ganado -** The City of Ganado will be at a greater risk of rolling blackouts during an extreme heat event due to high usage. This would have a greater effect on the young, elderly, and economically disadvantaged populations that may not have the means to respond to such an event. Uninformed residents and business owners on the effects of drought on their properties and water conservation tactics are more vulnerable. Communities that do not have Drought Contingency or Emergency Response Plans increase their risk as well.
- **City of La Ward** – The City of La Ward will be at high risk for rolling blackouts during an extreme heat event due to high usage from other cities and unincorporated areas throughout the county. This

would greatly impact the vulnerable population in the city. Residents and business owners unaware of the effects of drought on their properties and water conservation tactics are more vulnerable and could experience undue hardship during an event.

- **Jackson County (Unincorporated Area) -** Unincorporated county areas are at a greater risk of rolling blackouts during an extreme heat event due to high usage from other areas of the electrical grid. Due to the rural nature of some of Jackson County's Unincorporated Areas, response times restoring outages caused by a blackout could be lengthy. This would have a greater effect on the young, elderly, and economically disadvantaged. Communities not implementing wildfire mitigation measures are increasing their risk to potential negative impacts of this hazard as well. Many residents may not know of the risks extreme heat can place on themselves, their families, and homes. Those uninformed on the risks and hazards associated with drought are more vulnerable to its effects. Economically, Jackson County could experience hardship due to the large reliance on the agricultural industry which is heavily impacted during drought and extreme heat events.

Community Perception of Vulnerability

See the front page of the current chapter for a summary of hazard rankings for Jackson County and participating communities in this plan update. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

10.6.3 Critical Facilities

Drought

Critical facilities as defined for this plan will continue to be operational during a drought. Critical facility elements such as landscaping may not be maintained due to limited resources, but the risk to the planning area's critical facilities inventory will be largely aesthetic. For example, when water conservation measures are in place, landscaped areas will not be watered and may die. These aesthetic impacts are not considered significant. That being said, drought could result in soil contraction affecting critical facility foundations. In general, this is not a significant issue for critical facility functionality. See chapter 8 Expansive Soils for further explanation.

Extreme Heat

Power outages may occur as a result of extreme heat events. Additionally, transportation systems may experience disruption in services. It is common in Texas for concrete pavements to experience "blowouts or heaves" both on local highways and the higher volume parkway and interstate systems. Blowouts occur when pavements expand and cannot function properly within their allotted spaces. Pavement sections may rise several inches during such events. These conditions can cause motor vehicle accidents in their initial stages and can shut down traffic lanes or roadways entirely until such times as the conditions are mitigated.

10.6.4 Environment

Environmental losses from drought are associated with damage to plants, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

10.6.5 Economic Impact

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

10.7 FUTURE TRENDS IN DEVELOPMENT

Each municipal planning partner in this effort has an established comprehensive plan or policies directing land use and dealing with issues of water supply and the protection of water resources. These plans provide the capability at the local municipal level to protect future development from the impacts of drought. All planning partners reviewed their plans under the capability assessments performed for this effort. Deficiencies identified by these reviews can be identified as mitigation initiatives to increase the capability to deal with future trends in development. Vulnerability to drought will increase as population growth increases, putting more demands on existing water supplies. Future water use planning should consider increases in population as well as potential impacts of climate change.

10.8 SCENARIO

An extreme multi-year drought could impact the region with little warning. Combinations of low precipitation and unusually high temperatures could occur over several consecutive years. Intensified by such conditions, extreme wildfires could break out throughout the planning area, increasing the need for water. Surrounding communities, also in drought conditions, could increase their demand for water supplies relied upon by the planning partnership, causing social and political conflicts. If such conditions persisted for several years, the economy of Jackson County could experience setbacks, especially in water-dependent industries.

10.9 ISSUES

The following are extreme heat and drought-related issues:

- Identification and development of alternative water supplies.
- Utilization of groundwater recharge techniques to stabilize the groundwater supply.
- The probability of increased drought frequencies and durations due to climate change.
- The promotion of active water conservation even during non-drought periods.
- Increasing vulnerability to drought over time as demand for water from different sectors increases.
- The effects of climate change may result in an increase in the frequency of extreme heat events.
- The effects of recent droughts have exposed the vulnerability of the planning area's economy to drought events.

- Environmental and erosion control impact analysis for transportation projects.
- Wildlife habitat management for landowners.
- Human health impacts from droughts and extreme heat.
- Monitoring and evaluating risks to the power supply and water rights.
- Development of mitigation – or response-based state drought plans.

Chapter 11.
Earthquake

EARTHQUAKE RANKING	
Jackson County	N/A
City of Edna	N/A
City of Ganado	N/A
City of La Ward	N/A

DEFINITIONS	
Earthquake	The shaking of the ground caused by an abrupt shift of rock along a fracture in the earth or a contact zone between tectonic plates.
Epicenter	The point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.
Fault	A fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other
Focal Depth	The depth from the earth's surface to the hypocenter.
Hypocenter	The region underground where an earthquake's energy originates.
Liquefaction	Loosely packed, water-logged sediments losing their strength in response to strong shaking, causing major damage during earthquakes.

11.1 GENERAL BACKGROUND

11.1.1 How Earthquakes Happen

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

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

Geologists classify faults by their relative hazards. Active faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). Potentially active faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years). Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault. Although there are probably still some unrecognized active faults, nearly all the movement between the two plates, and therefore the majority of the seismic hazards, are on the well-known active faults.

Faults are more likely to have earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve accumulating tectonic stresses. A direct relationship exists between a fault's length and location and its ability to generate damaging ground motion at a given site. In some areas, smaller, local faults produce lower magnitude quakes, but ground shaking can be strong, and damage can be significant as a result of the fault's proximity to the area. In contrast, large regional faults can generate great magnitudes but, because of their distance and depth, may result in only moderate shaking in the area.

11.1.2 Earthquake Classifications

Earthquakes are typically classified in one of two ways: by the amount of energy released, measured a **magnitude**; or by the impact on people and structures, measured as **intensity**.

Magnitude

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

Great	Mw > 8
Major	Mw = 7.0 - 7.9
Strong	Mw = 6.0 - 6.9
Moderate	Mw = 5.0 - 5.9
Light	Mw = 4.0 - 4.9
Minor	Mw = 3.0 - 3.9
Micro	Mw < 3

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

Intensity

Currently, the most commonly used intensity scale is the modified Mercalli intensity scale, with ratings defined as follows (United States Geological Survey [USGS] 1989):

I. Not felt except by a very few under especially favorable conditions.

II. Felt only by a few persons at rest, especially on upper floors of buildings.

III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it is an earthquake. Standing cars may rock slightly. Vibrations are similar to the passing of a truck.

IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing cars rocked noticeably.

V. Felt by nearly everyone; many awakened. Some dishes, windows are broken. Unstable objects overturned. Pendulum clocks may stop.

VI. Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.

VII. Damage negligible in buildings of good design and construction; slight in well-built ordinary structures; considerable in poorly built or badly designed structures. Some chimneys are broken.

VIII. Damage slight in specially designed structures; considerable damage in ordinary buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage is great in substantial buildings, with partial collapse. Buildings shifted off foundations.

X. Some well-built wooden structures are destroyed; most masonry and frame structures are destroyed with foundations. Rails bent.

XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.

XII. Damage total. Lines of sight and level are distorted. Objects are thrown into the air.

11.1.3 Ground Motion

Earthquake hazard assessment is also based on expected ground motion. This involves determining the annual probability that certain ground motion accelerations will be exceeded, then summing the annual probabilities over the time period of interest. The most commonly mapped ground motion parameters are the horizontal and vertical peak ground accelerations (PGA) for a given soil or rock type. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. These readings are recorded by state and federal agencies that monitor and predict seismic activity.

Maps of PGA values form the basis of seismic zone maps that are included in building codes such as the International Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage “short-period structures” (e.g., single-family dwellings). Longer-period response components create the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges). Table 11-1 lists damage potential and perceived shaking by PGA factors, compared to the Mercalli scale.

TABLE 11-1. MERCALLI SCALE AND PEAK GROUND ACCELERATION COMPARISON				
Modified Mercalli Scale	Perceived Shaking	Potential Structure Damage		Estimated PGA[a] (%g)
		Resistant Buildings	Vulnerable Buildings	
I	Not Felt	None	None	<0.17%
II to III	Weak	None	None	0.17% - 1.4%
IV	Light	None	None	1.4% - 3.9%
V	Moderate	Very Light	Light	3.9% - 9.2%
VI	Strong	Light	Moderate	9.2% - 18%
VII	Very Strong	Moderate	Moderate/Heavy	18% - 34%
VIII	Severe	Moderate/Heavy	Heavy	34% - 65%
IX	Violent	Heavy	Very Heavy	65% - 124%
X to XII	Extreme	Very Heavy	Very Heavy	>124%

Note:
a. PGA measured in percentage of gravity (g), where g is the acceleration of gravity
From USGS, 2008; USGS, 2010

11.1.4 Effect of Soil Types

The impact of an earthquake on structures and infrastructure is largely a function of ground shaking, distance from the source of the quake, and liquefaction. Liquefaction is a secondary effect of an earthquake in which soils lose their shear strength and flow or behave as a liquid, thereby damaging structures that derive their support from the soil. Liquefaction generally occurs in soft, unconsolidated sedimentary soils. A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. Table 11-2 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E, and F. In general, these areas are also most susceptible to liquefaction.

TABLE 11-2. NEHRP SOIL CLASSIFICATION SYSTEM		
NEHRP Soil Type	Description	Mean Shear Velocity to 30 meters (meters per second)
A	Hard Rock	1,500
B	Firm to Hard Rock	760-1,500
C	Dense Soil/Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clays	< 180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 meters thick)	

11.2 HAZARD PROFILE

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

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

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

11.2.1 Past Events

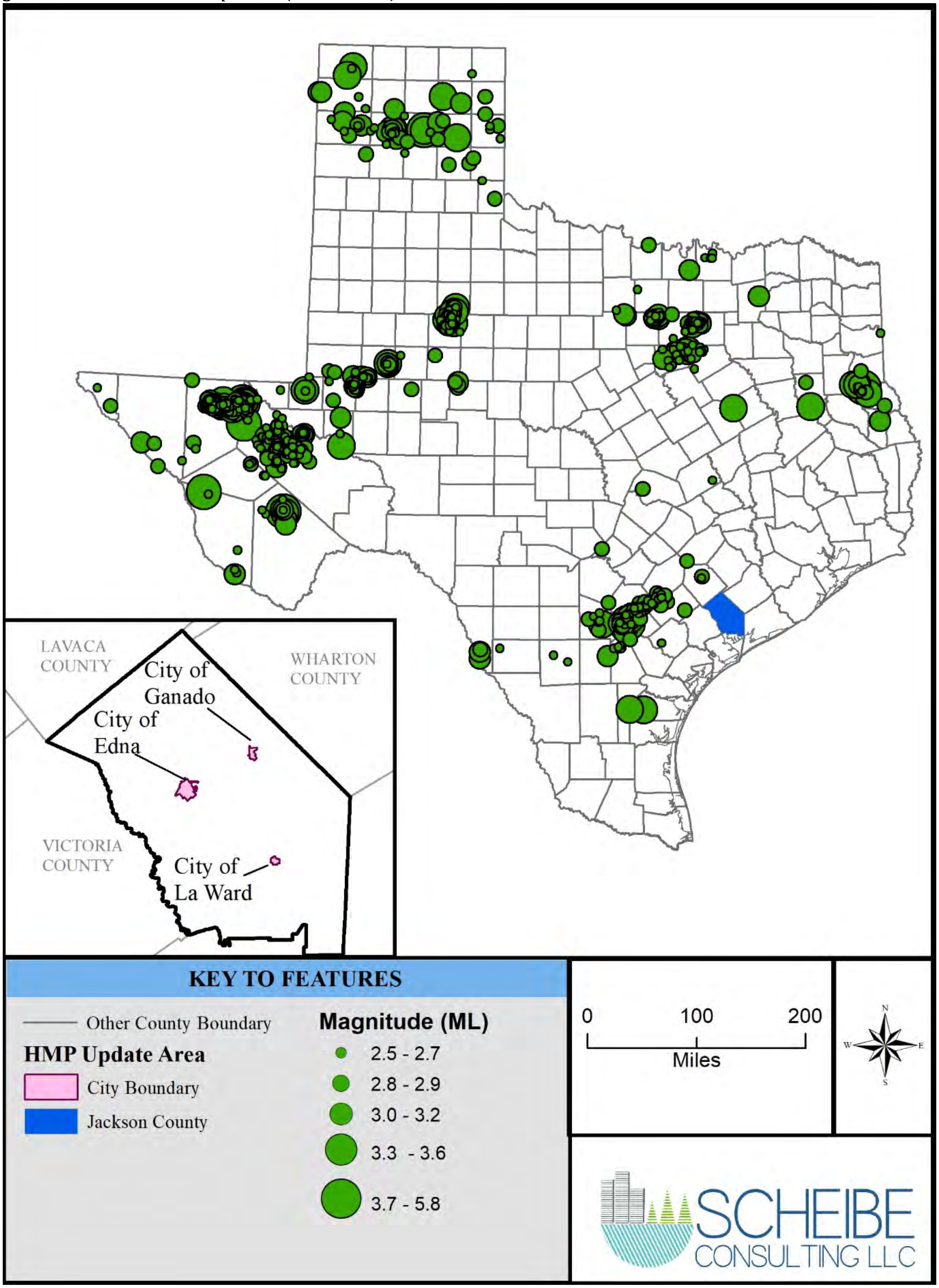
Most past earthquakes in Texas have been of low magnitude and have mainly occurred in west Texas or the Panhandle area. Figure 11-1 shows the location of recorded and documented earthquake events in Texas as well as the planning area. According to the USGS Earthquake Hazard Program, no earthquakes have been recorded in Jackson County and the participating communities since 1847, (the earliest date data is available). As can be seen in Figure 11-2, the probability of a severe earthquake in Jackson County and participating communities is low. According to the State Hazard Mitigation Plan, the probability of an earthquake in the Central Region is considered rare. This includes Jackson County and participating communities. Although a small event is possible, it would pose little to no risk for the area.

11.2.2 Location

While Texas does face some earthquake hazards, this hazard is very small in comparison to many other states. The biggest threat appears to be from the New Madrid fault system in Missouri, a system powerful enough to pose a risk to the north Texas area. Two regions, near El Paso and in the Panhandle, should expect earthquakes with magnitudes of approximately 5.5 to 6.0 to occur every 50 to 100 years, with even larger earthquakes possible. In Central Texas, the hazard is generally low, but residents should be aware that small earthquakes can occur, including some that are theoretically triggered by oil or gas production.

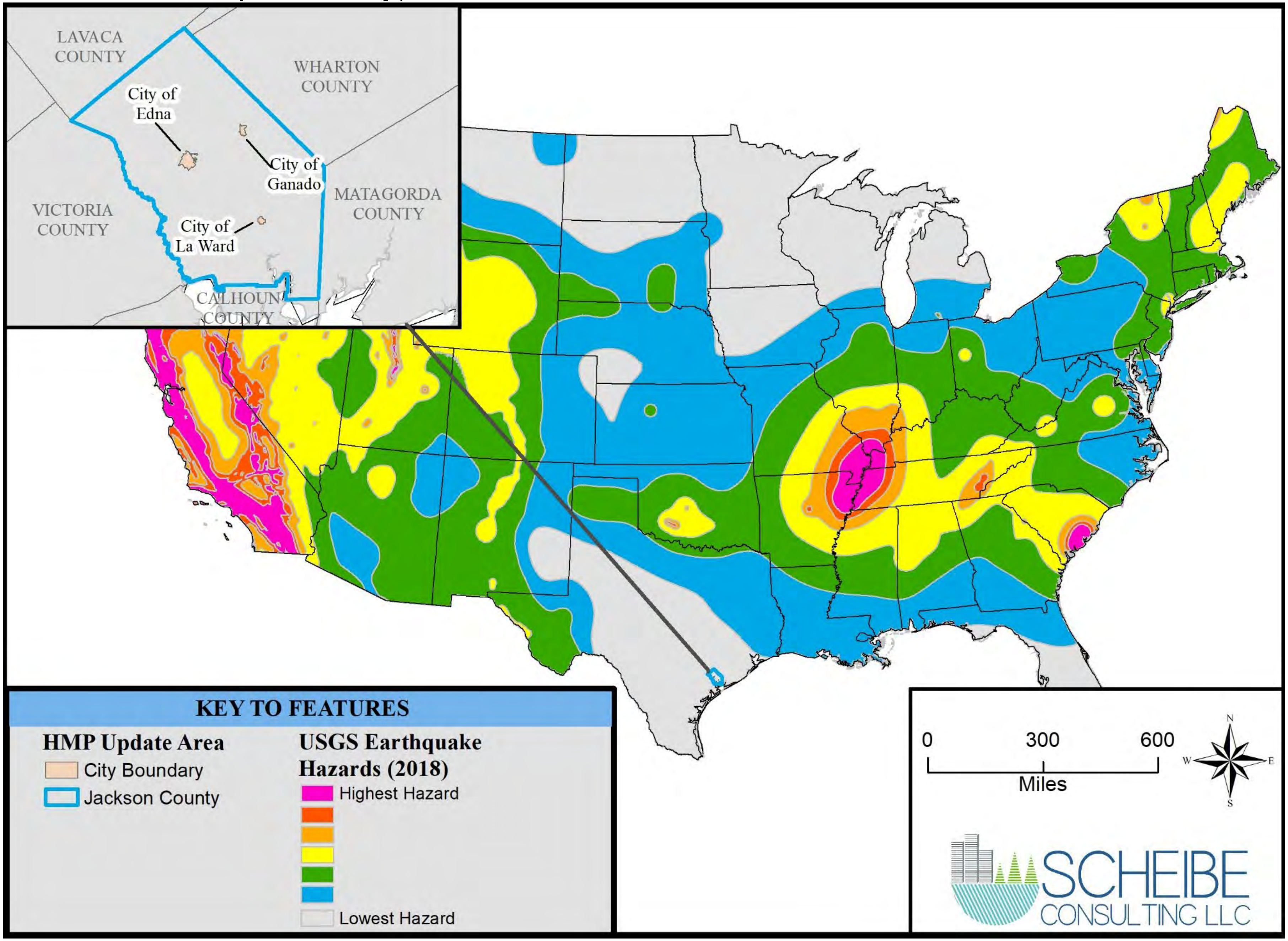
Elsewhere in Texas, earthquakes are exceedingly rare. However, the hazard level is not zero anywhere in Texas; small earthquakes are possible, and all regions face possible ill effects from very large, distant earthquakes. As shown in Figure 11-1 there are no recorded earthquake occurrences in the planning area.

Figure 11-1. Texas Earthquakes (1847-2021)



From USGS Earthquake Historical Records

Figure 11-2. Probabilistic Earthquake Hazard Map for the U.S.



Faults have been classified based on the geologic time frame of their latest suspected movement (in order of activity occurrence, most recent is listed first):

- H Holocene (within past 15,000 years)
- LQ Late Quaternary (15,000 to 130,000 years ago)
- MLQ Middle to Late Quaternary (130,000 to 750,000 years ago)
- Q Quaternary (approximately past 2 million years)
- LC Late Cenozoic (approximately past 23.7 million years)

Known named faults in Texas are the Balcones Fault Zone, Mexia Fault Zone, Luling Fault Zone, Hueco Bolson, Marathon Uplift, and Talco Fault Zone.

The impact of an earthquake is largely a function of the following components:

- Ground shaking (ground motion accelerations)
- Liquefaction (soil instability)
- Distance from the source (both horizontally and vertically)

No earthquake scenarios were selected for this plan because an earthquake event for the planning area is rare, according to the *2013 State of Texas Hazard Mitigation Plan*.

11.2.3 Frequency

According to the USGS, the probability that a magnitude 5 or greater earthquake will occur in the planning area in the next few years is unlikely (event not probable in the next 10 years). The USGS Earthquake Probability Mapping application estimates that the probability that a magnitude 5 or greater earthquake will occur in the next 500 years in Jackson County and the participating community is 2 percent or less. Overall, the probability of a damaging earthquake somewhere in Jackson County and participating community is considered rare. Small earthquakes that cause no or little damage are more likely (see Figure 11-2). Based on historical data the future probability of an earthquake event of any magnitude in Jackson County and the participating communities is unlikely (event not probable in the next 100 years).

11.2.4 Severity

Earthquakes can cause structural damage, injury, and loss of life, as well as damage to infrastructure networks, such as water, power, communication, and transportation lines. Damage and life loss can be particularly devastating in communities where buildings were not designed to withstand seismic forces (e.g., historic structures). Other damage-causing effects of earthquakes include surface rupture, fissuring, settlement, and permanent horizontal and vertical shifting of the ground. Secondary impacts can include landslides, rock falls, liquefaction, fires, dam failure, and hazardous materials incidents.

There are no known deaths or injuries from earthquakes in Jackson County and the participating communities. Some of the past earthquake events in Texas were severe enough to cause minor property damage such as broken windows or contents falling from shelves. The very low probability of an event suggests that the potential for these impacts is minimal.

The severity of an earthquake can be expressed in terms of intensity or magnitude. Intensity represents the observed effects of ground shaking on people, buildings, and natural features. The USGS has created ground motion maps based on current information about several fault zones. These maps show the PGA that has a certain probability (2% or 10%) of being exceeded in a 50-year period, as shown in Figure 11-3. The PGA is measured in numbers of g's (the acceleration associated with gravity). The 500-Year HAZUS-MH probabilistic-event scenario for Jackson County produced a PGA of 0.0184, which is lower than the FEMA PGA minimum requirement (3%g) for earthquake analysis profiling. Figure 11-4 shows the 500-year probability event, which produces only a light ground shaking and is likely to cause no damage. Vibrations feel like those of a heavy truck passing by. This means that during an event of such magnitude, dishes, windows, and doors rattle, walls and frames of structures creak, liquids in open vessels are slightly disturbed, and standing vehicles rock noticeably.

Magnitude is related to the amount of seismic energy released at the hypocenter of an earthquake. It is calculated based on the amplitude of the earthquake waves recorded on instruments. Whereas intensity varies depending on location with respect to the earthquake epicenter, magnitude is represented by a single, instrumentally measured value for each earthquake event.

In simplistic terms, the severity of an earthquake event can be measured in the following terms:

- How hard did the ground shake?
- How did the ground move? (horizontally or vertically)
- How stable was the soil?
- What is the fragility of the built environment in the area of impact?

Figure 11-3. Peak Ground Acceleration (10% Probability of Exceedance in 50-Year Map of Peak Ground Acceleration)

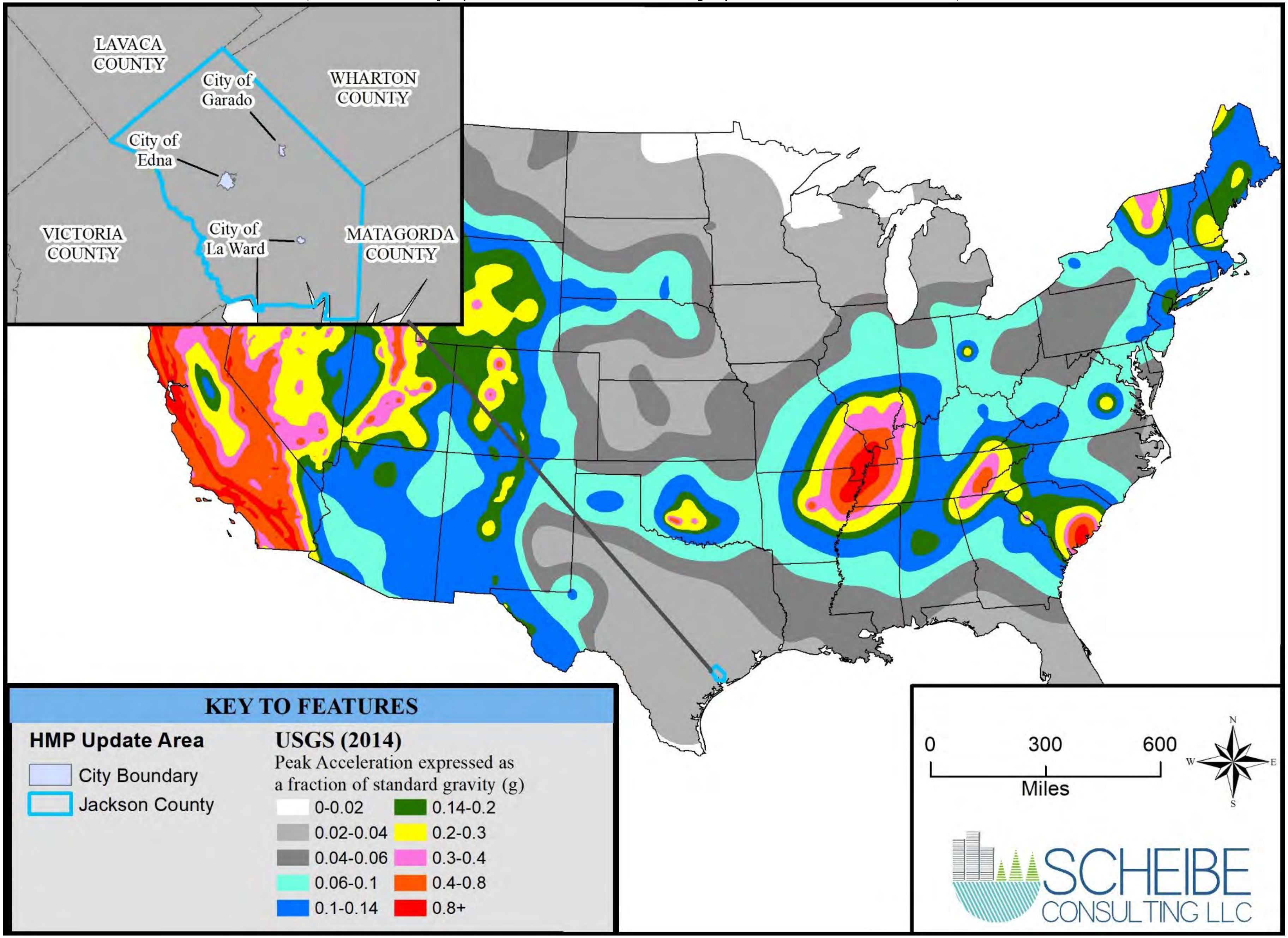
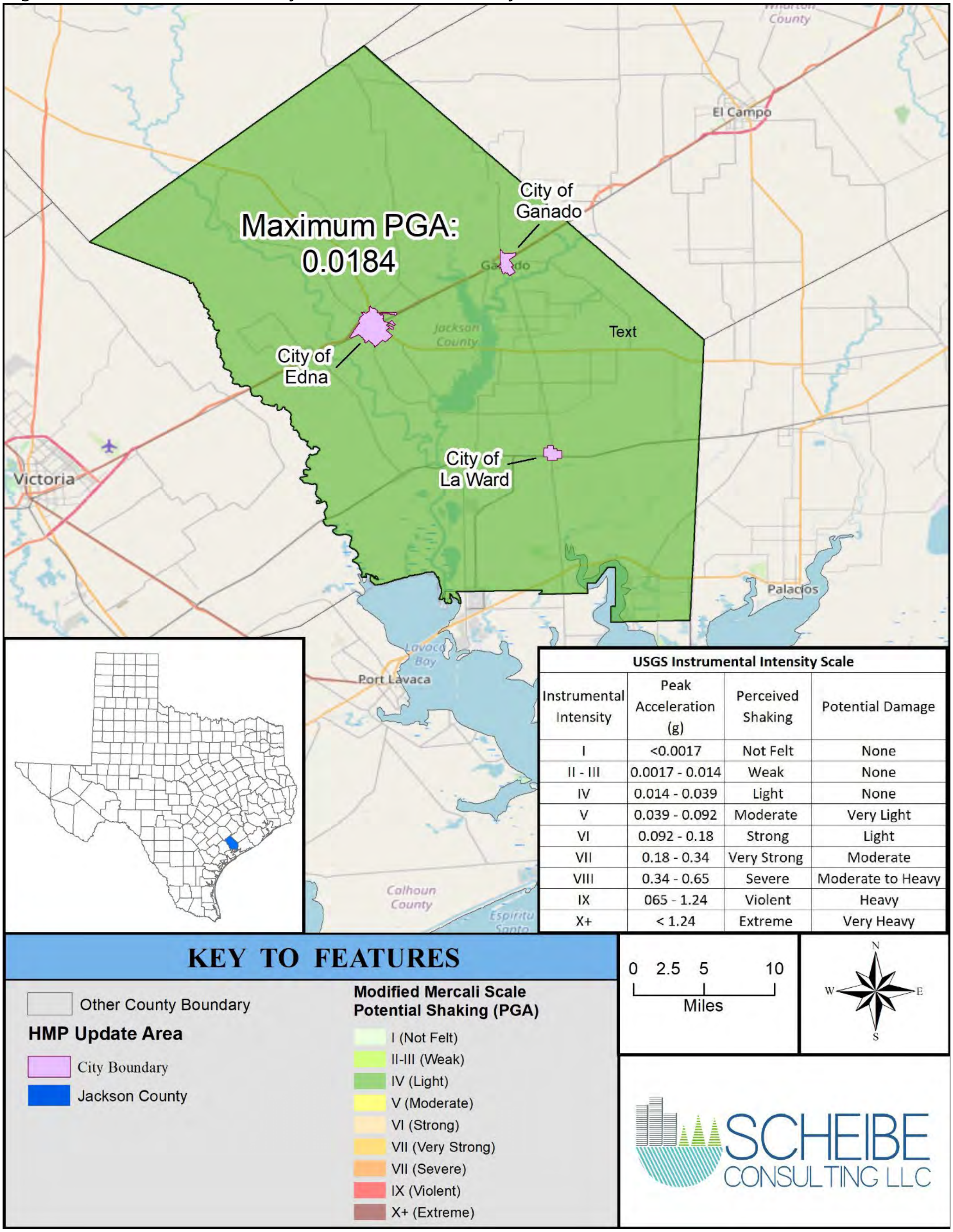


Figure 11-4. 500-Year Probability Event in Jackson County



USGS Instrumental Intensity Scale

Instrumental Intensity	Peak Acceleration (g)	Perceived Shaking	Potential Damage
I	<0.0017	Not Felt	None
II - III	0.0017 - 0.014	Weak	None
IV	0.014 - 0.039	Light	None
V	0.039 - 0.092	Moderate	Very Light
VI	0.092 - 0.18	Strong	Light
VII	0.18 - 0.34	Very Strong	Moderate
VIII	0.34 - 0.65	Severe	Moderate to Heavy
IX	065 - 1.24	Violent	Heavy
X+	< 1.24	Extreme	Very Heavy

11.2.5 Warning Time

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

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

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

11.3 SECONDARY HAZARDS

Earthquakes can cause large and sometimes disastrous landslides and mudslides. River valleys are vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts, or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes.

11.4 CLIMATE CHANGE IMPACTS

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

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

11.5 EXPOSURE

All structures, people, and infrastructure within the participating communities are vulnerable to earthquake damages. The FEMA Understanding Your Risks guide (FEMA 386-2, page 1-7), suggests the earthquake hazard should be profiled if the PGA is greater than 3%g. Jackson County and all participating communities PGA are less than 2%g (.02) and there have been no recorded earthquakes in or near the

HMP update area. Furthermore, Jackson County and participating communities do not have any geologic fault lines running through their jurisdiction (See Figure 11-1). Therefore, only a minimum level-1 HAZUS-MH analysis was profiled using the 500-year probability event scenario.

11.5.1 Population

The populations along the major geologic fault lines are the most potentially exposed to direct and indirect impacts from earthquakes. There are no fault lines within the HMP update area (See Figure 11-1). Therefore, the entire county population is at extremely minimal risk. The degree of exposure is dependent on many factors, including the age and construction type of the structures people live in, the soil types their homes are constructed on, their proximity to fault location, and other factors. Whether impacted directly or indirectly, the entire population will have to deal with the consequences of earthquakes to some degree. Business interruption could keep people from working, road closures could isolate populations, and functional loss of utilities could impact populations that suffered no direct damage from an event itself.

11.5.2 Property

According to the HAZUS-MH inventory data (updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs), there are 6,626 buildings within the census blocks that define the planning area with an asset replaceable value of almost $1.4 billion (excluding contents). About 93% of these buildings (and 79% of the building value) are associated with residential housing. All the structures along the major geologic fault lines in the planning area are susceptible to earthquake impacts to varying degrees. There are no fault lines within the HMP update area (See Figure 11-1), therefore the HMP Area is at extremely minimal risk.

11.5.3 Critical Facilities and Infrastructure

All critical facilities and infrastructure in the planning area are exposed to earthquake hazard. Table 6-3 and Table 6-4 list the number of each type of facility by jurisdiction. Hazardous material releases can occur during an earthquake from fixed facilities or transportation-related incidents. Transportation corridors can be disrupted during an earthquake, leading to the release of materials to the surrounding environment. Facilities holding hazardous materials are of particular concern because of the possible isolation of neighborhoods surrounding them. During an earthquake, structures storing these materials could rupture and leak into the surrounding area or an adjacent waterway, having a disastrous effect on the environment.

11.5.4 Environment

Secondary hazards associated with earthquakes will likely have some of the most damaging effects on the environment. Earthquake-induced landslides can significantly impact the surrounding habitat. It is also possible for streams to be rerouted after an earthquake. This can change the water quality, possibly damaging habitat and feeding areas. There is a possibility of streams fed by groundwater drying up because of changes in underlying geology.

11.6 VULNERABILITY

All structures, people, and infrastructure within the participating communities are vulnerable to earthquake damage, however, due to the low risk of occurrence, only a minimum level-1 HAZUS-MH 500-year probability event analysis was conducted. The 500-Year HAZUS-MH modeled event for Jackson County and the participating communities produced a maximum PGA of 1.84%g (Figure 11-4), which is lower than the FEMA PGA minimum requirement for earthquake analysis (3%g). The potential shaking (0.0184 PGA) of the 500-year event in Jackson County (and all participating communities) creates a 'weak' perceived shaking with no potential damage on the USGS Instrumental Intensity Scale. While the probability of an event is rare, if an event were to occur, it would be of minimal magnitude with no damage.

Due to no previous earthquake events in the planning area and the rare likelihood that such an earthquake event may occur for Jackson County and the participating communities, annualized economic losses from the HAZUS-MH 500-Year modeled event produced $0. Jackson County and participating communities can expect no loss of functionality for critical facilities and infrastructures, utility, transportation, and other essential services.

Vulnerability Narrative

- **City of Edna -** The City of Edna classified the hazard risk as 'No Exposure' due to the number of previous events (0), probability of future events (minimal), PGA of less than 2%, and local knowledge. In the event of an extreme Earthquake event surpassing the 500-Year HAZUS modeled event, one fire and three police departments, two medical facilities, and five schools could be affected.
- **City of Ganado-** The City of Ganado classified the hazard risk as 'No Exposure' due to the number of previous events (0), probability of future events (minimal), PGA of less than 2%, and local knowledge. In the event of an extreme Earthquake event surpassing the 500-Year HAZUS modeled event, one fire, and one police department, and three schools could be affected.
- **City of La Ward** – The City of La Ward classified the hazard risk as 'No Exposure' due to the number of previous events (0), probability of future events (minimal), PGA of less than 2%, and local knowledge. In the event of an extreme Earthquake event surpassing the 500-Year HAZUS modeled event one fire department could be affected.
- **Jackson County (Unincorporated Area)** – The Unincorporated Areas of Jackson County classified as the hazard risk as 'No Exposure' due to the number of previous events (0), probability of future events (minimal), PGA of less than 2%, and local knowledge. In the event of an extreme Earthquake event surpassing the 500-Year HAZUS modeled event, four fire departments, and three schools could be affected.

Community Perception of Vulnerability

See the front page of the current chapter for a summary of hazard rankings for Jackson County and participating communities in this plan update. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

11.7 FUTURE TRENDS IN DEVELOPMENT

Land use in the planning area will be directed by master plans adopted by the county and its planning partners as well as local permitting departments and zoning maps. The information in this plan provides the participating partners a tool to ensure that there is no increase in exposure in areas of high seismic risk. Development in the planning area will be regulated through building standards and performance measures so that the degree of risk will be reduced. The International Building Code also establishes provisions to address seismic risk.

11.8 SCENARIO

An earthquake does not have to occur within the planning area to have a significant impact on the people, property, and economy of the county and participating cities. However, any seismic activity of 6.0 or greater on faults within the planning area would have significant impacts throughout the county. Earthquakes of this magnitude or higher would lead to massive structural failure of property on highly liquefiable soils. Levees and revetments built on these poor soils would likely fail, representing a loss of critical infrastructure. These events could cause secondary hazards, including landslides and mudslides that would further damage structures. River valley hydraulic-fill sediment areas are also vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils.

11.9 ISSUES

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

- Many structures within the planning area were built prior to 1994 when seismic provisions became uniformly applied through building code applications.
- Critical facility owners should be encouraged to create or enhance continuity of operations plans using the information on risk and vulnerability contained in this plan.
- Geotechnical standards should be established that take into account the probable impacts from earthquakes in the design and construction of new or enhanced facilities.
- Earthquakes could trigger other natural hazard events such as dam failures and landslides, which could severely impact the county and participating cities.
- A worst-case scenario would be the occurrence of a large seismic event during a flood or high-water event. Failures could happen at multiple locations, increasing the impacts of individual events.
- The cost of retrofitting buildings to meet earthquake seismicity standards may be cost-prohibitive.
- Dams located in the county and participating cities may not have been engineered to withstand probable seismic events.
- Information regarding the liquefaction susceptibility of soils in the planning area is lacking.

Chapter 12.
Flood

FLOOD RANKING	
Jackson County	High
City of Edna	High
City of Ganado	High
City of La Ward	High

DEFINITIONS	
Flood	The inundation of normally dry land resulting from the rising and overflowing of a body of water.
Floodplain	The land area along the sides of a river that becomes inundated with water during a flood.
100-Year Floodplain	The area flooded by a flood that has a 1% chance of being equaled or exceeded each year. This is a statistical average only; a 100-year flood can occur more than once in a short period of time. The 1% annual chance flood is the standard used by most federal and state agencies.
Riparian Zone	The area along the banks of a natural watercourse.

12.1 GENERAL BACKGROUND

12.1.1 Flood

The following description of flooding is an excerpt from the *2013 State of Texas Flood Mitigation Plan*.

A flood is a general and temporary condition of partial or complete inundation of normally dry land areas from:

- The overflow of stream banks
- The unusual and rapid accumulation of runoff of surface waters from any source
- Mudflows or the sudden collapse of shoreline land

Flooding results when the flow of water is greater than the normal carrying capacity of the stream channel. The rate of rise, magnitude (or peak discharge), duration, and frequency of floods are a function of specific physiographic characteristics. Generally, the rise in water surface elevation is quite rapid on small (and steep gradient) streams and slow on large (and flat sloped) streams.

The causes of floods relate directly to the accumulation of water from precipitation, or the failure of man-made structures, such as dams or levees. Floods caused by precipitation are further classified as coming from rain in a general storm system, rain in a localized intense thunderstorm, melting snow and ice, and hurricane/tropical storms. Floods may also be caused by structural or hydrologic failures of dams or levees. A hydrologic failure occurs when the volume of water behind the dam or levee exceeds the structure‘s capacity resulting in overtopping. Structural failure arises when the physical stability of the dam or levee is compromised due to age, poor construction, and maintenance, seismic activity, rodent tunneling, or myriad other causes. For more information on floods resulting from dam and levee failure refer to Chapter 9 of this plan.

General Rain Floods

General rain floods can result from moderate to heavy rainfall occurring over a wide geographic area lasting several days. They are characterized by a slow steady rise in stream stage and a peak flood of long duration. As various minor streams empty into larger and larger channels, the peak discharge on the mainstream channel may progress upstream or downstream (or remain stationary) over a considerable length of a river. General rain floods can result in considerably large volumes of water. Because the rate of rise is slow and the time available for a warning is great, few lives are usually lost, but millions of dollars in valuable public and private property are at risk.

Thunderstorm Floods

Damaging thunderstorm floods are caused by intense rain over basins of a relatively small area. They are characterized by a sudden rise in stream level, short duration, and a relatively small volume of runoff.

Because there is little or no warning time, the term “flash flood” is often used to describe thunderstorm floods. Texas is known as the “Flash Flood Alley” and the area along the Balcones Escarpment (from Austin south to San Antonio, then west to Del Rio) is one of the nation's three most flash flood-prone regions. Figure 12-1 shows the number of flash floods recorded in each county from 1986 to 1999. Jackson County lies just south of the “Flash Flood Alley”.

Thunderstorm floods occur every month of the year in Texas but are most common in the spring and summer. The mean annual number of thunderstorm flood days varies from 40 in eastern Texas to 60 in western Texas. Most flash flooding is caused by slow-moving thunderstorms, thunderstorms repeatedly moving over the same area, or heavy rains from hurricanes and tropical storms.

Flash floods can occur within a few minutes or after hours of excessive rainfall. Flash floods can roll boulders, tear out trees, destroy buildings and bridges, and carve out new channels. Rapidly rising water can reach heights of thirty feet or more. Flash flood-producing rains can also trigger catastrophic mudslides. Often there is no warning that flash floods are coming. Hill Country flash floods devastated the river basin and are a major reason why the LCRA located Mansfield Dam and Lake Travis (the flood control components of the Highland Lake chain) upstream of Austin. Flash flooding poses a deadly danger to residents of the Lower Colorado River Basin. A number of roads run through low-lying areas that are prone to sudden and frequent flooding during heavy rains. Motorists often attempt to drive through barricaded or flooded roadways. It takes only 18 to 24 inches of water moving across a roadway to carry away most vehicles. Floating cars easily get swept downstream, making rescues difficult and dangerous.

Rain on Snowmelt Floods

Winter is the driest time of the year in Texas. Snowfall occurs at least once every winter in the northern half of Texas, although accumulations rarely are substantial except in the High Plains. Snow is not uncommon in the mountainous areas of the Trans-Pecos, though heavy snows (five inches or more) come only once every two or three winters. More often than not, snow falling in the southern half of the state melts and does not stick to the surface; snow stays on the ground only once or twice in every decade. Snowfall rarely is observed before early November and hardly ever occurs after mid-April. Where it is not uncommon, snow is almost always heaviest in either January or February. Mean seasonal snowfall is 15 to 18 inches in the Texas Panhandle and 4 to 8 inches elsewhere in the High and Low Rolling Plains. It is worth noting that the recent snow/ice storm of 2021 resulted in significant snow accumulation in the headwaters of the Colorado River, it was an extremely unusual event with essentially no flood risk impacts downstream and into Jackson County.

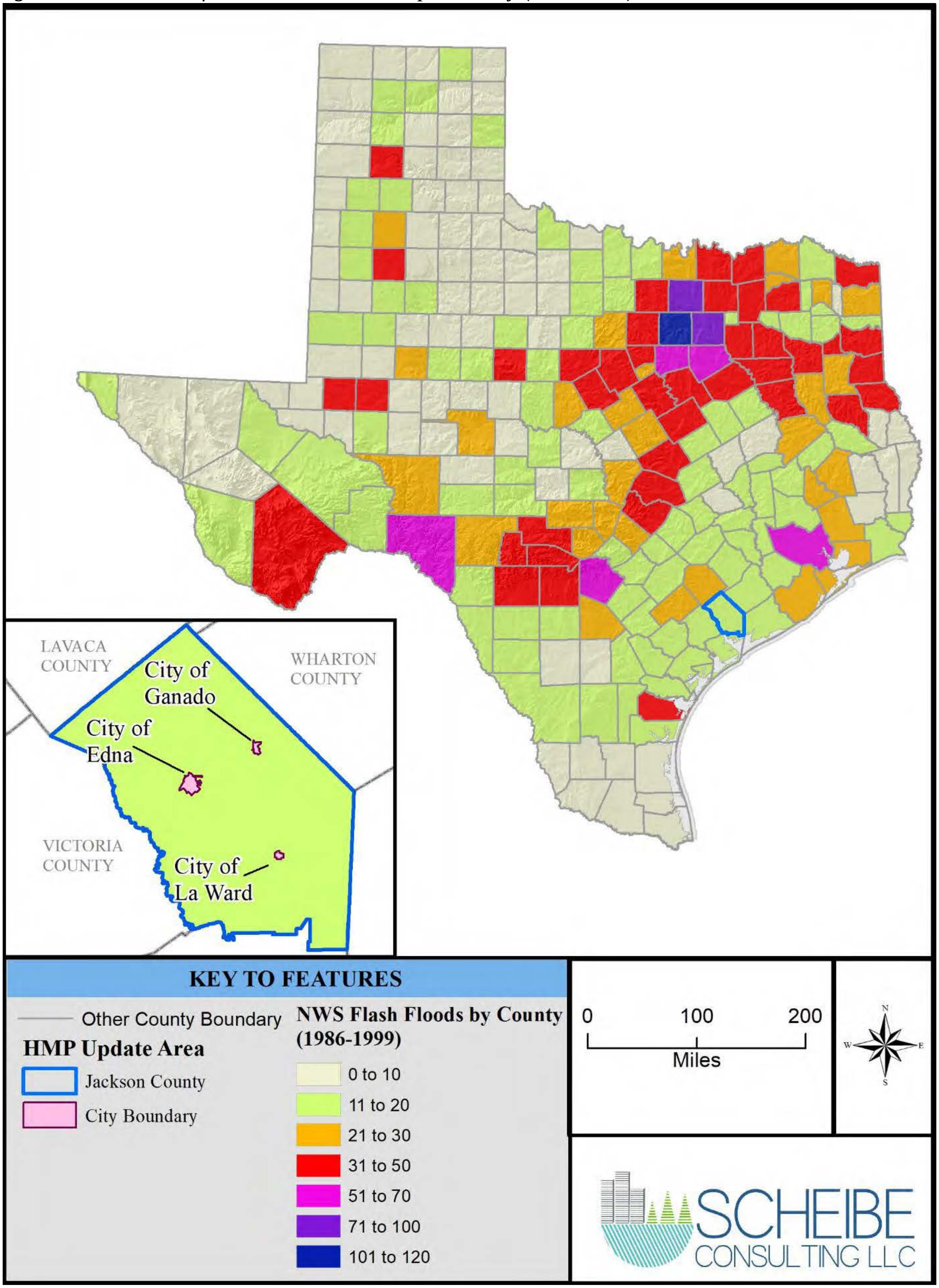
Hurricanes and Tropical Storms

The United States has a significant hurricane problem. More than 60% of the U.S. population lives in coastal states from Maine to Texas, Washington to California, Hawaii, and Puerto Rico. In the United States, the Atlantic and Gulf Coast coastlines are densely populated and many regions lie less than 3 meters (10 feet) above mean sea level.

Jackson County, being a Texas Gulf Coast County, is exposed to flooding from hurricanes and tropical storms. Coastal flooding triggered by hurricanes is as destructive as wind but can be even more deadly, and is by far the greatest threat to life and property along the coastline. Storm surge, wave, and tides are the greatest contributors to coastal flooding, while precipitation and river flow also contribute during some storms. Hurricanes produce soaking rain, high winds, flying debris, storm surges, tornadoes, and often the deadliest of all, inland flooding. Rain-triggered flooding is not just limited to coastlines as the reach of a large hurricane can cause deadly flooding well inland to communities hundreds of miles from the coast as intense rain falls from these huge tropical air masses. Increased flooding and erosion rates may cause landslides in some areas, especially mountainous regions.

Besides causing extensive damage in coastal areas, hurricanes and tropical storms can often cause extensive damages to communities several miles inland. Just a few inches of water from a flood can cause tens of thousands of dollars in damage. Examples include Hurricane Katrina, Hurricane Ike, Hurricane Harvey, and Tropical Strom Allison. For more information on floods resulting from hurricanes and tropical storms, refer to Chapter 13 of this plan.

Figure 12-1. Number of Flash Floods in Texas per County (1986-1999)



12.1.2 Floodplain

A floodplain is an area adjacent to a river, creek, or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon.

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce, and residential development.

Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

12.1.3 Measuring Floods and Floodplains

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to estimate the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1% chance of being equaled or exceeded in any given year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

The extent of flooding associated with a 1% annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by FEMA and many agencies. Also referred to as the special flood hazard area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water surface elevations describe the elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating flood damage.

12.1.4 Floodplain Ecosystems

Floodplains can support ecosystems that are rich in plant and animal species. A floodplain can contain 100 or even 1,000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those leftover from the last flood and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly, but the surge of new growth endures for some time. This makes floodplains valuable for agriculture. Species growing in floodplains are significantly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees.

12.1.5 Effects of Human Activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available, the land is fertile and suitable for farming, transportation by water is easily accessible, and land is flatter and easier to develop. However, human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream’s capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities’ adverse impacts on floodplain functions.

12.2 HAZARD PROFILE

Texas has the most flash flood deaths of any state in the country. Although Jackson County and participating communities do not fall in the “Flash Flood Alley” area of Texas, it is still susceptible to flash flood events every year. The terrain is punctuated by a large number of limestone or granite rocks and boulders and a thin layer of topsoil, which makes the region very dry and prone to flash flooding. Other factors contributing to flash floods in the area include its location between the Rocky Mountains and the moisture-laden Gulf of Mexico. As weather systems stall and dissipate over Texas, and they drop intense rains over small areas. In the past, Jackson County has had significant seasonal floods along the Lavaca and Navidad Rivers, as well as creeks throughout the county and participating communities; however, these floods have been greatly reduced by the construction of large reservoirs along the Lavaca and Navidad Rivers. This has also helped to reduce the impacts of seasonal floods in the planning area. During Hurricane Harvey, the headwaters' creeks became inundated with overflows from the Lavaca and Navidad Rivers that rushed through neighborhoods causing extreme flooding in a very short period of time.

Flooding in the county and participating cities is mostly caused by slow-moving thunderstorms, thunderstorms repeatedly moving over the same area, or heavy rains from hurricanes and tropical storms. Flash floods can occur within a few minutes or after hours of excessive rainfall. These rain events are most often microbursts, which produce a large amount of rainfall in a short amount of time. Flash floods, by their nature, occur suddenly but usually dissipate within hours. Despite their sudden nature, the NWS is usually able to issue advisories, watches, and warnings in advance of a flood, but some level of additional work is still needed on this front.

The potential for flooding can change and increase through various land-use changes and changes to the land surface. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining watersheds or natural drainage channels. These changes are commonly created by human activities (e.g., development). These changes can also be created by other events such as wildfires. Wildfires create hydrophobic soils, a hardening or “glazing” of the earth’s surface that prevents rainfall from being absorbed into the ground, thereby increasing runoff, erosion, and downstream sedimentation of channels.

Potential flood impacts include loss of life, injuries, and property damage. Floods can also affect infrastructure (water, gas, sewer, and power utilities), transportation, jobs, tourism, the environment, and ultimately local and regional economies.

12.2.1 Past Events

The NCDC Storm Events Database includes flood events that occurred in Jackson County and participating communities between 1965 and 2021. Table 12-1 provides a summary of the results of these statistics. Events listed as Jackson County and participating communities in the table below affected large portions of the HMP update area. Specific events described for each participating community are counted and described below. Large flood storms may have affected additional jurisdictions.

TABLE 12-1.
HISTORIC FLOOD EVENTS IN JACKSON COUNTY AND PARTICIPATING COMMUNITIES (1996-2021)

Location	Date	Estimated Damage Cost		Injuries	Deaths
		Property	Crops		
Ganado	12/31/1996	$5,000	$0	0	0
Countywide	04/04/1997	$5,000	$0	0	0
Countywide	05/09/1997	$5,000	$0	0	0
Countywide	06/21/1997	$5,000	$0	0	0
Jackson (Zone)	08/21/1998	$5,000	$0	0	0
Jackson (Zone)	09/07/1998	$100,000	$0	0	0
South Portion	09/11/1998	$0	$0	0	0
Countywide	09/16/1998	$30,000	$0	0	0
Countywide	09/16/1998	$15,000	$0	0	0
Jackson (Zone)	10/17/1998	$0	$0	0	0
Countywide	10/18/1998	$0	$0	0	0
Edna	10/18/1998	$15,000	$0	0	0
Countywide	11/12/1998	$20,000	$0	0	0
Jackson (Zone)	11/12/1998	$0	$0	0	0
Countywide	11/13/1998	$10,000	$0	0	0
Countywide	11/14/1998	$5,000	$0	0	0
Countywide	08/30/2001	$80,000	$0	0	0
Countywide	09/01/2001	$45,000	$0	0	0
West Portion	07/16/2002	$3,000	$0	0	0
Jackson (Zone)	09/05/2002	$0	$0	0	0
Jackson (Zone)	07/14/2003	$594,000	$0	2	0
La Ward	06/23/2004	$0	$0	0	0
Edna	06/30/2004	$20,000	$0	0	0
Countywide	11/21/2004	$500,000	$0	0	0
Ganado	05/28/2006	$20,000	$0	0	0
Cordele	07/02/2007	$0	$0	0	0
Countywide	05/25/2015	$0	$0	0	0
Jackson (Zone)	06/15/2015	$0	$0	0	0
Morales	08/25/2017	$100,000	$0	0	0
Morales	08/26/2017	$100,000	$0	0	0
Matilda	05/12/2020	$10,000	$0	0	0
Matilda	09/22/2020	$0	$0	0	0
Francitas	05/16/2021	$0	$0	0	0
Ganado	05/16/2021	$0	$0	0	0

Note: From NCDC Storm Event Database

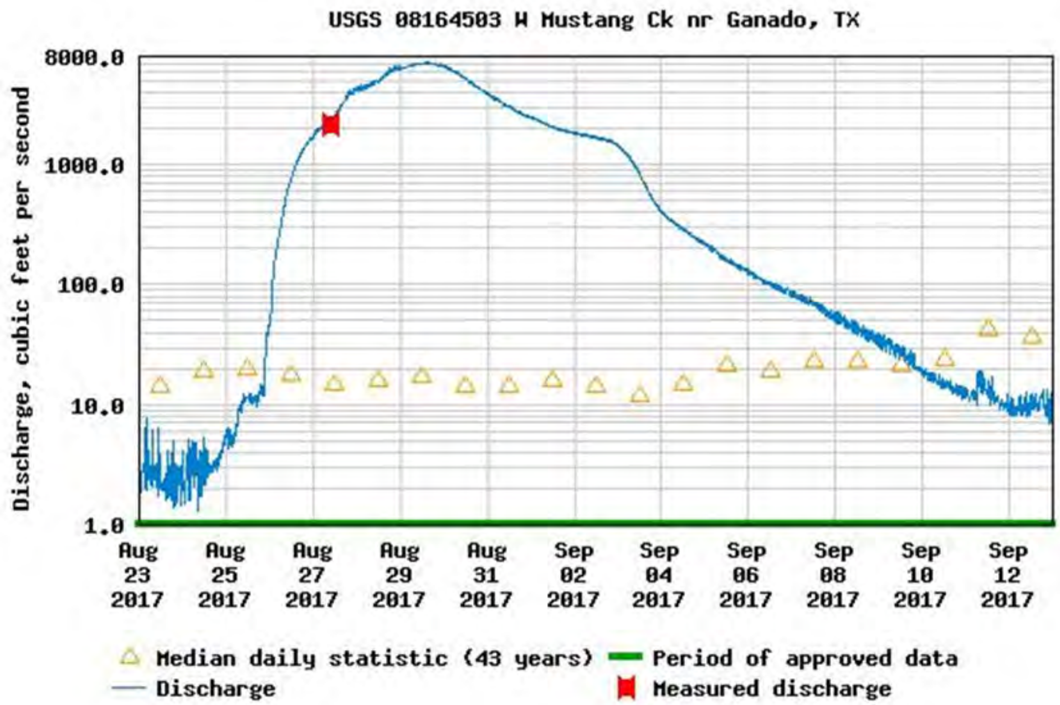
Notable incidents from the NDCD Storm Events Database (and confirmed by local data) in Jackson County and participating communities are described below:

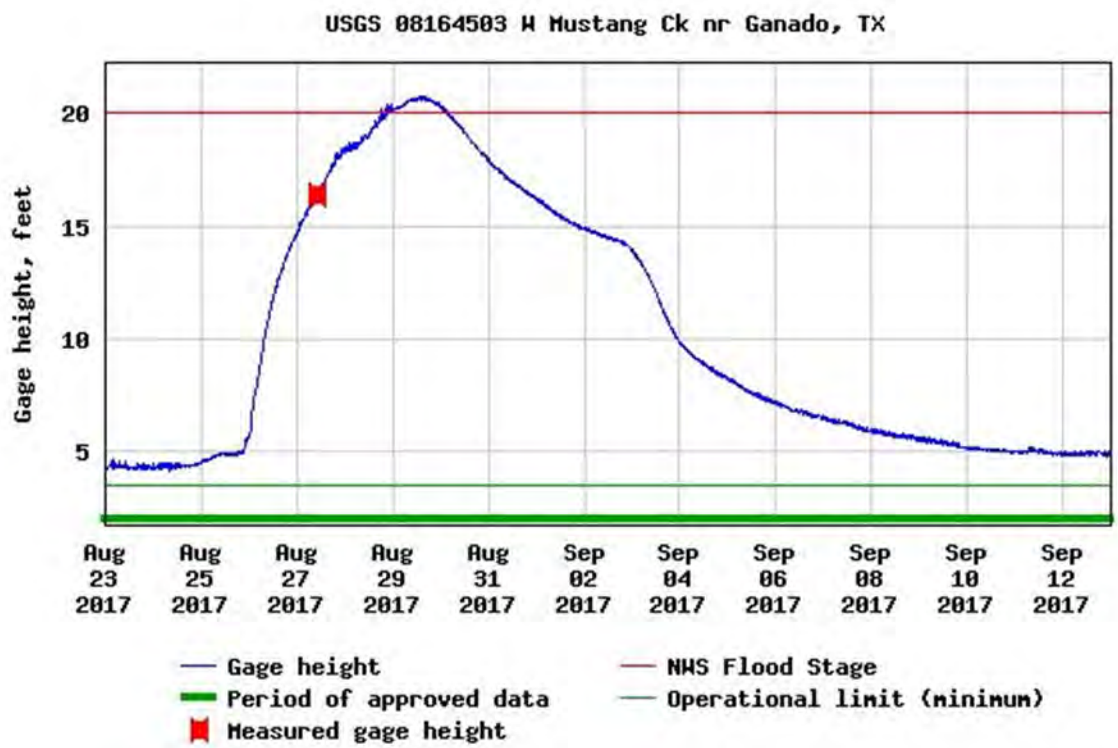
- December 31, 1996 – Heavy rains caused street flooding in Ganado and caused $5,000 of property damage. No injuries or fatalities were associated with the storm.
- April 4, 1997 – Intense rainfall rates of 3 to 4 inches per hour led to flash flooding throughout the county, inundating many streets. Total property damage for the storm was $5,000. No injuries or fatalities were reported.
- May 9, 1997 – Creek flooding occurred due to 2 to 5 inches of rain throughout the county. Property damage totaled $5,000, but no injuries or fatalities were associated with the storm.
- June 21, 1997 – Heavy thunderstorms produced flash flooding throughout the county causing parts of CR 285 to be submerged. Total property damage for the storm was $5,000, with no injuries or fatalities reported.
- September 16, 1998 – Persistent rain led to flash flooding throughout the day, leading to 21 closed county roads due to high water. Volunteer evacuations for low-lying parts of Edna occurred around 12:00 pm. Property damage totaled $45,000 for the county, and no injuries or fatalities were reported.
- October 18, 1998 – Many counties throughout southeast Texas experienced flash flooding, and as a result, moderate street flooding occurred. No injuries or fatalities were reported, however, property damage totaled $15,000.
- November 13, 1998 – Flash flooding throughout the county led to numerous road closures, including County Roads 112, 282, 462, 319, and 320. The storm caused $20,000 in property damages, but no injuries or fatalities were reported.
- August 30, 2001 – Heavy rains and severe weather produced rainfall rates of one inch per hour for up to 6 hours at a time. Widespread street flooding occurred in the area, and some roads were completely washed out. No injuries or fatalities were reported. Property damage was totaled at $80,000.
- September 1, 2001 – Countywide flash flooding caused numerous secondary roads to be inundated. Property damage totaled $45,000, but no injuries or fatalities were reported.
- June 30, 2004 – Flash flooding in Edna caused $20,000 of property damage and forced portions of County Road 112 to be closed due to high water. No injuries or fatalities were reported.
- November 21, 2004 – Widespread major flooding in the area affected the cities of Edna and Ganado. Several residents in the area required aerial rescues. Seventy-nine homes and businesses received minor and major flood damage, with 56 of those facilities in Ganado. Property damage totaled $500,000. No injuries or fatalities were reported.
- May 28, 2006 – Flash flooding in Ganado resulted in street flooding, with water entering some buildings. Property damage totaled $20,000, but no injuries or fatalities were reported.
- May 23-25, 2015 – An extreme precipitation event occurred throughout the Central and South Texas regions over Memorial Day weekend. A large volume of precipitation fell within a relatively short period of time, resulting in damaging floodwaters throughout the region. According to NWS, observed rainfalls in Comal, Guadalupe, Hays, Comal, Travis, and Kerr Counties exceeded 6 inches within a 48-hour period. Areas within Blanco, Comal, and Kendall Counties received at

least 8 inches within 48 hours, and a Blanco County rain gauge managed by LCRA recorded 9.41 inches of rain over the same time period. Jackson County received an average of 2.5 inches of precipitation throughout the county, according to NWS. On May 26, West Mustang Creek near Ganado reached a peak flow of approximately 1,000 cubic feet per second and LakeTexana near Edna reached an elevation of 44.15 feet above datum. No flood damages were reported. There were no injuries or fatalities in Jackson County.

- August 23-27, 2017—Hurricane Harvey made landfall as a category 4 hurricane near Rockport, Texas. The storm weakened to a tropical storm and slowed looping back and tracking over south-east Texas, back over the Gulf of Mexico then making a second landfall along the Louisiana coast during the early morning hours of August 30th. Matagorda and Jackson counties experienced moderate storm surge along Matagorda Bay, tropical-storm-force winds, and major lowland flooding along the Palacious and Navidad Rivers. West Mustang Creek near Ganado reached a peak flow of approximately 7,070 cubic feet per second reaching a gauge height of 20.70 ft, 0.70 feet above the NWS flood stage (Figure 12-2). After the storm, LakeTexana near Edna reached an elevation of 43.42 feet above datum on August 30th (Figure 12-3). Numerous roads and bridges north of Highway 59 and west of FM 822 were inundated with floodwaters. Property damage totaled over $500,000,000, but no injuries or fatalities were reported.
- May 12, 2020—Slow-moving showers and thunderstorms produced heavy rains that led to flooding. Numerous roads were impassable in the Edna area. A few residential homes and a retirement home in Ganado experienced flooding. There were no injuries or fatalities reported, but property damage totaled $10,000.

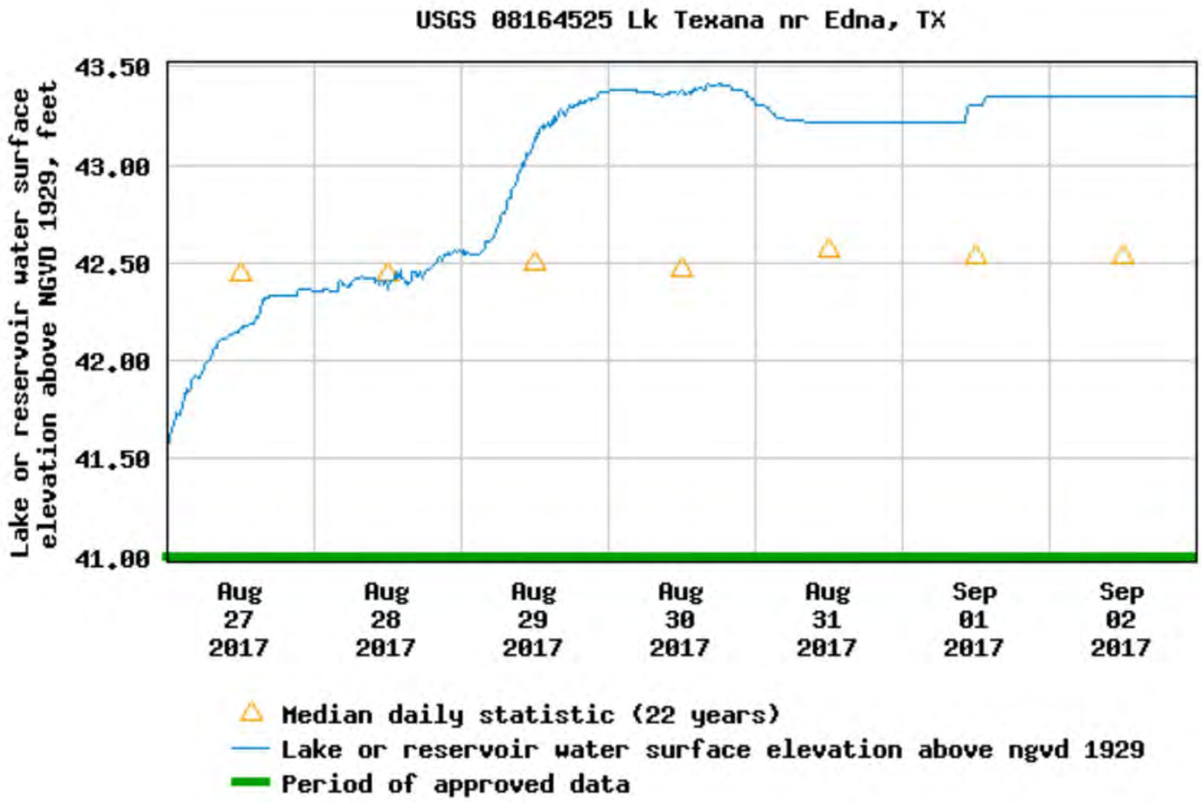
Figure 12-2. West Mustang Creek Flow & Height near City of Ganado During Hurricane Harvey





Note: From USGS

Figure 12-3. Lake Texana near the City of Edna During Hurricane Harvey



Note: From USGS

12.2.2 Location

The Colorado-Lavaca Coastal Basin lies in the eastern part of Jackson County. Significant waterways in Jackson County include Carancahua, Keller, and Cox Creeks, as well as the Lavaca and Edna Rivers. Due to relatively flat topography, these waterways serve as conduits for many bayous and sloughs throughout the county and participating communities.

Runoff is captured to fill several lakes and reservoirs in the county and participating communities. Lake Texana is a large water supply reservoir formed by the Palmetto Bend Dam, which is managed by the Lavaca-Navidad River Authority. Other private dams used for water supply and flood mitigation include the Hal Koop, Bonnot, and Prudential Reservoirs.

In addition to the riverine flooding, Jackson County may experience urban flooding caused by urbanization which can increase the run-off potential of an area. Due to its relatively small urban development, urban flooding is limited. Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, and other large coastal storms that migrate northward from the Gulf of Mexico.

The floodplain boundary extents for most of the creeks, streams, rivers, and lakes in the HMP update area have been mapped by FEMA during its Map Modernization Program. The resulting FIRMs provide an official depiction of flood hazard risks and risk premium zones for each community and properties located within it. While the FEMA digital flood data is recognized as the best available data for planning purposes, it does not always reflect the most accurate and up-to-date flood risk. Riverine flooding, stormwater flooding, and flood-related losses often do occur outside of delineated SFHAs.

Jackson County and participating communities have 113,629 acres in the 100-year floodplain and 129,844 acres in the 500-year floodplain. Table 12-2 shows the distribution of the acreage across the participating jurisdictions in the planning area.

TABLE 12-2.
ACREAGE IN THE 100-YEAR AND 500-YEAR FLOODPLAIN

Jurisdiction	Area (acres)	
	100-Year	500-Year
City of Edna	993	1,136
City of Ganado	60	88
City of La Ward	152	161
Unincorporated Area	112,478	128,459
Jackson County Total	**113,629**	**129,844**

Figure 12-4 shows the SFHAs in Jackson County. Figure 12-5 through Figure 12-7 show the SFHAs for each participating community.

Figure 12-4. Special Flood Hazard Areas in Jackson County and Participating Communities

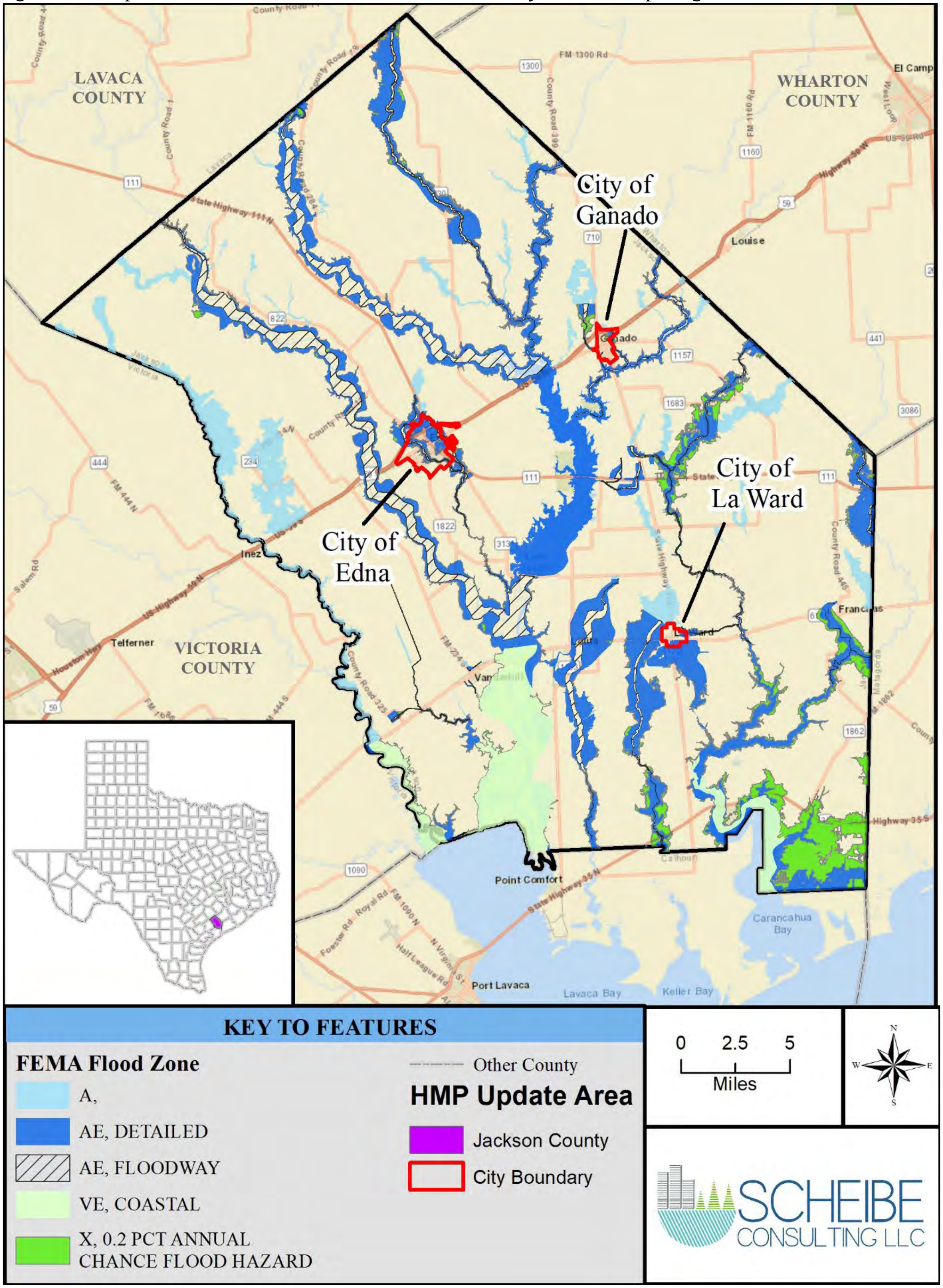


Figure 12-5. Special Flood Hazard Areas in the City of Edna

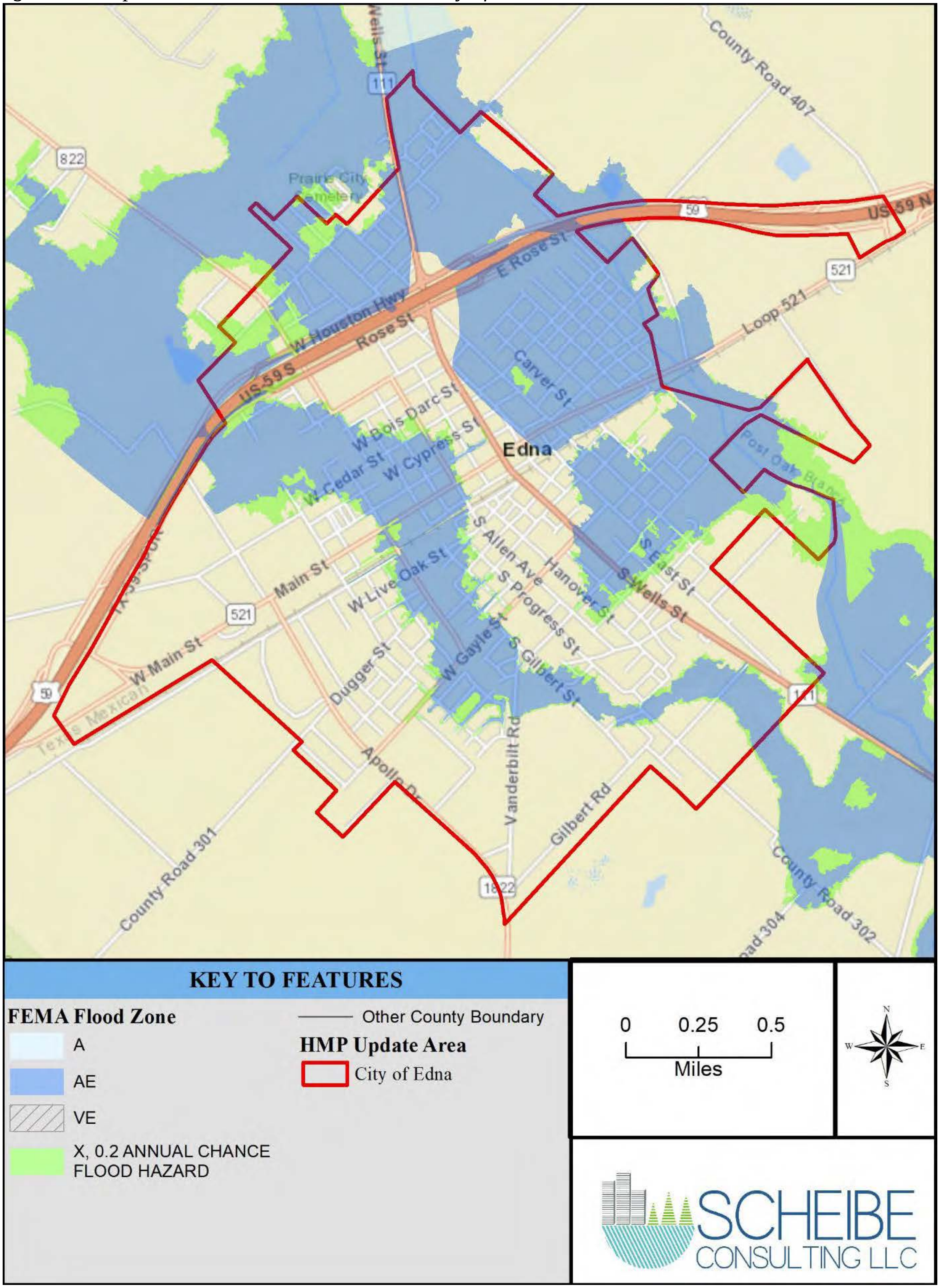


Figure 12-6. Special Flood Hazard Areas in the City of Ganado

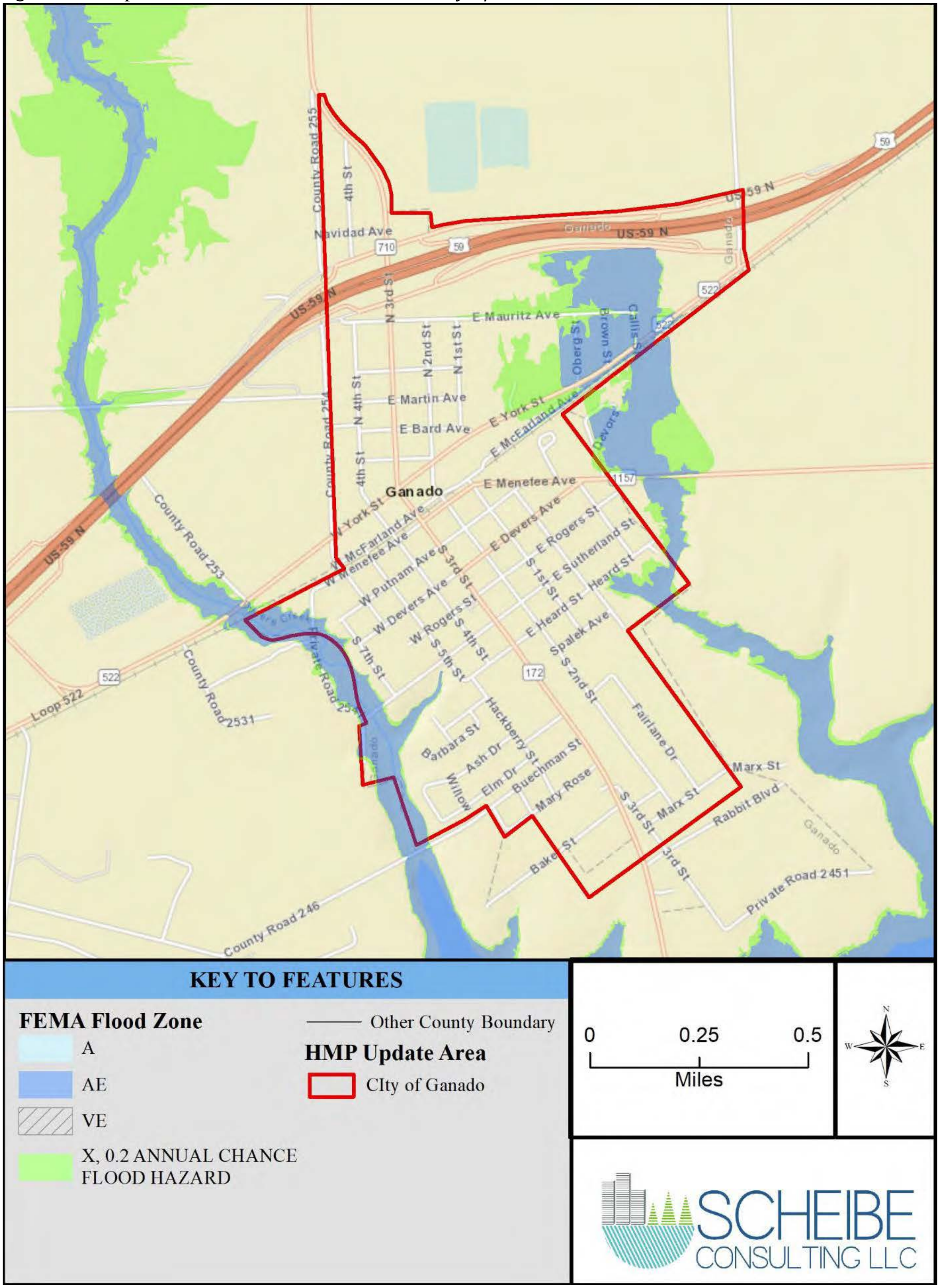
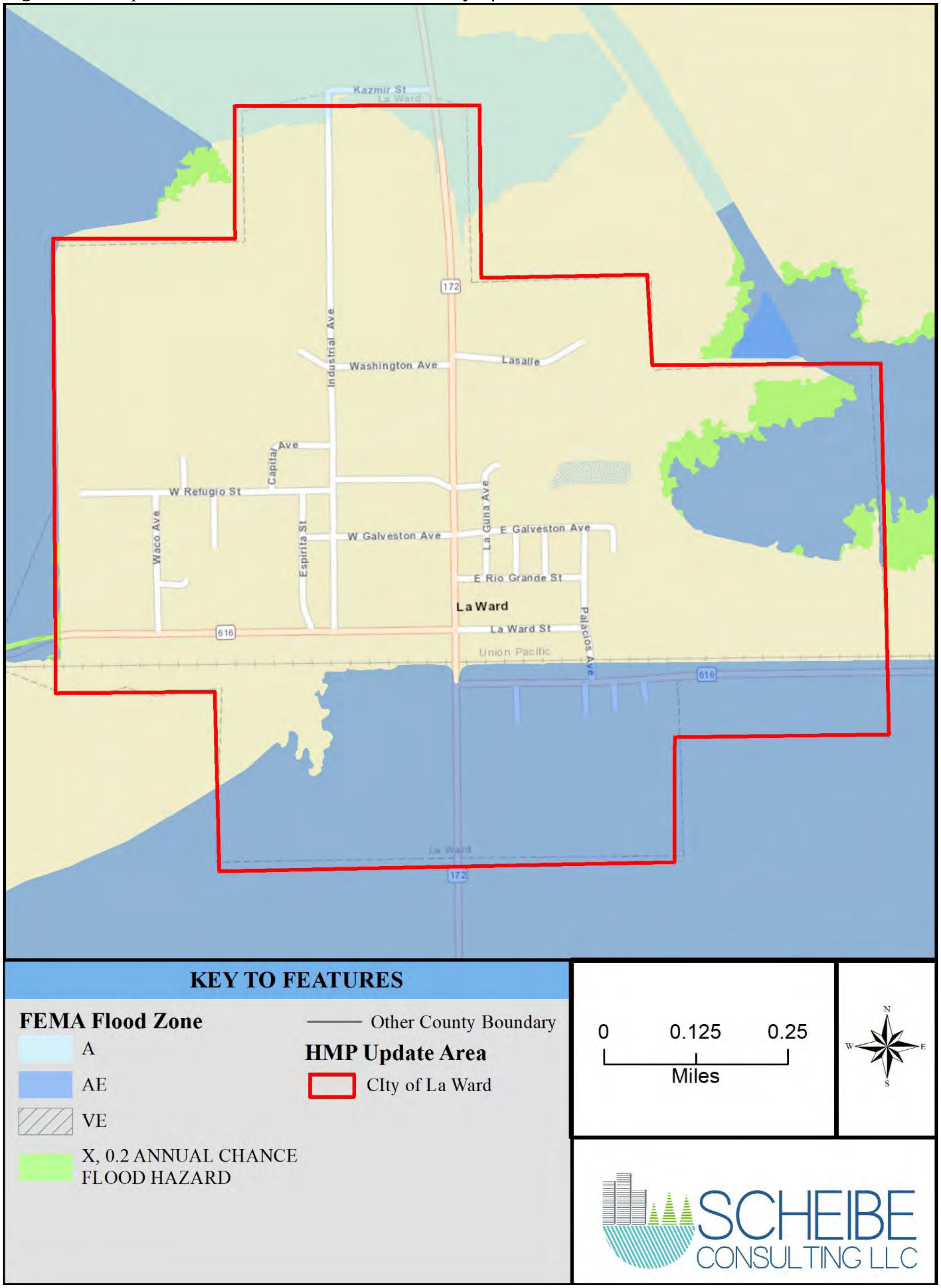


Figure 12-7. Special Flood Hazard Areas in the City of La Ward



12.2.3 Frequency

Seasonal flooding on the rivers and creeks of Jackson County (Including the Navidad and Lavaca River) has increased over time due to increase rainfall events and weather patterns. Flash floods are still considered to be highly likely to occur with nearly a 44% chance of occurrence in any given year. This probability is based on the 29 events occurring in 11 years over a 25-year period reported in the National Climatic Data Center Storm Events Database and other historical records (local knowledge and news sources). Based on historical analysis, Jackson County's unincorporated area can expect 1 event every 1-2 years and has the same frequency and probability for future events. The Cities of Edna, Ganado, and La Ward can expect approximately 1 event every 3 years. These communities also have the same frequency and probability for future events.

12.2.4 Severity

Based on the 100-Year HAZUS-MH probabilistic event scenario for Jackson County and participating communities, the magnitude/severity of flooding is severe. The 100-Year HAZUS-MH flood scenario estimates more than 3,592 residents will be displaced and will seek temporary lodging in public shelters. Overall significance is considered severe.

The intensity and magnitude of a flood event are also determined by the depth of floodwaters. Table 12-3 describes the type of risk and potential magnitude of an event in relation to water depth. The water depths shown in Table 12-3 are estimated based on elevation data above mean sea level.

TABLE 12-3.
EXTENT SCALE – WATER DEPTH

SEVERITY	WATER DEPTH (feet)	DESCRIPTION
BELOW FLOOD STAGE	0 to 5	Water begins to exceed the low sections of banks and the lowest sections of the floodplain.
ACTION STAGE	5 to 10	Flow is well into the floodplain. Minor lowland flooding reaches low areas of the floodplain. Livestock should be moved from low-lying areas.
FLOOD STAGE	10 to 15	Homes are threatened and properties downstream of river flows or in low-lying areas begin to flood.
MODERATE FLOOD STAGE	15 to 20	At this stage, the lowest homes downstream flood. Roads and bridges in the floodplain flood severely and are dangerous to motorists.
MAJOR FLOOD STAGE	20 and Above	Major flooding approaches homes in the floodplain. Primary and Secondary roads and bridges are severely flooded and very dangerous. Major flooding extends well into the floodplain, destroying property, equipment, and livestock.

The range of flood intensity that Jackson County and the participating communities experience is high, even for the 100-Year flood events. This ranges from 0 feet to 10 feet in most areas. Even though most of the depths place the participating communities at the 'action stage' as shown in Table 12-3, West Mustang Creek near Ganado can experience flooding with almost 20 feet (flood stage). Based on historical occurrences, the planning area could experience an average of 5-10 inches of water within a 24 hour period. Figure 12-8 to Figure 12-11 shows the flood depths for the planning area.

Figure 12-8. Flood Depths in Jackson County and Participating Communities

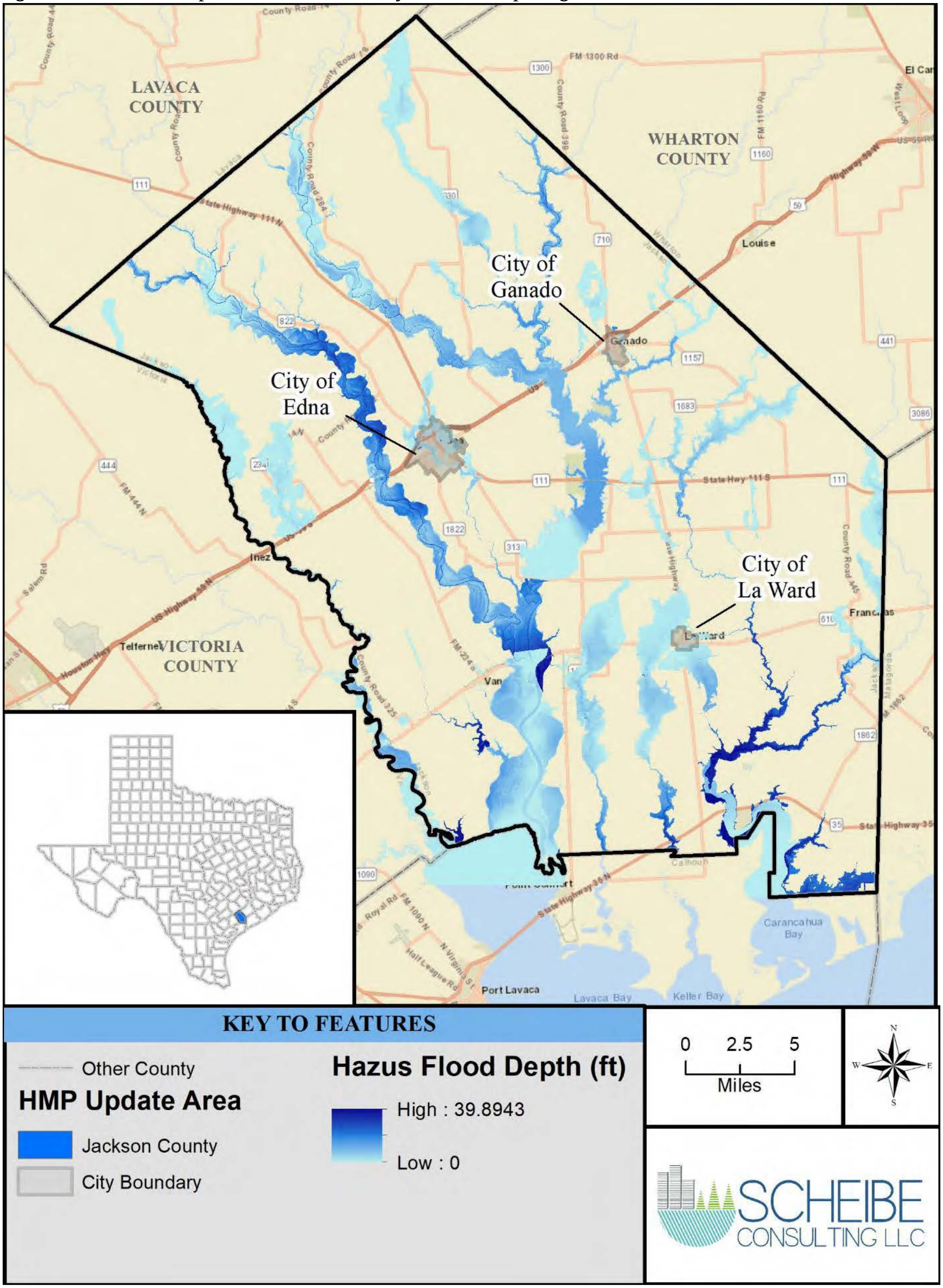


Figure 12-9. Flood Depths in the City of Edna

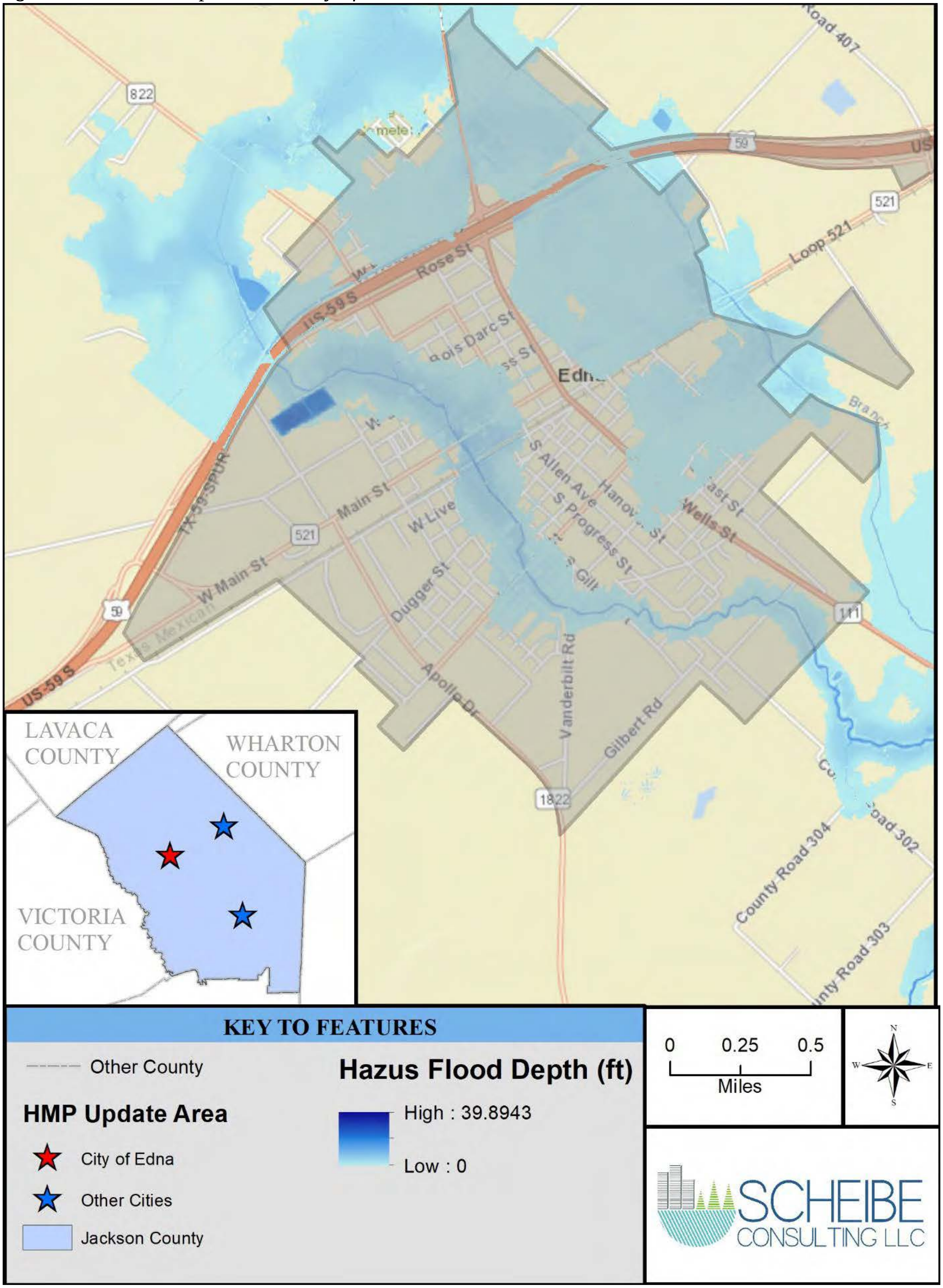


Figure 12-10. Flood Depths in the City of Ganado

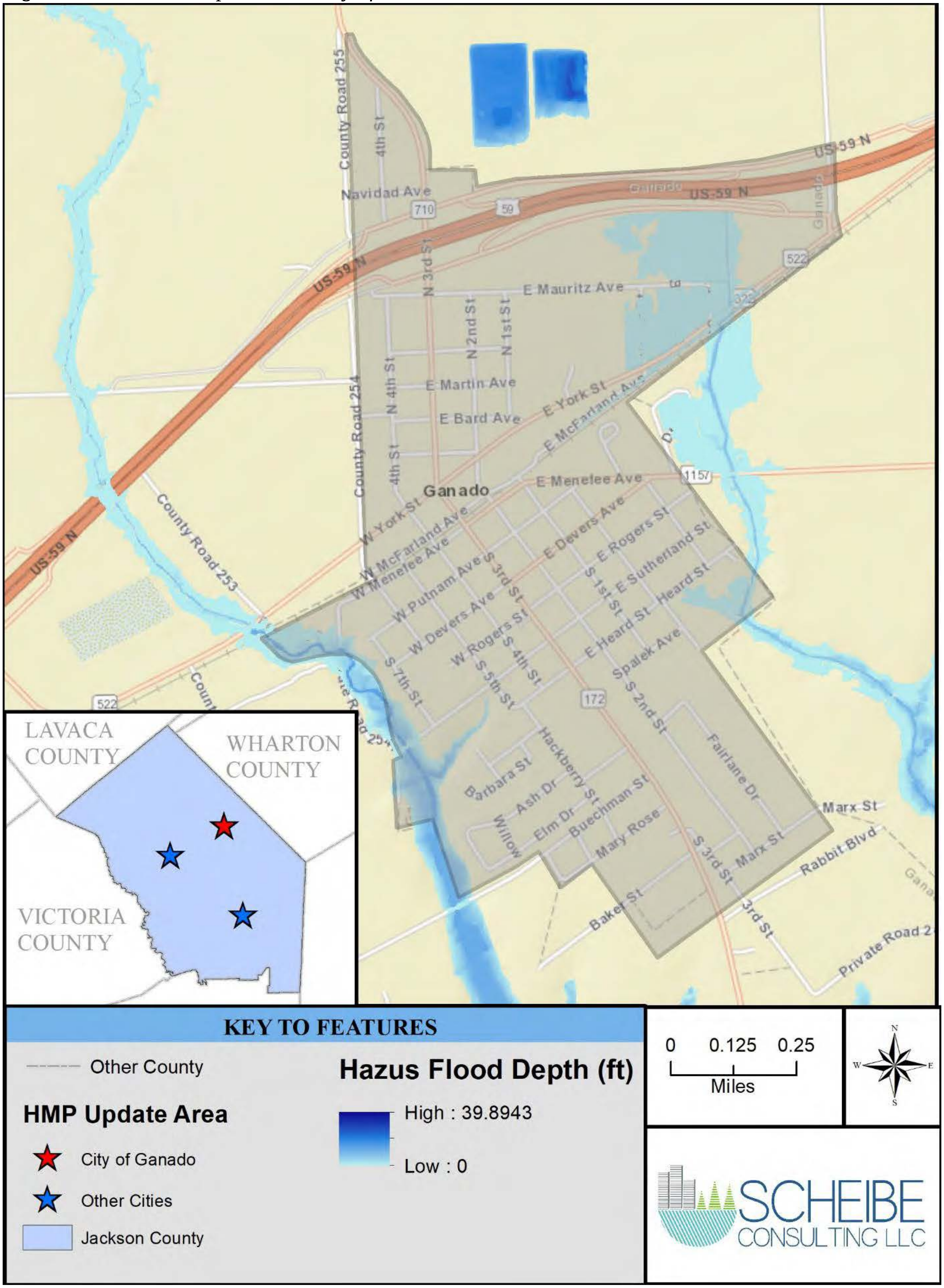
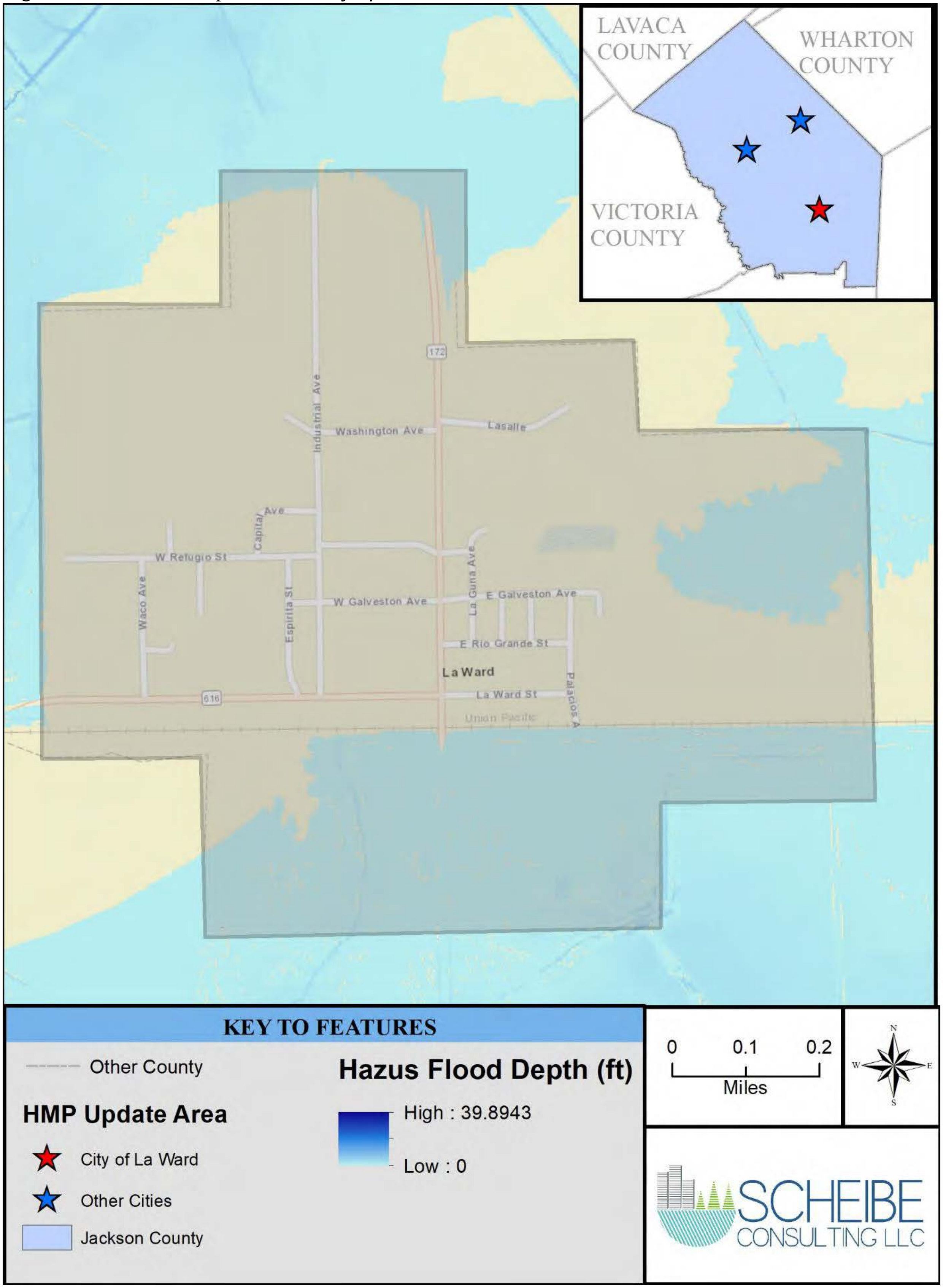


Figure 12-11. Flood Depths in the City of La Ward



12.2.5 Warning Time

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable. It should be noted that during very extreme flooding improved flood warning is needed.

12.3 SECONDARY HAZARDS

The most problematic secondary hazard for flooding is bank erosion, which in some cases can be more harmful than actual flooding. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers, or storm sewers.

12.4 CLIMATE CHANGE IMPACTS

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

- Historical hydrologic patterns should not be solely relied upon to forecast the future. A false sense of confidence had been developed over the years based on the primase the natural forces are a constant, but observations of the data clearly illustrate that these natural forces are constantly changing and past records are only a snapshot as to what could likely happen but are by no means a solid source for future predictions.
- Precipitation and runoff patterns continue to change, highlight uncertainty for water supply and quality, flood management, and ecosystem functions.
- Due to the current warming patterns observed (and assuming they continue in an upward trajectory), it is safe to assume that more extreme climatic events will become more frequent. This assumption is based on the fact that warmer summers near the equator will produce more and likely larger tropic depressions that will in turn produce more and likely larger hurricanes. Until a global cooling cycle begins again, these more extreme weather patterns should be expected.

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

12.5 EXPOSURE

The Level 2 HAZUS-MH protocol was used to assess the risk and vulnerability to flooding in the planning area. The model used U.S. Census data at the block level and calculated floodplain data, which has a level of accuracy acceptable for planning purposes. Where possible, the generated HAZUS-MH flood depth data was enhanced using revised FEMA flood depth grids for the area. The HAZUS-MH default inventory (updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs) data was used.

12.5.1 Population

Population counts of those living in the floodplain in the planning area were generated by census block demographic data (2010 U.S. Census data) that intersect with the 100-year and 500-year floodplains identified on FIRMs. The methodology used to generate population estimates intersected census block demographic data, coupled with population centroids, and overlayed this data with the identified floodplains and then aggregating the resulting data to the community boundaries. Using this approach, it was estimated that the exposed population for the planning area within the 100-year floodplain or SFHA is 3,634 (25.8% of the total county population). In the 500-year floodplain, it is estimated that 4,656 people countywide live within the mapped non-SFHA areas (33.1% of the total county population).

12.5.2 Property

Present Land Use

Table 12-4 and Table 12-5 show the present land uses in the 100-year and 500-year floodplains for the entire planning area.

TABLE 12-4.
PRESENT LAND USE IN THE 100-YEAR FLOODPLAIN

Present Use Classification	Area (acres) City of Edna	City of Ganado	City of La Ward	Unincorporated Area	Jackson County Total	% of Total
Barren Land (Rock/Sand/Clay)	0	0	0	240	240	0.2
Cultivated Crops	7	0	1	16,983	16,991	15.0
Deciduous Forest	5	1	2	4,760	4,768	4.2
Developed High Intensity	15	1	0	39	55	0.05
Developed, Low Intensity	255	7	4	429	695	0.6
Developed, Medium Intensity	71	3	1	82	157	0.1
Developed, Open Space	719	22	13	1,567	2,131	1.9
Evergreen Forest	7	1	0	5,304	5,312	4.7
Emergent Wetlands	0	1	0	13,322	13,323	11.7
Grassland/Herbaceous	7	1	0	894	898	0.8
Mixed Forest	3	0	0	5,799	5,802	5.1
Open Water	9	23	0	14,377	14,409	12.7
Pasture/Hay	105	1	131	35,491	35,728	31.4
Shrub/Scrub	2	4	0	2,021	2,027	1.8
Woody Wetlands	0	0	0	11,108	11,108	9.8
Jackson County Total	1,001	65	152	112,578	113,644	100

TABLE 12-5.
PRESENT LAND USE IN THE 500-YEAR FLOODPLAIN

Present Use Classification	Area (acres) City of Edna	City of Ganado	City of La Ward	Unincorporated Area	Jackson County Total	% of Total
Barren Land (Rock/Sand/Clay)	0	0	0	304	304	0.2
Cultivated Crops	6	0	1	20,786	20,793	16.0
Deciduous Forest	5	1	2	4,969	4,977	3.8
Developed High Intensity	15	1	0	42	58	0.04
Developed, Low Intensity	253	7	4	560	824	0.6
Developed, Medium Intensity	70	3	1	95	169	0.1
Developed, Open Space	516	22	14	2,249	2,791	2.2
Evergreen Forest	0	1	0	13,442	13,443	10.4
Emergent Wetlands	7	0	0	6,150	6,157	4.8
Grassland/Herbaceous	3	1	0	999	1,003	0.8
Mixed Forest	3	1	0	6,665	6,669	5.1
Open Water	9	0	0	14,572	14,581	11.3
Pasture/Hay	104	23	139	43,889	44,155	34.1
Shrub/Scrub	2	1	1	2,274	2,278	1.8
Woody Wetlands	0	4	0	11,380	11,384	8.8
Jackson County Total	993	65	162	128,366	129,586	100

Structures in the Floodplain

Table 12-6 and Table 12-7 summarize the total area and number of structures in the floodplain by participating community. The updated HAZUS-MH model inventory data estimated that there are 1,718 structures within the 100-year floodplain and 2,315 structures within the 500-year floodplain. In the 100-year floodplain, 31% of these structures are in unincorporated areas and 94% are residential.

TABLE 12-6.
STRUCTURES AND POPULATION IN THE 100-YEAR FLOODPLAIN

Jurisdiction	Residential	Commercial	Other*	**Total Structures Affected**	**Total Population Affected**
City of Edna	1,054	46	29	**1,130**	**2,510**
City of Ganado	25	1	0	**26**	**58**
City of La Ward	18	0	0	**18**	**47**
Unincorporated Area	520	14	11	**544**	**1,019**
Jackson County Total	**1,617**	**61**	**40**	**1,718**	**3,634**

Notes: *Other includes industrial, agricultural, religious, governmental, and educational classifications.

TABLE 12-7.
STRUCTURES AND POPULATION IN THE 500-YEAR FLOODPLAIN

Jurisdiction	Residential	Commercial	Other*	**Total Structures Affected**	**Total Population Affected**
City of Edna	1,179	51	34	**1,264**	**2,843**
City of Ganado	31	1	1	**33**	**70**
City of La Ward	19	0	0	**19**	**50**
Unincorporated Area	962	19	18	**999**	**1,693**
Jackson County Total	**2,191**	**71**	**53**	**2,315**	**4,656**

Note: *Other includes industrial, agricultural, religious, governmental, and education classifications.

Exposed Value

Table 12-8 and Table 12-9 summarize the estimated value of exposed buildings in the planning area in the 100-year and 500-year floodplains. The updated HAZUS-MH model inventory data estimated $502 million worth of building and contents exposed to the 100-year flood. This represents 21.2% of the total assessed value of the planning area. Approximately $660 million worth of building and content value was estimated to be exposed to the 500-year flood. This represents 27.9% of the total assessed value of the planning area.

TABLE 12-8. VALUE OF STRUCTURES IN THE 100-YEAR FLOODPLAIN					
	Value Exposed ($)				
Jurisdiction	Structure	Contents	**Total**	**Total Assessed Value ($)**	% of Total Assessed Value
City of Edna	210,335,344	123,362,557	**333,697,901**	**873,172,834**	38.2
City of Ganado	5,077,681	2,753,123	**7,830,804**	**253,570,646**	3.1
City of La Ward	3,125,712	1,584,517	**4,710,229**	**27,144,277**	17.4
Unincorporated Area	100,347,955	55,659,417	**156,007,372**	**1,215,680,242**	12.8
Jackson County Total	**318,886,692**	**183,359,614**	**502,246,306**	**2,369,568,000**	**21.2**

TABLE 12-9. VALUE OF STRUCTURES IN THE 500-YEAR FLOODPLAIN					
	Value Exposed ($)				
Jurisdiction	Structure	Contents	**Total**	**Total Assessed Value ($)**	% of Total Assessed Value
City of Edna	233,047,852	136,588,771	**369,636,623**	**873,172,834**	42.3
City of Ganado	6,272,603	3,401,611	**9,674,214**	**253,570,646**	3.8
City of La Ward	3,329,819	1,692,915	**5,022,735**	**27,144,277**	18.5
Unincorporated Area	180,414,265	97,929,538	**278,333,802**	**1,215,680,242**	22.9
Jackson County Total	**423,064,539**	**239,612,835**	**662,667,374**	**2,369,568,000**	**28.0**

12.5.3 Critical Facilities and Infrastructure

Table 12-10 and Table 12-11 summarize the critical facilities and infrastructure in the 100-year and 500-year floodplains of the planning area. Details are provided in the following sections.

TABLE 12-10.
CRITICAL FACILITIES AND INFRASTRUCTURE IN THE 100-YEAR FLOODPLAIN

	City of Edna	City of Ganado	City of La Ward	Unincorporated Area	Jackson County Total
Medical and Health	0	0	0	0	**0**
Government Functions	0	0	0	0	**0**
Police/Fire Station	0	0	0	1	**1**
Schools	0	0	0	0	**0**
Hazardous Materials	0	0	0	1	**1**
Bridges	11	6	0	87	**104**
Water Storage	0	0	0	0	**0**
Wastewater	1	0	0	5	**6**
Power	0	0	0	0	**0**
Communications	0	0	0	0	**0**
Transportation	1	0	0	0	**1**
Dams	0	0	0	3	**3**

TABLE 12-11. CRITICAL FACILITIES AND INFRASTRUCTURE IN THE 500-YEAR FLOODPLAIN					
	City of Edna	City of Ganado	City of La Ward	Unincorporated Area	**Jackson County Total**
Medical and Health	0	0	0	0	**0**
Government Functions	0	0	0	0	**0**
Police/Fire Station	0	0	0	1	**1**
Schools	0	0	0	0	**0**
Hazardous Materials	0	0	0	1	**1**
Bridges	12	6	0	88	**106**
Potable Water	0	0	0	0	**0**
Wastewater	1	0	0	5	**6**
Power	0	0	0	0	**0**
Communications	0	0	0	0	**0**
Transportation	2	0	0	0	**2**
Dams	0	0	0	3	**3**

Utilities and Infrastructure

It is important to identify who may be at risk if infrastructure is damaged by flooding. Roads or railroads that are blocked or damaged can isolate residents and can prevent access throughout the county, including emergency service providers needing to get to vulnerable populations or to make repairs. Bridges washed out or blocked by floods or debris also can cause isolation. Water and sewer systems can be flooded or backed up, causing health problems. Underground utilities can be damaged. Levees can fail or be overtopped, inundating the land that they protect. The following sections describe specific types of critical infrastructure.

*Road*s

The major roads in the planning area that pass through the 100-year floodplain and thus are exposed to flooding are State Highways 35, 59, 60, 71, 111, and 172. In severe flood events, these roads can be blocked or damaged, preventing access to some areas. This was experienced post Hurricane Harvey, where large portions of US 59 and Hwy 60 were flooded for days and were impassable. This prevented the movement of goods and also greatly inhibited emergency access throughout Jackson County and the Cities within.

Bridges

Flooding events can significantly impact road bridges. These are important because often they provide the only ingress and egress to some neighborhoods. Countywide, 105 bridges are in or cross over the 100-year floodplain.

Water and Sewer Infrastructure

Water and sewer systems can be affected by flooding. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers, and streams.

12.5.4 Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in, flooding can impact the environment in negative ways. Migrating fish can wash into roads or over levees into flooded fields, with no possibility of escape. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees, and logjams from timber harvesting can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

12.6 VULNERABILITY

Many of the areas exposed to flooding may not experience serious flooding or flood damage. This section describes vulnerabilities in terms of population, property, infrastructure, and environment. The vulnerability analysis was performed at the census-block level. This methodology is likely to overestimate impacts from both the modeled 100-year and 500-year flood events as it is assumed that both structures and the population are distributed evenly over each census block.

12.6.1 Population

A geographic analysis of demographics (countywide) using the default HAZUS-MH model data (2010 U.S. Census demographics) identified populations vulnerable to the flood hazard as follows. These numbers are calculated assuming that the population/households are evenly distributed over the census blocks.

- Economically Disadvantaged Populations—It is estimated that approximately 8.1% of the population within the 100-year floodplain are economically disadvantaged. Economically disadvantaged is defined as having household incomes of $20,000 or less.
- Population over 65 Years Old—It is estimated that approximately 14.6% of the population in the 100-year floodplain are over 65 years old.
- Population under 16 Years Old—It is estimated that approximately 27.7% of the population in the 100-year floodplain are under 16 years of age.

The following impacts on persons and households in Jackson County were estimated for the 100-year and 500-year flood events through the Level 2 HAZUS-MH analysis:

- During a 100-year flood event

   - Displaced population = 3,592
   - Persons requiring short-term shelter = 369
- During a 500-year flood event
   - Displaced population = 4,640
   - Persons requiring short-term shelter = 456

12.6.2 Property

HAZUS-MH calculates direct losses to structures from flooding by looking at the depth of flooding and the type of structure. Using historical flood insurance claim data, HAZUS-MH estimates the percentage of direct damage to structures and their contents by applying established damage functions to an inventory. Other losses often coincide with direct losses but for purposes of this analysis, these indirect losses are not accounted for. For this analysis, the default inventory data provided with HAZUS-MH was used. The analysis is summarized in Table 12-12 for the 100-year flood event. It is estimated that there would be up to $66 million in total direct flood loss from a 100- year flood event in the planning area. This represents 13.2% of the total exposure to the 100-year flood for the county. Losses are estimated to be $74 million in total direct flood losses from a 500- year flood event, representing 11.1% of the exposure to the 500-year event for the county (Table 12-13).

TABLE 12-12.
LOSS ESTIMATES FOR THE 100-YEAR FLOOD EVENT

Jurisdiction	Loss ($)			Exposed Value ($)	% of Total Exposed Value
	Structure	Contents	**Total**		
City of Edna	12,940,000	10,590,000	**23,530,000**	333,697,901	7.1
City of Ganado	390,000	310,000	**700,000**	7,830,804	8.9
City of La Ward	30,000	20,000	**50,000**	4,710,229	1.1
Unincorporated Area	26,470,000	15,700,000	**42,170,000**	156,007,372	27.0
Jackson County Total	**39,800,000**	**26,600,000**	**66,400,000**	**502,246,306**	**13.2**

TABLE 12-13. LOSS ESTIMATES FOR THE 500 YEAR FLOOD EVENT					
Jurisdiction	Loss ($)			Exposed Value ($)	% of Total Exposed Value
	Structure	Contents	**Total**		
City of Edna	13,010,000	10,590,000	**23,600,000**	369,636,623	6.4
City of Ganado	400,000	320,000	**720,000**	9,674,214	7.4
City of La Ward	30,000	20,000	**50,000**	5,022,735	1.0
Unincorporated Area	31,240,000	18,120,000	**49,360,000**	278,333,802	17.7
Jackson County Total	**44,650,000**	**29,030,000**	**73,680,000**	**662,667,374**	**11.1**

National Flood Insurance Program

Table 12-14 lists flood insurance statistics (from 1979 to May 2017) that help identify vulnerability in the planning area. Jackson County and the Cities of Edna and Ganado participate in the NFIP.

TABLE 12-14. NATIONAL FLOOD INSURANCE PROGRAM STATISTICS			
Jurisdiction	Initial FIRM Effective Date	Claims	Value of Claims Paid
City of Edna	11/12/1971	155	$1,917,000
City of Ganado	09/28/1979	24	$348,128
City of La Ward	09/28/1979	1	$85,026
Unincorporated Area	08/05/1978	17	$254,456
Jackson County Total	**05/02/2012 ***	**196**	**$2,519,584**

Notes:
FIRM Flood Insurance Rate Map
* Effective date of initial countywide Flood Insurance Study
From FEMA Flood Loss Statistics

Properties constructed after a FIRM has been adopted are eligible for reduced flood insurance rates. Such structures are less vulnerable to flooding since they were constructed after regulations and codes were adopted to decrease vulnerability. Properties built before a FIRM is adopted are more vulnerable to flooding because they do not meet code or are located in hazardous areas. The first Flood Hazard Boundary Map (FHBM) for the City of Edna was available in 1971, the City of Ganado in 1979, the City of La Ward in 1979, and Jackson County in 1978.

The following information from flood insurance statistics is relevant to reducing flood risk:

- The use of flood insurance in the planning area is less than the national average.

- The average claim paid in Jackson County (1978 to May 2021) is approximately $12,855, well below the national average.

The County continues NFIP compliance with the Flood Damage Prevention Ordinance and Floodplain Ordinance administered by the Permit and Inspection Department. The County has mitigation actions such as listed in Table 23-2.

The City of Edna continues NFIP compliance with the Standard for Floodplain Management Ordinance and is administered by the Public Works Department. The City has mitigation actions listed in Table 23-2

The City of Ganado continues NFIP compliance with the Flood Damage Prevention Regulations adopted in 1987 and is administered by the Public Works Director. The City has mitigation actions listed in Table 23-2.

The City of La Ward continues NFIP compliance under the Counties floodplain ordinance, which is administered by the County Floodplain Administrator. The City has mitigation actions listed in Table 23-2.

These measures are intended to reduce the future flood risks in the SFHA and continue the participating partners' good standing with NFIP. All the municipal planning partners are informed of the training schedule for their Floodplain Administrators through the TCRFC and the TWDB and attend continuing education seminars and classes on a yearly basis.

Repetitive Loss

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

- Any insurable building for which two or more claims of more than $1,000 were painted by the NFIP within any rolling 10-year period

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

- Four claims greater than $5,000
- Two or more paid losses that equal or exceed the current value of the insured property

Repetitive loss properties make up only 1% to 2% of flood insurance policies in force nationally, yet they account for 40% of the nation's flood insurance claim payments. In 1998, FEMA reported that the NFIP's 75,000 repetitive loss structures have already cost $2.8 billion in flood insurance payments and that numerous other flood-prone structures remain in the floodplain at high risk. The government has instituted programs encouraging communities to identify and mitigate the causes of repetitive losses. A recent report on repetitive losses by the National Wildlife Federation found that 20% of these properties are outside any mapped 100-year floodplain. The key identifiers for repetitive loss properties are the existence of flood insurance policies and claims paid by the policies.

FEMA-sponsored programs, require participating communities to identify repetitive loss areas. A repetitive loss area is the portion of a floodplain holding structures that FEMA has identified as meeting the definition of repetitive loss. Identifying repetitive loss areas helps to identify structures that are at risk but are not on FEMA's list of repetitive loss structures because no flood insurance policy was in force at the time of loss. Information regarding repetitive loss properties is on file with the Texas Water Development Board.

As of March 2022, Jackson County has a total of 20 residential repetitive loss and 2 severe repetitive loss properties. The City of Edna has 16 residential repetitive loss properties and 2 residential severe repetitive loss properties. The City of Ganado has 1 residential repetitive loss property. Jackson Co. unincorporated area (which includes La Ward) has 3 residential repetitive loss properties.

12.6.3 Critical Facilities and Infrastructure

HAZUS-MH was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Using depth/damage function curves to estimate the percent of damage to the building and contents of critical facilities, HAZUS-MH correlates these estimates into an estimate of functional down-time (the estimated time it will take to restore a facility to 100% of its functionality). This helps to gauge how long the planning area could have limited usage of facilities deemed critical to flood response and recovery.

The HAZUS-MH critical facility analysis found that, on average, critical facilities would receive some damage to structure and contents during a 100-year or 500-year flood event. Countywide, both the 100-year and 500-year flood scenarios would result in moderate damage (10 to 50%) to one police station, one hospital, and two schools. Significant functionality would be lost during these events.

12.6.4 Environment

The environment vulnerable to flood hazard is the same as the environment exposed to the hazard. Loss estimation platforms such as HAZUS-MH are not currently equipped to measure the environmental impacts of flood hazards. The best gauge of the vulnerability of the environment would be a review of damage from past flood events. Loss data that segregates damage to the environment was not available at the time of this plan. Capturing this data from future events could be beneficial in measuring the vulnerability of the environment for future updates.

12.7 FUTURE TRENDS IN DEVELOPMENT

Jackson County and its planning partners are equipped to handle future growth within flood hazard areas. All municipal planning partners have plans and policies that address frequently flooded areas. All partners have committed to linking their plans to this hazard mitigation plan update. This will create an opportunity for sound watershed-wide land-use decisions and floodplain management practices as future growth impacts flood hazard areas.

Additionally, all municipal planning partners are participants in the NFIP and have adopted flood damage prevention ordinances in response to its requirements. All municipal planning partners have committed to maintaining their good standing under the NFIP through initiatives identified in Section 6.9, Chapter 7, Section 12.6.2, and Table 23-2.

Urban flooding issues that contribute to flash floods are also a concern in more highly developed areas in Jackson County. Jurisdictions in the county are required to develop a stormwater permitting program as mandated by the National Pollutant Discharge Elimination System. This program will help jurisdictions apply effective mitigation measures for stormwater runoff.

The recent dam modernization program on LCRA’s dams meets required design safety standards to resist the water load and pressure of the PMF is a step in the right direction. There is, however, always some residual risk and it is expected that the emergency action plans for the dams will be maintained so the appropriate responses can be exercised in case of a dam failure.

12.8 SCENARIO

An intense, short-duration storm could move slowly across the planning area creating significant flash floods with little or no warning. Injuries or fatalities may result if residents are caught off guard by the flood event. Stormwater systems could be overwhelmed and significant flooding could impact a substantial portion of structures within the planning area. Transportation routes could be cut off due to floodwaters, isolating portions of the planning area. These impacts may last after the floodwater recedes as flash floods in the area have been known to cause extensive damage to roadway infrastructure. Areas that have recently experienced wildfires would contribute to the extent of flooding impacts.

12.9 ISSUES

The major issues for flooding are the following:

- Flash flooding that occurs with little or no warning will continue to impact the planning area.
- The duration and intensity of storms contributing to flooding issues may increase due to climate change.
- Flooding may be exacerbated by other hazards, such as wildfires.
- Damages resulting from a flood may impact tourism, which may have significant impacts on the local economy.
- The promotion of flood insurance as a means of protecting private property owners from the economic impacts of frequent flood events should continue.

Chapter 13.
Hurricanes and Tropical Storms

HURRICANE AND TROPICAL STORM RANKING	
Jackson County	High
City of Edna	High
City of Ganado	High
City of La Ward	High

DEFINITIONS

Hurricane	A tropical cyclone with maximum sustained surface winds (using the U.S. 1-minute average) of 64 knot (kt) (74 miles per hour [mph]) or more.
Tropical Storm	A tropical cyclone with maximum sustained surface wind speed (using the U.S. 1-minute average) ranges from 34 kt (39 mph) to 63 kt (73 mph).
Tropical Depression	A tropical cyclone with maximum sustained surface wind speed (using the U.S. 1-minute average) ranges from 4 kt (39 mph) to 63 kt (73 mph).

13.1 GENERAL BACKGROUND

13.1.1 Hurricanes and Tropical Storms

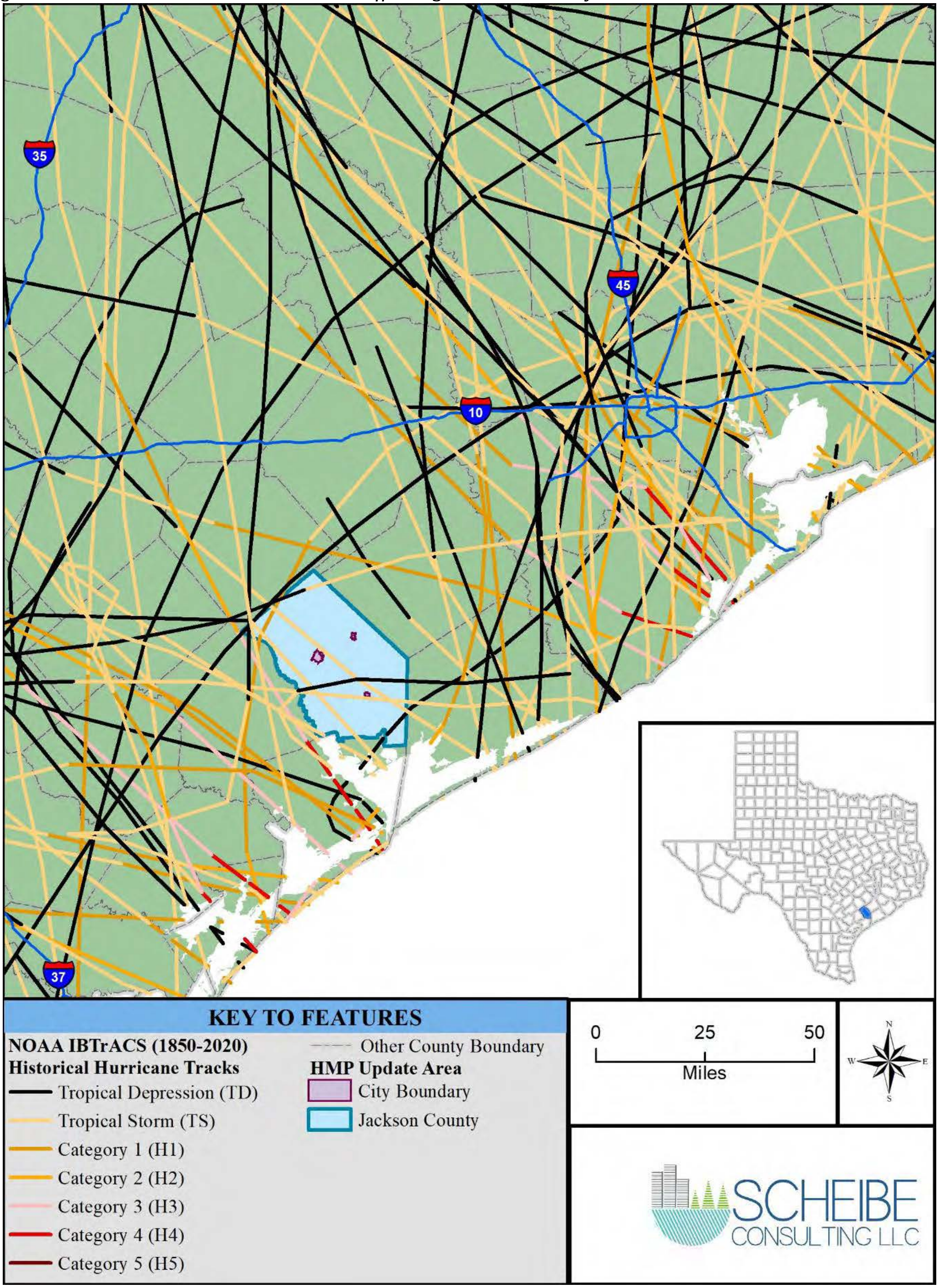
Tropical cyclones are classified into three main categories (per intensity): hurricanes, tropical storms, and tropical depressions. Tropical cyclones that affect Texas form in the Gulf of Mexico or the Atlantic Ocean.

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

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

A tropical storm is a tropical cyclone in which the maximum sustained surface wind speeds range from 39 to 73 mph. At this time the tropical cyclone is assigned a name. During this time, the storm itself becomes more organized and begins to become more circular, resembling a hurricane. Figure 13-1 illustrates historical hurricane tracks affecting the entire study area.

Figure 13-1. Historical Hurricane Paths Affecting Jackson County



Notes: From NOAA IBTrACS Version 4

13.1.2 Hurricane and Tropical Storm Classifications

Hurricanes are classified according to the Saffir-Simpson Hurricane Wind Scale from Category 1 to Category 5 by sustained wind intensity. Table 13-1 lists a description of each category.

TABLE 13-1.
SAFFIR SIMPSON HURRICANE WIND SCALE

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

Notes: Other non-hurricane classifications are tropical storms (39-73 miles per hour) and tropical depressions (0-38 miles per hour)
From NOAA – National Hurricane Center and Central Pacific Hurricane Center

13.2 HAZARD PROFILE

While hurricanes pose the greatest threat to life and property, tropical storms and depressions also can be devastating. Floods from heavy rains and severe weather, such as tornadoes, can cause extensive damage and loss of life. For example, Tropical Storm Allison produced over 40 inches of rain in the Houston area in 2001, causing approximately $5 billion in damage and multiple fatalities.

13.2.1 Past Events

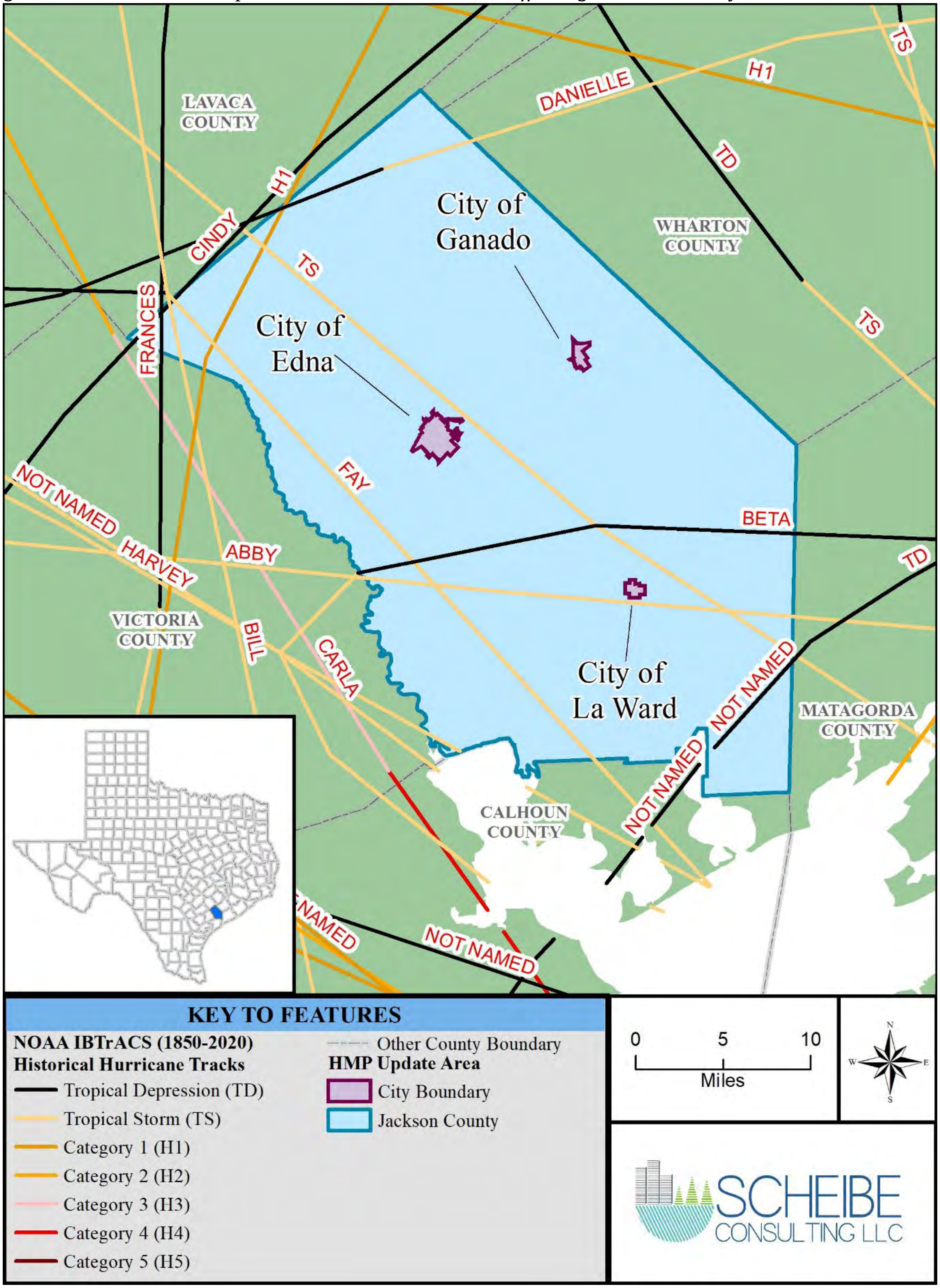
Due to Jackson County and participating communities' interior location on the Texas Gulf Coast, it is directly exposed to hurricanes. The hurricanes usually fade and downgrade to tropical storms or tropical depressions as they move away from the coast. According to NOAA, Jackson County and participating communities have been in the direct track of 10 tropical cyclones between 1851 and 2020 and felt the impacts of 57 events. According to Colorado State University, the impact of a hurricane can be directly felt within 50 nautical miles of its tracks. A record count of the seven different hurricane categories within this time period shows six measured tropical storms. Notable hurricane, tropical storm, and depression landfalls documented by NOAA between 1851 and 2020 for Jackson County and participating communities are described below:

- August 5 to 8, 1964 (Tropical Storm Abby) – Maximum wind speeds were approximately 65 mph. Tropical Storm Abby made landfall near Matagorda Island, then moved west across south-central Texas. Jackson and Victoria Counties received the most rainfall ranging from 3 to 6 inches. However, because of previous storms and ongoing harvesting efforts, damages to Jackson County's rice farms were limited. Damages were estimated at approximately $750,000 throughout the State of Texas for this event.
- September 4 to 7, 1980 (Tropical Storm Danielle) – Maximum wind speeds were approximately 60 mph. Tropical Storm Danielle made landfall in East Texas (near Sabine Pass), incurring the most damage along the Texas and Louisiana border. The tropical storm then moved west across the Texas Coastline. Jackson County did not receive significant damages or impact.
- September 7, 2002 (Tropical Storm Fay) – Maximum wind speeds were approximately 50 mph.
- July 15, 2003 (Tropical Storm Claudette) – Maximum wind speeds were approximately 75 mph. More than $500,000 in damages were reported; all damages were wind-related. Two injuries (no fatalities) occurred from this event.
- June 16 to 17, 2015 (Tropical Storm Bill) – Tropical Storm Bill made landfall on Matagorda Island, Matagorda County, Texas at 11:45 am. Its maximum sustained wind speed at landfall was 60 mph. Tropical Storm Bill moved inland and was downgraded to a tropical depression at 1:00 am on June 17. After spending three days over land as a tropical depression, Bill finally transitioned into a post-tropical cyclone on the afternoon of June 20 over eastern Kentucky. Although Bill brought coastal flooding and gusty winds to the Texas Coast at landfall, its primary impact was rainfall flooding. Peak rainfall totals from Bill were: 13.28 inches near El Campo, Texas; 12.53 inches near Healdton, Oklahoma; and 11.77 inches near Ganado, Texas. A Flash Flood Watch was issued for Jackson County, but no serious flooding occurred. Rainfall totals for the Jackson County area during this event averaged approximately 14 inches.
- August 25 to 27, 2017 (Hurricane Harvey) – Hurricane Harvey made landfall along the Texas coast near Port Aransas on August 25 as category 4. Harvey maintained tropical intensity the entire time while inland over the Texas coastal bend and southeast Texas. According to a recreated model of Harvey, a total of 872 properties were impacted in Jackson County and a state of disaster was declared by FEMA.
- September 16 to 25, 2020 (Tropical Storm Beta) – Tropical Storm Beta made landfall near Matagorda Peninsula as a minimal tropical storm and subsequently weakened to a tropical depression. A voluntary evacuation was issued for parts of the county and a disaster declaration was signed by Jackson County judge Jill S. Sklar. High tides were predicted to be close to 4 to 5 feet, wind gusts were close to 30 mph, and Jackson County recorded 5+ inches of rainfall.

13.2.2 Location

A recorded event can occur anywhere in the HMP update area, moving inland from the Gulf of Mexico. Figure 13-2 illustrates historical hurricane paths affecting Jackson County and participating communities. Most of these hurricane events become tropical depressions or tropical storms by the time they reach the participating communities. Some however make landfall as major hurricanes.

Figure 13-2. Historical Tropical Storms and Hurricanes Affecting Jackson County



Note: From NOAA IBTrACS Version 4

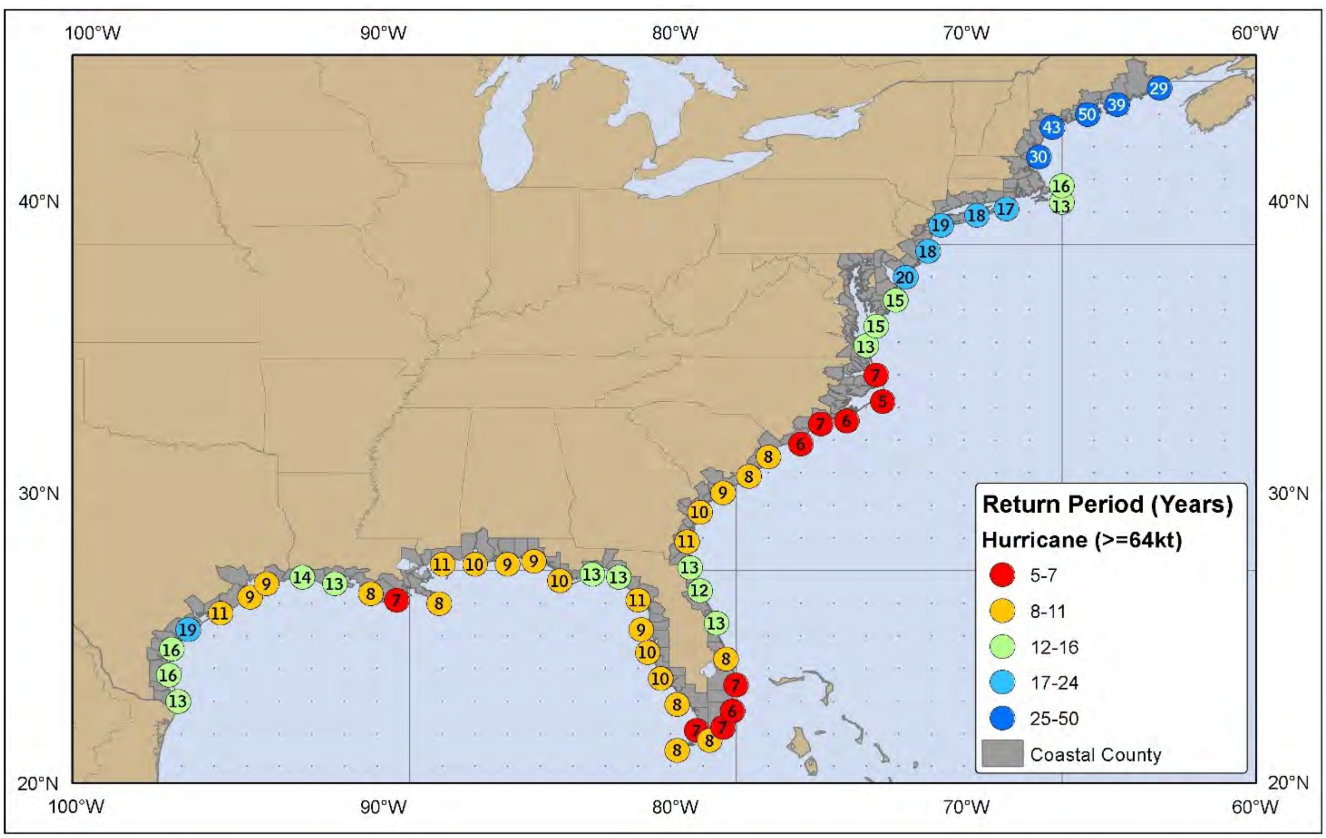
13.2.3 Frequency

Tropical storms are an annual event occurring from May through November in either the Gulf of Mexico or the Atlantic Ocean. The peak of the Atlantic hurricane season is in early- to mid-September. On average, approximately seven storms reach hurricane intensity each year. Hurricanes appear to be less frequent during La Niña periods and more prevalent during strong El Niño periods. El Niño and La Niña, its counterpart, refer to climate conditions in the Pacific Ocean that influence weather patterns in Texas. El Niño is associated with warmer sea surface temperatures and high air pressure systems, while La Niña is associated with cooler ocean temperatures and low air pressure systems. These changes in water temperature and air pressure systems occur in somewhat regular intervals, with El Niño periods having longer durations. Figure 13-3 illustrates the return period in years for hurricanes passing within 50 nautical miles of various locations, where damage can still occur from high-intensity events. Jackson and participating communities have felt the impact of 57 tropical events between 1851 to 2020.

Future Probability

Ten tropical events followed a path through Jackson County. An event with a track through the community is unlikely but possible. Based on historical occurrences, Jackson County can expect to be in the direct path of a tropical event approximately once every 11 years. However, Jackson and participating communities are likely to experience the effects of a near passing tropical event. Based on historical events it is likely Jackson County will feel the effects of a tropical event once every three years.

Figure 13-3: Estimated Return Period in Years for Hurricanes Passing Within 50 Nautical Miles of Various Locations



Note: From National Hurricane Center and Central Pacific Hurricane Center – Tropical Cyclone Climatology

13.2.4 Severity

Historic events indicate that a hurricane will affect Jackson County and participating communities as a lower category hurricane, thunderstorm, tropical depression, or related weather event (high winds, hail). These hazards are discussed in more detail in Chapter 14.

13.2.5 Warning Time

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

13.3 SECONDARY EVENTS

Secondary events associated with a hurricane reaching Jackson County and participating communities are similar to that of a tropical storm, depression, or related weather event (such as wind, hail, or lightning). By the time a hurricane reaches Jackson County and participating communities, it will be more closely classified as a secondary weather thunderstorm event (such as wind, hail, or lightning). These are the secondary events of a hurricane or tropical event. Even after the high winds subside, floods brought on by the heavy rainfalls can be dangerous. As a hurricane or tropical storm moves inland and begins to break up, the storm remnants can drop 6 to 12 or more inches of rain, resulting in extensive damage and loss of life. The most significant secondary hazards associated with severe local storms are floods, falling and downed trees, and downed power lines. Landslides occur when the soil on slopes becomes oversaturated and fails. Fires can occur as a result of lightning strikes. High winds from the storm can turn debris into flying projectiles. Debris carried by high winds can also result in injury or damage to property. The lack of proper management of trees may exacerbate damage from high winds. The damage to the infrastructure and land of Jackson County and participating communities may impact fishing, tourism, beaches, and related service industries.

13.4 CLIMATE CHANGE IMPACTS

It’s unclear whether climate change will increase or decrease the frequency of hurricanes and tropical storms, but warmer ocean surface temperatures and higher sea levels are expected to intensify their impacts. Hurricanes are subject to various climate change-related influences. Warmer sea surface temperatures could intensify tropical storms' wind speeds, potentially delivering more damage if they make landfall. Based on sophisticated computer modeling, scientists expect hurricane speeds to increase by up to 10% and precipitation to increase by 10 to 15%. In the past 10-years, the average Atlantic hurricane season has had an increased probability of named storms and hurricanes with an average of two more named storms and one more hurricane.

In addition, sea-level rise is likely to make future coastal storms, including hurricanes, more damaging. Globally averaged, sea level is expected to rise by 1 to 4 feet during the next century, which will amplify coastal storm surge. For example, sea-level rise intensified the impact of Hurricane Sandy, which caused an estimated $65 billion in damages in New York, New Jersey, and Connecticut in 2012. Much of this damage was related to coastal flooding (Center for Climate and Energy Solutions, n.d.).

13.5 EXPOSURE

Property, population, and the natural environment are all exposed to hurricanes and tropical storms, however, by the time such an event reaches Jackson County, it will be more closely classified as a tropical storm, depression, or related event (such as hail, high winds, or lightning). The entire population of the planning area would be affected by the tropical storm or tropical depression to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event. Table 13-2 lists the exposed structures and population to hurricanes, tropical storms, and tropical depressions per participating community.

TABLE 13-2
EXPOSED STRUCTURES AND POPULATION

Jurisdiction	Residential	Commercial	Other *	**Total Structures**	**Total Population**
City of Edna	2,143	133	100	**2,376**	**5,499**
City of Ganado	657	34	17	**708**	**2,003**
City of La Ward	88	6	6	**100**	**213**
Unincorporated Area	3,256	82	104	**3,442**	**6,360**
Jackson County Total	**6,144**	**255**	**227**	**6,626**	**14,075**

Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.

13.6 VULNERABILITY

The Level 1 HAZUS-MH protocol was used to assess the vulnerability of the planning area to hurricanes and tropical storms. The model used U.S. Census data at the tract level and modeled storms initiated in the Atlantic Ocean, Caribbean Sea, Gulf of Mexico, and eastern and central Pacific Ocean. The HAZUS-MH default data (updated with 2010 Census data and 2018 RS Means Square Foot Costs) were used.

Although the entire community will be exposed to a hurricane or tropical storm, the more vulnerable populations are at high risk. The most vulnerable demographics will be the economically disadvantaged population areas, children under 16 years of age, and the elderly. These population groups might not have the financial and/or physical means to prepare for an event and can experience greater impacts during a hazard event. See Table 13-3 for vulnerable populations per participating community.

HAZUS-MH calculates losses to structures from hurricanes by looking at wind speeds, winds tracks, and amount of precipitation. Using historical storm data, HAZUS-MH estimates probabilistic storm scenarios. The historic storm database contains precomputed wind fields and storm tracks for Category 3, 4, and 5 landfalling hurricanes from 1900 to 2018. For this analysis, a probabilistic HAZUS-MH hurricane scenario was selected for the County. HAZUS does not allow for a hurricane analysis specific to a city limit, thus the loss estimates for each city were weighted based on the flood loss estimates presented in Chapter 12 of this report. Table 13-4 lists annualized loss estimates for the 100-year probabilistic event scenario. Peak gust wind speeds for the 100-year probabilistic scenario are between 110 mph to 120 mph (Figure 13-4). Approximately 14% of the buildings (mostly residential) are expected to sustain moderate damages for this scenario. The annualized economic loss estimated for this probabilistic hurricane scenario (for Jackson County) is approximately $5.5 million.

TABLE 13-3 MOST VULNERABLE POPULATION						
Jurisdiction	Youth Population (< 16)	% of Total Population	Elderly Population (> 65)	% of Total Population	Economically Disadvantage (Income < $20,000)	% of Total Population
City of Edna	1,481	26.93%	876	15.93%	371	6.75%
City of Ganado	502	25.06%	270	13.48%	100	4.99%
City of La Ward	71	33.33%	24	11.27%	22	10.33%
Unincorporated Area	1,525	23.98%	1,143	17.97%	448	7.04%
Jackson County Total	3,579	25.43%	2,313	16.43%	941	6.69%

TABLE 13-4. LOSS ESTIMATES FOR HURRICANE EVENT					
	Annualized Loss ($)			Exposed Value* ($)	% of Total Exposed Value
	Structure	Contents	**Total**		
City of Edna	17,135	5,799	**26,905**	873,172,834	<0.1
City of Ganado	5,600	2,384	**9,291**	253,570,646	<0.1
City of La Ward	4,273	1,819	**7,089**	27,144,277	<0.1
Unincorporated Area	3,385,992	1,302,998	**5,477,715**	1,215,680,242	0.45
Jackson County Total	**3,413,000**	**1,313,000**	**5,521,000**	**2,369,568,000**	**0.23**
Note: *Exposed Value is equal to the total Assessed Value in each community (building and content)					

Vulnerability Narrative

All participating communities are equally at risk to hurricanes, tropical storms, and tropical depressions. The extent of a hurricane event for each jurisdiction is described below.

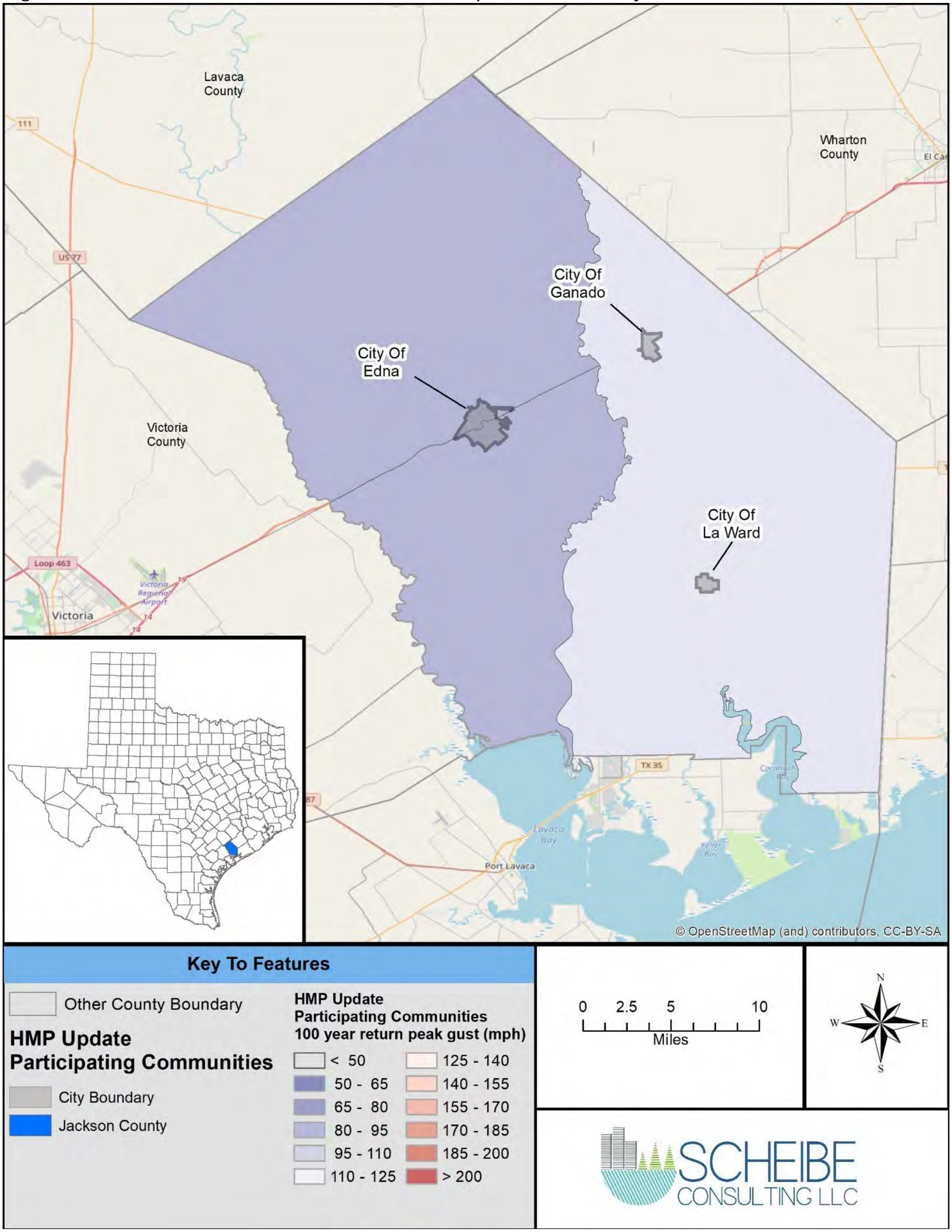
- **City of Edna-** Probabilistic Peak Wind Gusts for the City of Edna are approximately 111 mph. Approximately 9% of the City's housing is manufactured homes. These are more vulnerable to high winds from an event. Property along drainage areas that have not been cleaned out or that are in need of improvements are more prone to flooding. If an event were to impact critical facilities (such as emergency response facilities and schools) many residents could be negatively affected and response times could increase. This risk increases for those communities who do not equip these facilities with a source of backup power supply, such as a generator.

- **City of Ganado -** Probabilistic Peak Wind Gusts for the City of Ganado are approximately 113 mph. Less than 21% of the City's housing is manufactured homes. These are more vulnerable to high winds from an event. Any ungrounded structures or property could become flying debris causing further damage to properties in the area. Property along drainage areas that have not been cleaned out or that are in need of improvements are more prone to flooding. Residents unable to receive notification (those in communities without emergency alert systems) are more at risk. Communities that do not provide shelter for vulnerable residents increase risk as well.
- **City of La Ward** – Probilistic Peak Wind Gust for the City of La Ward is approximately 113 mph. Less than 34% of the City's housing is manufactured homes. These are more vulnerable to high winds from an event. Any ungrounded structures or property could become flying debris causing further damage to properties in the area. Property along drainage areas that have not been cleaned out or that are in need of improvements are more prone to flooding. Residents unable to receive notification (those in communities without emergency alert systems) are more at risk. Communities that do not provide shelter for vulnerable residents increase risk as well.
- **Jackson County (Unincorporated Area) -** Probabilistic Peak Wind Gusts for Jackson County Unincorporated Areas range between approximately 84-113 mph. Approximately 23% of the County's Unincorporated Area's housing is manufactured homes. These are more vulnerable to high winds from an event. Properties throughout the County located along the Lavaca River are vulnerable to wave action erosion and flooding caused by high winds and intense rainfall. Communities that do not implement flood planning and hazard mitigation efforts increase the vulnerability to hurricanes. Transportation routes impacted by an event (such as TX 111 or US 59) could limit access to and from emergency responders. Critical facilities, such as medical care facilities or police and fire departments, could be affected by an event increasing response times further. Facilities without the provisions to respond to a flooding event, such as water pumps or generators are more vulnerable as well.

Community Perception of Vulnerability

See the front page of the current chapter for a summary of hazard rankings for Jackson County and participating communities in this HMP update. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

Figure 13-4. 100-Year Probabilistic Peak Wind Gusts for Jackson County



13.7 FUTURE TRENDS IN DEVELOPMENT

The threat of tropical storms is constant in Texas. From the Gulf of Mexico coastline to Central Texas, the adverse effects of tropical storms and hurricanes will be felt. Tropical storms and hurricanes may cause billions of dollars in damages. Hurricane trends change yearly and future trends are difficult to predict. Colorado State University released their 2021 hurricane season outlook predicted that an above-average hurricane season is likely. This outlook predicts 17 named storms, 8 hurricanes, and 3 major hurricanes. However, Global Weather Oscillations Inc., a leading hurricane cycle prediction company, predicts 17 named storms, 9 hurricanes, 5 major hurricanes. Therefore, it is important for communities and community leaders to remain alert and informed of seasonal predictions and developments.

13.8 SCENARIO

A worst-case scenario would be for a very large and severe hurricane to make landfall at the Texas Gulf Coast. Such a powerful storm at landfall would have significant impacts in Jackson County and beyond. This storm could cause severe flooding, tornadoes, and wind damage to infrastructure throughout the county. This could significantly slow emergency response time and cause public utilities to be offline for weeks. A large storm would leave a large path of damage across South and Central Texas, straining resources throughout the county and state.

13.9 ISSUES

Important issues associated with a tropical storm in Jackson County and the participating communities include the following:

- The older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as hurricanes and tropical storms.
- The redundancy of the power supply must be evaluated.
- The potential for isolation after a severe storm event is high.
- Flash flooding that occurs with little or no warning will continue to impact the planning area.
- The promotion of flood insurance as a means of protecting private property owners from the economic impacts of frequent flood events should continue.
- Roads and bridges blocked by debris or otherwise damaged might isolate populations.
- Warning time may not be adequate for residents to seek appropriate shelter or such shelter may not be widespread throughout the planning area.
- The impacts of climate change on the frequency and severity of hurricanes and tropical storms are not well understood.

Chapter 14.
Lightning, Hail, & Wind

LIGHTNING, HAIL, AND WIND RANKING			
	Lightning	**Hail**	**Wind**
Jackson County	Low	Medium	Medium
City of Edna	Low	Medium	High
City of Ganado	Low	High	Medium
City of La Ward	Low	Medium	Medium

DEFINITIONS

Severe Local Storm	Small-scale atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms, and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.
Thunderstorm	A storm featuring heavy rains, strong winds, thunder, and lightning, typically about 15 miles in diameter and lasting about 30 minutes. Hail and tornadoes are also dangers associated with thunderstorms. Lightning is a serious threat to human life. Heavy rains over a small area in a short time can lead to flash flooding.
Windstorm	A storm featuring violent winds. Windstorms tend to damage ridgelines that face into the wind.

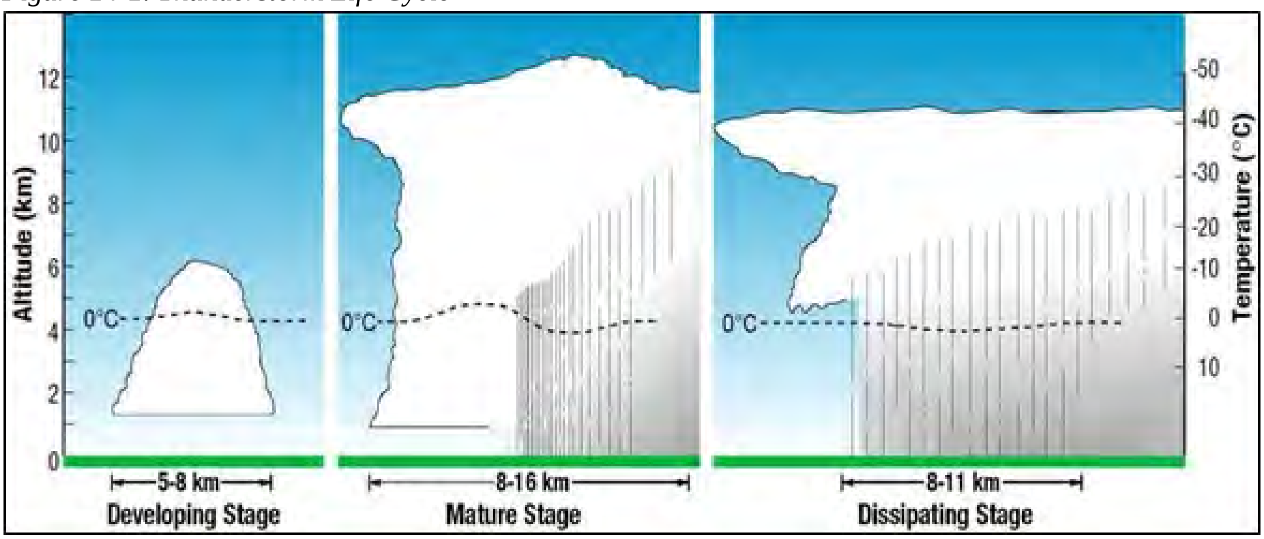
14.1 GENERAL BACKGROUND

A thunderstorm is a rain event that includes thunder, wind, hail, and lightning. A thunderstorm is classified as “severe” when it contains one or more of the following: hail with a diameter of one inch or greater, winds gusting in excess of 50 kt (57.5 mph), or tornadoes. For this hazard mitigation plan, each component of a thunderstorm (lightning, hail, and winds) will be profiled below. Thunderstorms, as a whole, are not a hazard in the *2018 Texas State Hazard per the Texas State Mitigation Plan*. ‘Thunderstorm’ is used in this section as a descriptive term to qualify hail, wind, and lightning atmospheric events. Thunderstorms are described below for general reference information and not a profiled hazard.

Three factors cause thunderstorms to form: moisture, rising unstable air (air that keeps rising when disturbed), and a lifting mechanism to provide the disturbance. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise (hills or mountains can cause rising motion, as can the interaction of warm air and cold air or wet air and dry air) it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder. Thunderstorms have three stages (see Figure 14-1):

- The **developing stage** of a thunderstorm is marked by a cumulus cloud that is being pushed upward by a rising column of air (updraft). The cumulus cloud soon looks like a tower (called towering cumulus) as the updraft continues to develop. There is little to no rain during this stage but occasional lightning. The developing stage lasts about 10 minutes.
- The thunderstorm enters the **mature stage** when the updraft continues to feed the storm, but precipitation begins to fall out of the storm, and a downdraft begins (a column of air pushing downward). When the downdraft and rain-cooled air spread out along the ground, they form a gust front or a line of gusty winds. The mature stage is the most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes. The storm occasionally has a black or dark green appearance.
- Eventually, a large amount of precipitation is produced and the updraft is overcome by the downdraft beginning the **dissipating stage**. On the ground, the gust front moves out a long distance from the storm and cuts off the warm moist air that was feeding the thunderstorm. Rainfall decreases in intensity, but lightning remains a danger.

Figure 14-1. Thunderstorm Life Cycle



There are four types of thunderstorms:

- **Single-Cell Thunderstorms**—Single-cell thunderstorms usually last 20 to 30 minutes. A true single-cell storm is rare because the gust front of one cell often triggers the growth of another. Most single-cell storms are not usually severe, but a single-cell storm can produce a brief severe weather event. When this happens, it is called a pulse severe storm.
- **Multi-Cell Cluster Storm**—A multi-cell cluster is the most common type of thunderstorm. The multi-cell cluster consists of a group of cells, moving as one unit, with each cell in a different phase of the thunderstorm life cycle. Mature cells are usually found at the center of the cluster and dissipating cells at the downwind edge. Multi-cell cluster storms can produce moderate-size hail, flash floods, and weak tornadoes. Each cell in a multi-cell cluster lasts only about 20 minutes; the

multi-cell cluster itself may persist for several hours. This type of storm is usually more intense than a single-cell storm.

- **Multi-Cell Squall Line**—A multi-cell line storm, or squall line, consists of a long line of storms with a continuous well-developed gust front at the leading edge. The line of storms can be solid, or there can be gaps and breaks in the line. Squall lines can produce hail up to golf ball size, heavy rainfall, and weak tornadoes, but they are best known as the producers of strong downdrafts. Occasionally, a strong downburst will accelerate a portion of the squall line ahead of the rest of the line. This produces what is called a bow echo. Bow echoes can develop with isolated cells as well as squall lines. Bow echoes are easily detected on radar but are difficult to observe visually.
- **Super-Cell Storm**—A super-cell is a highly organized thunderstorm that poses a high threat to life and property. It is similar to a single-cell storm in that it has one main updraft, but the updraft is extremely strong, reaching speeds of 150 to 175 mph. Super-cells are rare. The main characteristic that sets them apart from other thunderstorms is the presence of rotation. The rotating updraft of a super-cell (called a mesocyclone when visible on radar) helps the super-cell to produce extreme weather events, such as giant hail (more than 2 inches in diameter), strong downbursts of 80 mph or more, and strong to violent tornadoes.

14.1.1 Lightning

Lightning is an electrical discharge between positive and negative regions of a thunderstorm. A lightning flash is composed of a series of strokes with an average of about four. The length and duration of each lightning stroke vary but typically average about 30 microseconds.

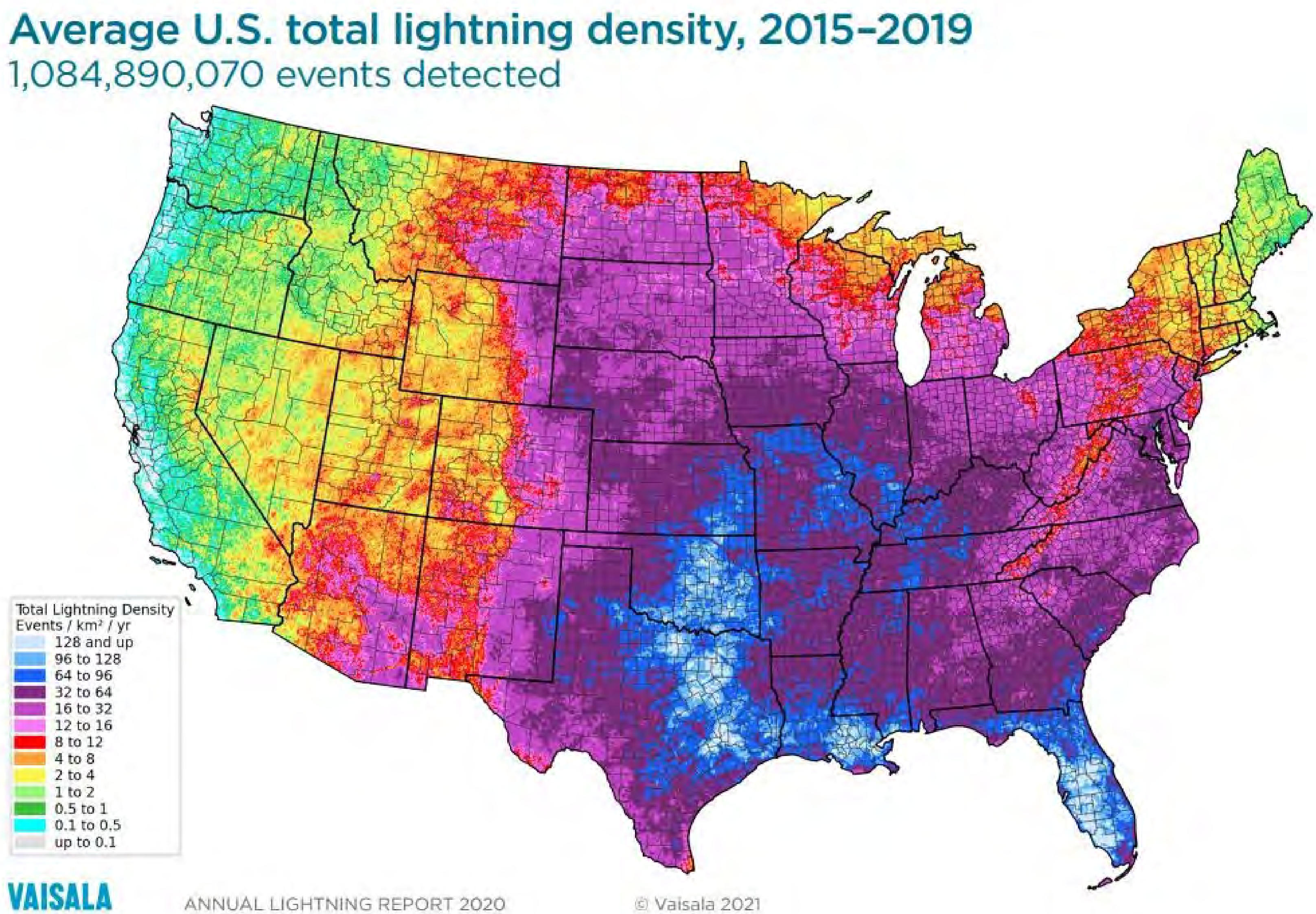
Lightning is one of the more dangerous and unpredictable weather hazards in the United States and in Texas. Each year, lightning is responsible for deaths, injuries, and millions of dollars in property damage, including damage to buildings, communications systems, power lines, and electrical systems. Lightning also causes forest and brush fires as well as deaths and injuries to livestock and other animals. According to NOAA, lightning strikes the U.S about 25 million times and on average kills 49 people and injures hundreds more each year. The latest data available from the National Fire Protection Association (NFPA) shows that there was an average of 22,600 lighting caused fires per year between 2007 and 2011. These fires caused an average of nine civilian deaths and $451 million in direct property damage per year, according to the NFPA. U.S. lightning statistics compiled by NOAA between 2006 and 2019 indicate that most lightning incidents occur during the summer months of June, July, and August. The impact of lightning can be direct or indirect. People or objects can be directly struck, or damage can occur indirectly when the current passes through or near it.

Intra-cloud lightning is the most common type of discharge. This occurs between oppositely charged centers within the same cloud. From outside the cloud, this discharge appears as brightening and flickering from within. However, the flash may exit the boundary of the cloud, and a bright channel can be visible for many miles.

Although not as common, cloud-to-ground lightning is the most damaging and dangerous form of lightning. Most flashes originate near the lower-negative charge center and deliver a negative charge to the earth. However, a minority of flashes carry a positive charge to earth. These positive flashes often occur during the dissipating stage of a thunderstorm’s life. Positive flashes are also more common as a percentage of total ground strikes during the winter months. This type of lighting is particularly dangerous for several reasons. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat. Positive lightning also has a longer duration, so fires are more easily ignited. When positive lightning strikes, it usually carries a high peak electrical current, potentially resulting in greater damage.

The ratio of cloud-to-ground and intra-cloud lightning can vary significantly from storm to storm. Depending upon cloud height above ground and changes in electric field strength between cloud and earth, the discharge stays within the cloud or makes direct contact with the earth. If the field strength is highest in the lower regions of the cloud, a downward flash may occur from cloud to earth. Using a network of lightning detection systems, NOAA monitors a yearly average of 25 million strokes of lightning from the cloud to the ground. Figure 14-2 shows the lightning flash density for the nation.

Figure 14-2. Average Annual National Lightning Density



Note: From Vaisala-National Lightning Detecting Network

14.1.2 Hail

Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. Figure 14-3 shows the hail path across the nation. Recent studies suggest that super-cooled water may accumulate on frozen particles near the back-side of a storm as they are pushed forward across and above the updraft by the prevailing winds near the top of the storm. Eventually, the hailstones encounter downdraft air and fall to the ground.

Hailstones grow two ways: by wet growth or dry growth. In wet growth, a tiny piece of ice is in an area where the air temperature is below freezing, but not super cold. When the tiny piece of ice collides with a super-cooled drop, the water does not freeze on the ice immediately. Instead, liquid water spreads across tumbling hailstones and slowly freezes. Since the process is slow, air bubbles can escape, resulting in a layer of clear ice. Dry growth hailstones grow when the air temperature is well below freezing and the water droplet freezes immediately as it collides with the ice particle. The air bubbles are “frozen” in place, leaving cloudy ice.

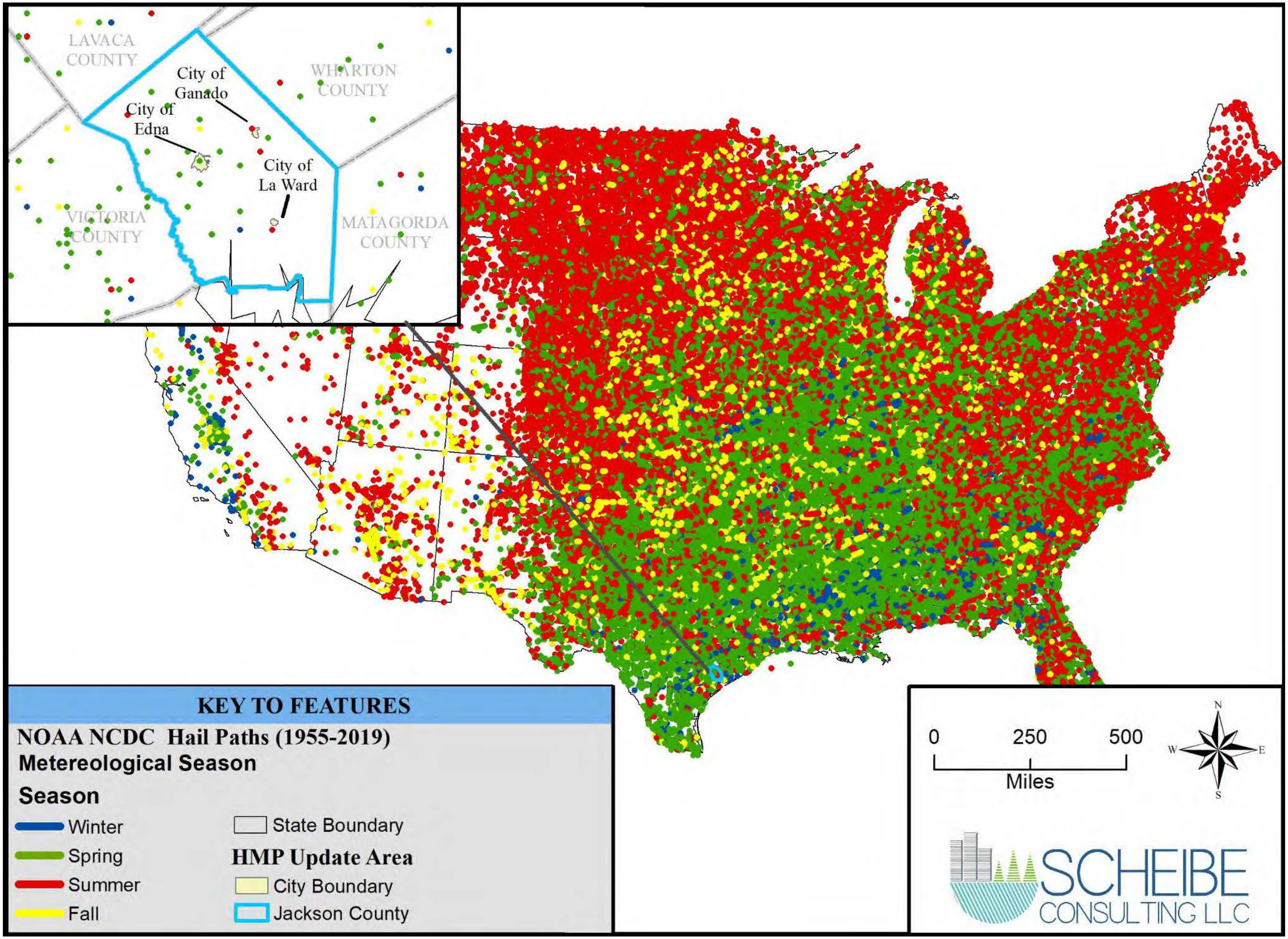
Hailstones can have layers like an onion if they travel up and down in an updraft, or they can have few or no layers if they are “balanced” in an updraft. One can tell how many times a hailstone traveled to the top of the storm by counting its layers. Hailstones can begin to melt and then re-freeze together, forming large and very irregularly shaped hail. NWS classifies hail as non-severe and severe based on hail diameter size. Descriptions and diameter sizes are provided in Table 14-1.

TABLE 14-1.
NATIONAL WEATHER SERVICE HAIL SEVERITY

<table>
<tr><th>Severity</th><th>Description</th><th>Hail Diameter Size</th></tr>
<tr><td rowspan="4">Non-Severe Hail
Does not typically cause damage and does not warrant severe thunderstorm warning from National Weather Service.</td><td>Pea</td><td>1/4"</td></tr>
<tr><td>Plain M&M Candy</td><td>1/2"</td></tr>
<tr><td>Penny</td><td>3/4"</td></tr>
<tr><td>Nickel</td><td>7/8"</td></tr>
<tr><td rowspan="11">Severe Hail
Research has shown that damage occurs after hail reaches around one inch in diameter and larger. Hail of this size will trigger a severe thunderstorm warning from National Weather Service.</td><td>Quarter</td><td>1" (severe)</td></tr>
<tr><td>Half Dollar</td><td>1 1/4"</td></tr>
<tr><td>Walnut/Ping Pong Ball</td><td>1 1/2"</td></tr>
<tr><td>Golf Ball</td><td>1 3/4"</td></tr>
<tr><td>Hen Egg/Lime</td><td>2"</td></tr>
<tr><td>Tennis Ball</td><td>2 1/2"</td></tr>
<tr><td>Baseball</td><td>2 3/4"</td></tr>
<tr><td>Teacup/Large Apple</td><td>3"</td></tr>
<tr><td>Grapefruit</td><td>4"</td></tr>
<tr><td>Softball</td><td>4 1/2"</td></tr>
<tr><td>Computer CD-DVD</td><td>4 3/4"- 5"</td></tr>
</table>

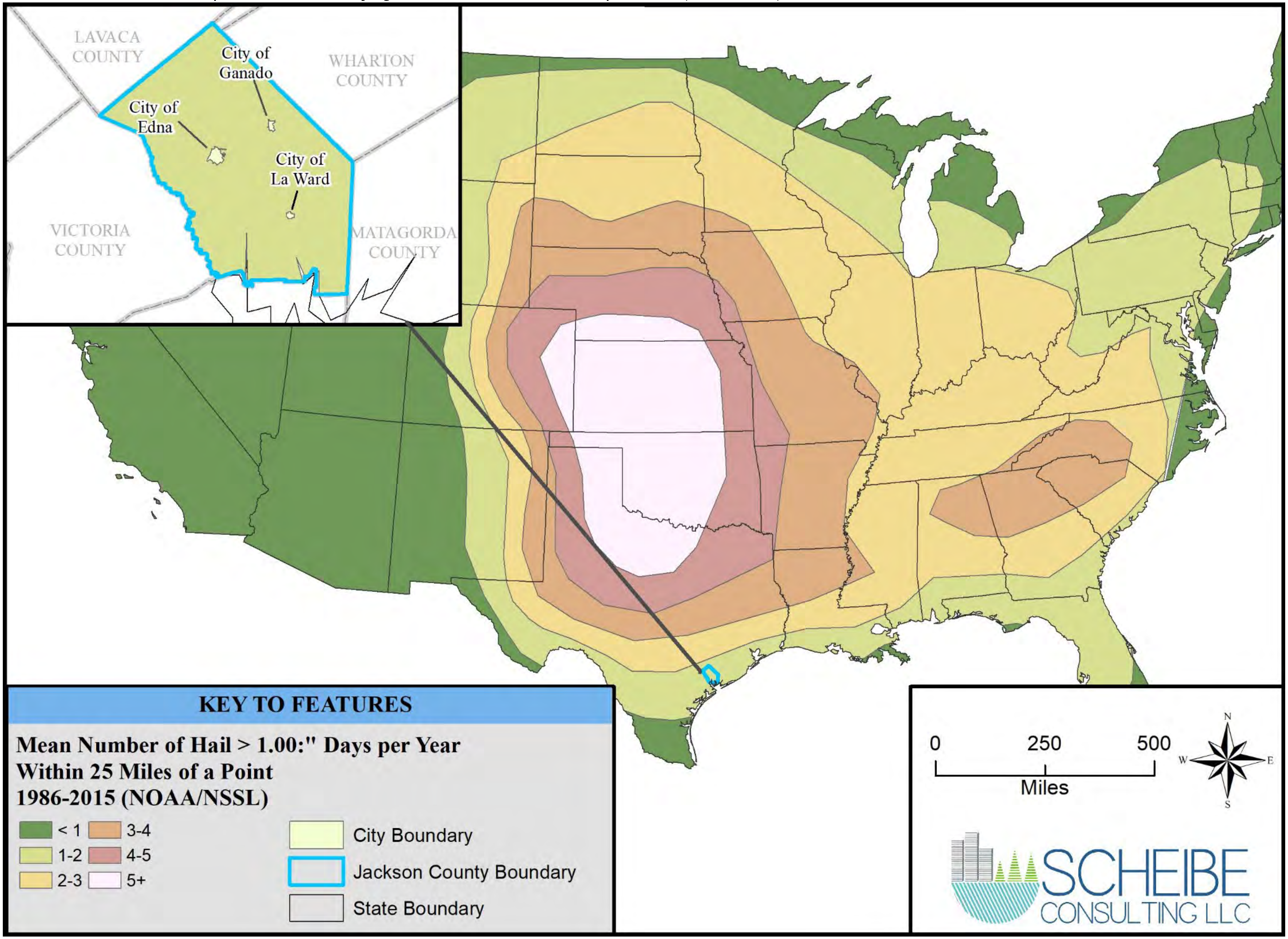
NOAA’s National Severe Storms Laboratory used historical data to estimate the daily probability of hail occurrences across the U.S., regardless of storm magnitude. Figure 14-4 shows the average number of hail days per year. The density per 25 square miles in the map’s legend indicates the probable number of hail days for each 25 square mile cell within the contoured zone that can be expected over a similar period of record. It should be noted that the density number does NOT indicate the number of events that can be expected across the entire zone on the map.

Figure 14-3. National Hail Paths



Note: From NOAA/NWS Storm Prediction Center

Figure 14-4. Mean Number of Hail > 1.00" Days per Year Within 25 miles of a Point (1986-2015)



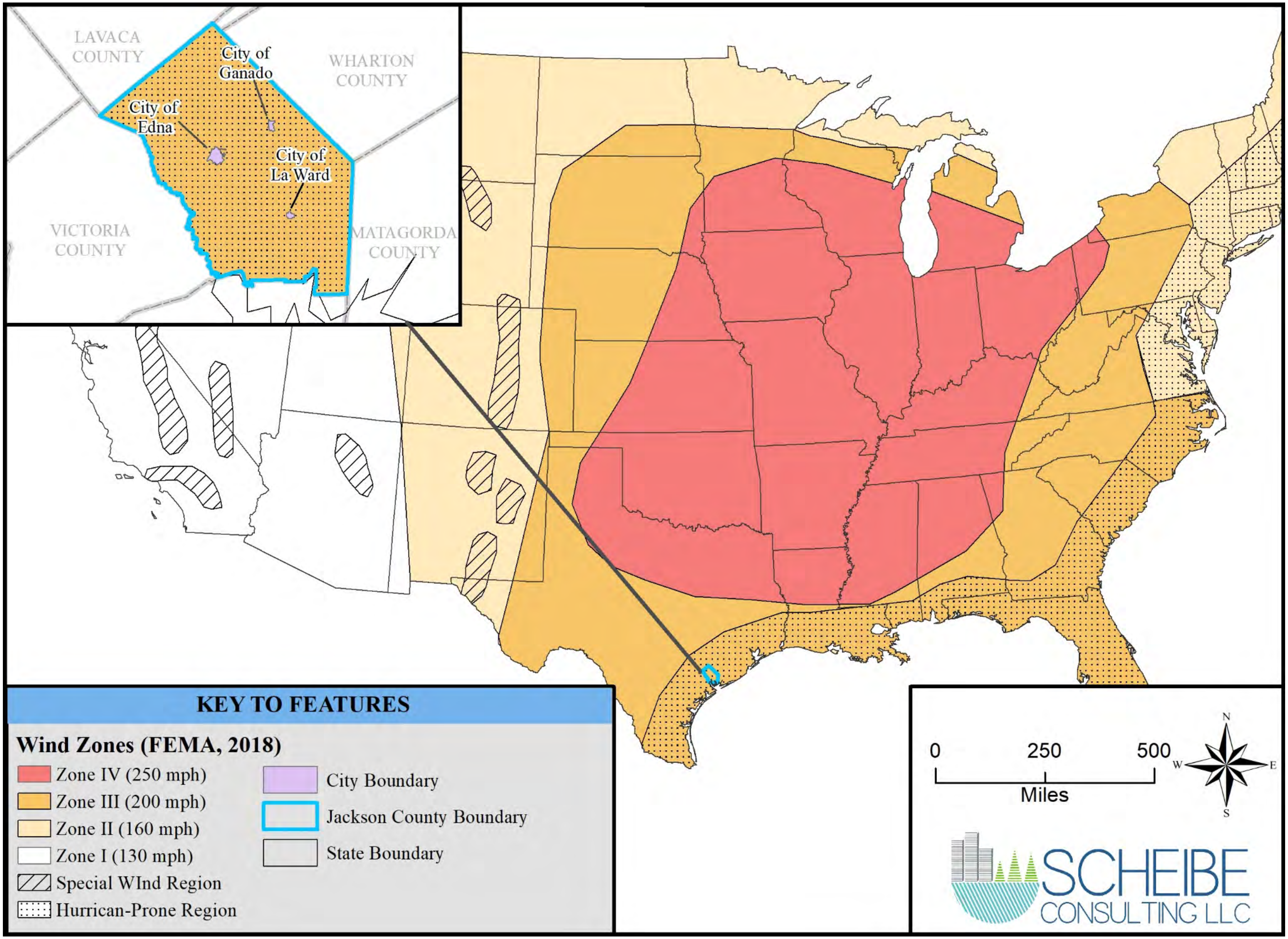
14.1.3 Wind

Damaging winds are classified as those exceeding 60 mph. Figure 14-5 shows the wind zones in the nation. NOAA’s Storm Events Database has a strong wind inventory from 1955 to 2020. Figure 14-6 shows the national high wind paths from 1955 to 2019. According to NOAA’S National Severe Strom Laboratory (NSSL), damage from such winds accounts for half of all severe weather reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles. There are seven types of damaging winds:

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

NOAA’s NSSL used historical data to estimate the daily probability of wind occurrences across the U.S., regardless of storm magnitude. Figure 14-7 shows the average number of high wind days (50 kts or greater). The density per 25 square miles in the map’s legend indicates the probable number of winds for each 25 square mile cell within the contoured zone that can be expected over a similar period of record. It should be noted that the density number does NOT indicate the number of events that can be expected across the entire zone on the map.

Figure 14-5. National Wind Zones



Note: From FEMA - Taking Shelter from The Storm

Figure 14-6. National High Wind Paths

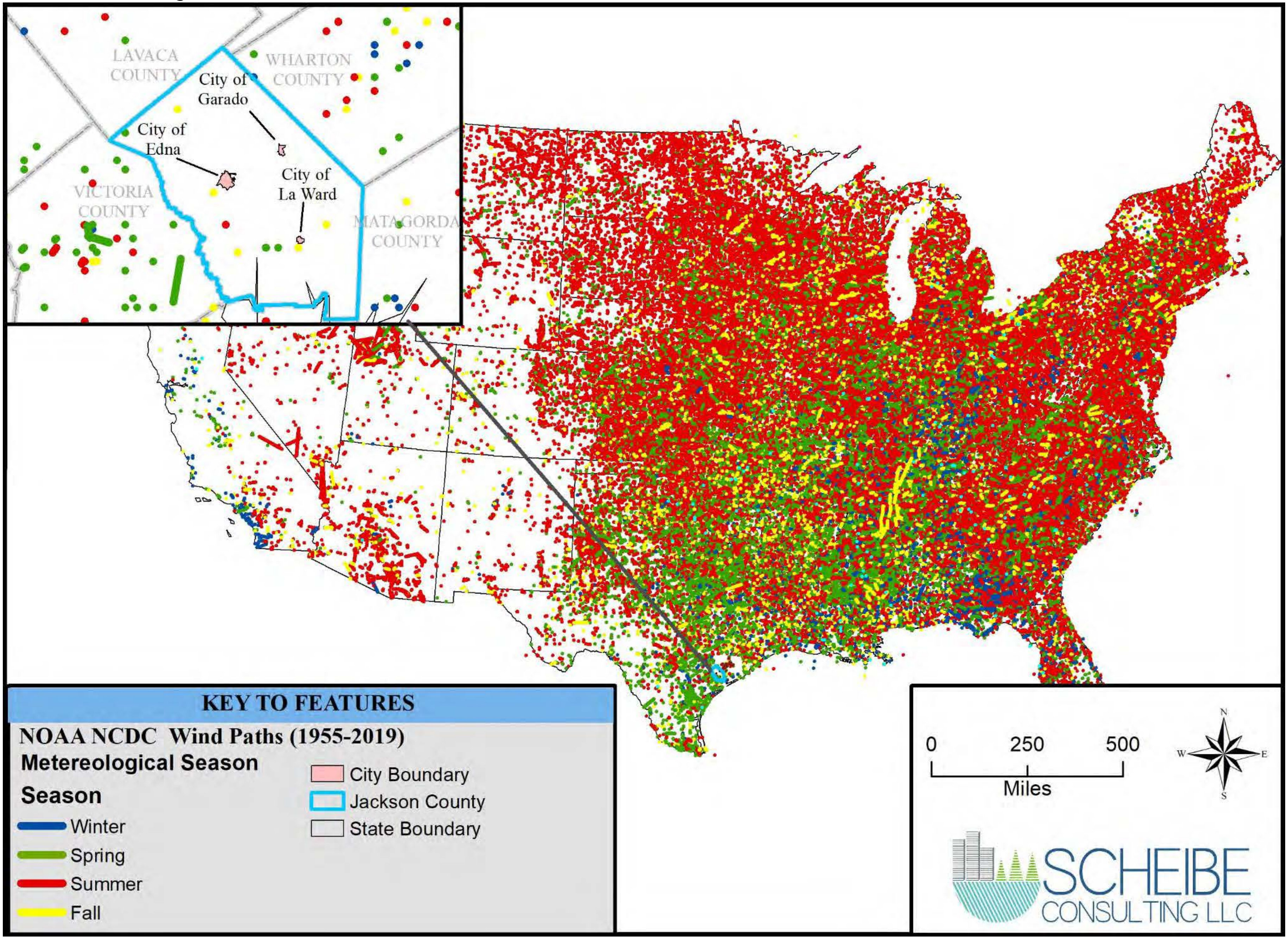
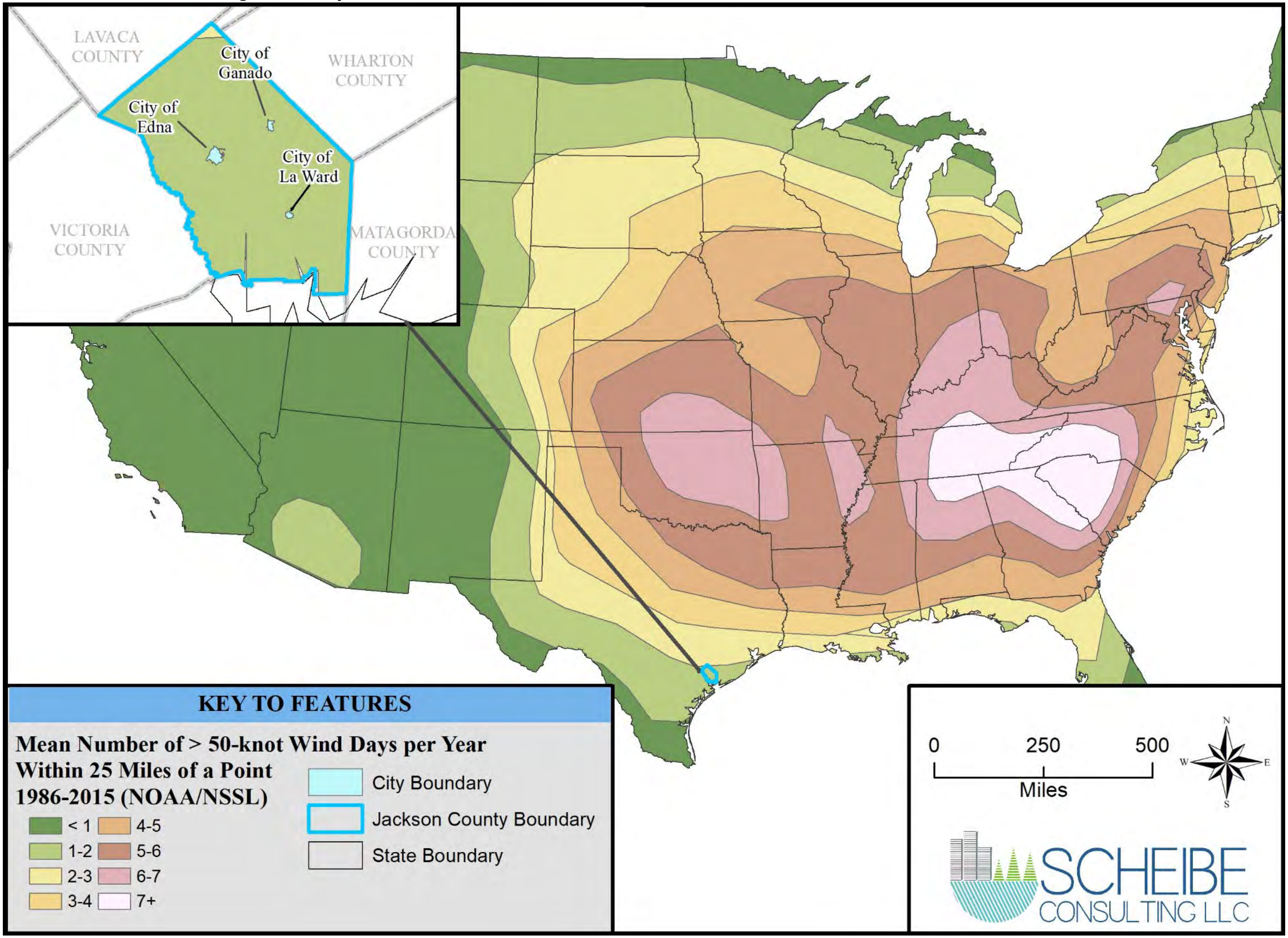


Figure 14-7. National Annual High Wind Days



14.2 HAZARD PROFILE

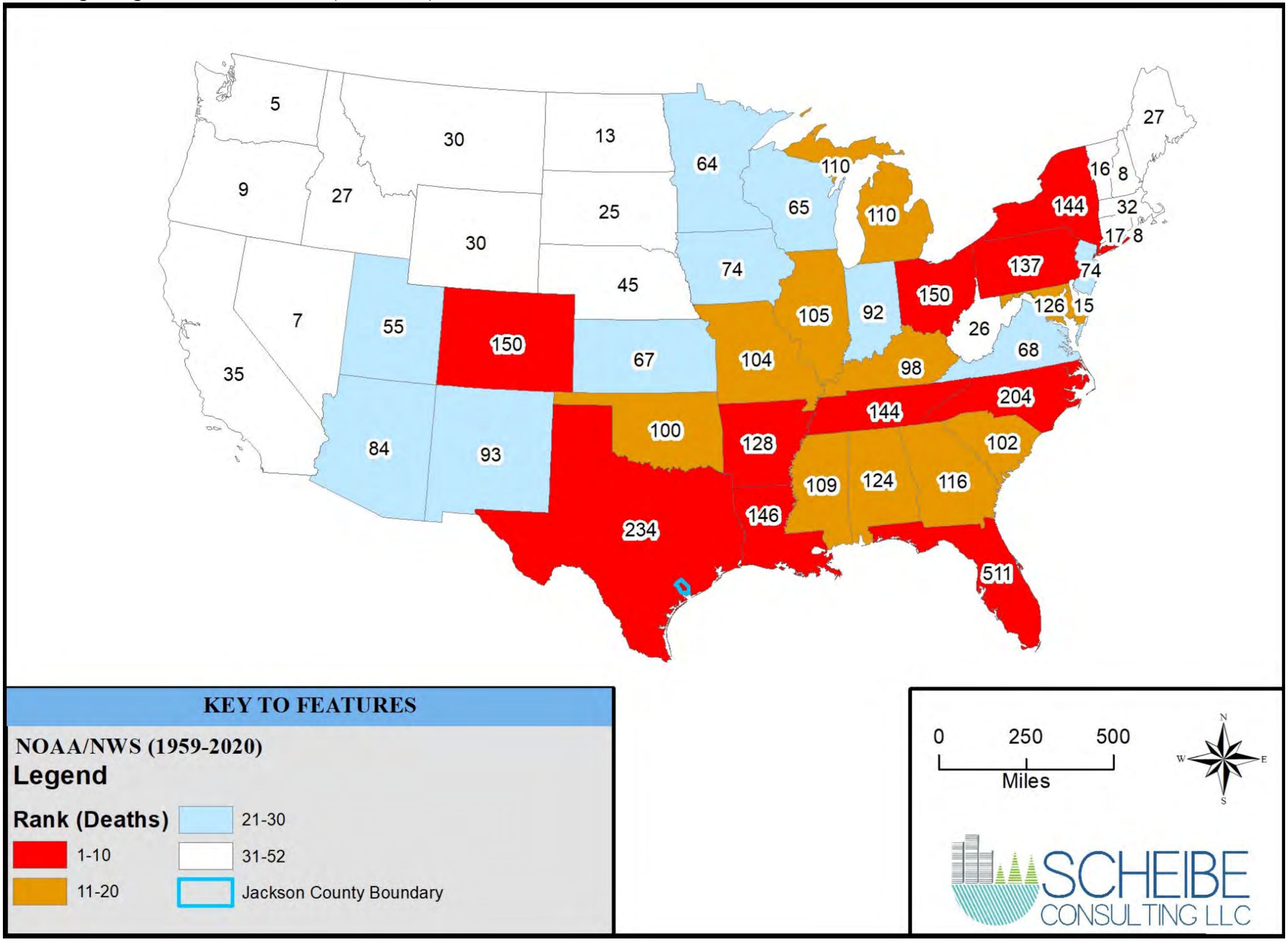
14.2.1 Past Events

Lightning

Data from the National Lightning Detection Network ranked Texas first in the nation (excluding Alaska and Hawaii) with respect to the number of cloud-to-ground lightning flashes in 2020. In 2020 Texas recorded 33,816,168 cloud-to-ground lightning strikes. The majority of lightning events occur in the Eastern part of the state with the highest total lightning density occurring in the central plains. In 2020 there were a total of 247,966 lightning strikes in Jackson County. The 5-year average for lightning events in Jackson County was 32 to 64 events per km2 per year as shown in Figure 14-2.

Figure 14-8 shows state-by-state lightning deaths between 1959 and 2020. Texas ranks second for the number of deaths at 234. Only Florida, with 511 deaths, had more. Texas has a 0.25 death rate per million people from lightning strikes according to 1959 to 2017 data published by NWS. There were no lightning events reported in Jackson County or participating communities between 1996 and February 2021.

Figure 14-8. Lightning Fatalities in the U.S. (1959-2020)



Note: From NOAA/NWS Storm Prediction Center

Hail

The National Centers for Environmental Information Storm Events Database lists 52 hail events in Jackson County and participating communities between 1955 and 2020. Severe hail events (hail size > 1.00") are noted in Table 14-2. None of these events resulted in injuries or deaths. Events listed as Jackson County, Countywide, or County in Table 14-2 affected large portions of the HMP update area. Large systems may have affected additional jurisdictions. Specific events for the participating communities are described below.

Event Descriptions

City of Edna – The City of Edna had 9 significant events from 1960 to 2020. Three significant events are described below.

- On October 12, 1993, Jackson County Sheriff's Offices reported nickel-size hail north of Edna. Approximately two hours later, the Sheriff's Office reported two billboards near the intersection of Highway 59 and 234 destroyed.
- On April 11, 2004, penny-sized hail was reported in Edna.
- On April 2, 2017, a storm system produced golf ball sized hail which destroyed a vehicle windshield near the intersection of Highway 172 and Highway 111.

City of Ganado- The City of Ganado had 8 significant events from 1960 to 2020. Three significant events are described below.

- On December 12, 2002, there was 2.75-inch hail reported in the city of Ganado.
- On May 26, 2011, the trailing cold front from a strong storm system across the north-central states triggered evening and overnight severe thunderstorms with very large hail and strong wind gusts across portions of southeast Texas.
- On June 5, 2011, late afternoon through the early evening a pulse severe thunderstorms erupted under a record-breaking hot afternoon.

City of La Ward – The City of La Ward has 7 significant events from 1960 to 2020. Two significant events are described below

- On May 26, 2011, marble to quarter-size hail was reported along FM-172 north of La Ward. The County Sheriff's Office reported power lines down east of Lolita on Highway 616.
- On December 12, 2012, 1.75-inch hail was reported in La Ward causing an estimated $5,000 worth of damage.

Jackson County (Unincorporated Areas) - Jackson County Unincorporated Areas had 28 significant events from 1960 to 2020. Three significant events are described below.

- On July 31, 1972, hail, averaging one-half inch in diameter, fell at Ganado, with the largest stones one inch in diameter. No damage was reported. A funnel cloud moved over the area but did not touch the ground.
- On April 19, 1992, the Jackson County Sheriff's Office reported marble to golf ball size hail in the northern part of the county.

- On May 28, 1992, the same thunderstorm that produced golf ball size hail in Dewitt County, continued to move east into Jackson County. Nickle size hail was reported across the northern part of the county.

TABLE 14-2.
HISTORIC HAIL EVENTS IN JACKSON COUNTY AND PARTICIPATING COMMUNITIES
(1960-2017)

Location	Date	Hail Size	Estimated Damage Cost		Injuries	Deaths
			Property	Crops		
JACKSON CO.	03/31/1955	2	$0	$0	0	0
JACKSON CO.	05/11/1968	1	$0	$0	0	0
JACKSON CO.	05/11/1968	1.75	$0	$0	0	0
JACKSON CO.	05/11/1968	1.75	$0	$0	0	0
JACKSON CO.	05/08/1969	1.5	$0	$0	0	0
JACKSON CO.	07/31/1972	1	$0	$0	0	0
JACKSON CO.	04/26/1973	2	$0	$0	0	0
JACKSON CO.	04/26/1973	2	$0	$0	0	0
JACKSON CO.	04/22/1978	1.75	$0	$0	0	0
JACKSON CO.	04/22/1978	1.75	$0	$0	0	0
JACKSON CO.	05/09/1981	1.75	$0	$0	0	0
JACKSON CO.	05/09/1981	1.75	$0	$0	0	0
JACKSON CO.	04/19/1992	1.75	$0	$0	0	0
La Ward	05/10/1993	1	$0	$0	0	0
La Ward	05/10/1993	1	$0	$0	0	0
LOLITA	04/05/1996	1.75	$5,000	$0	0	0
MORALES	06/20/1996	1.75	$5,000	$0	0	0
LA WARD	05/28/1997	1	$5,000	$0	0	0
VANDERBILT	05/28/1997	1.75	$10,000	$0	0	0
LOLITA	05/28/1997	1.75	$10,000	$0	0	0

TABLE 14-2.
HISTORIC HAIL EVENTS IN JACKSON COUNTY AND PARTICIPATING COMMUNITIES
(1960-2017)

Location	Date	Hail Size	Estimated Damage Cost		Injuries	Deaths
			Property	Crops		
CORDELE	05/02/1999	1.25	$25,000	$0	0	0
EDNA	04/02/2000	1.75	$25,000	$0	0	0
GANADO	07/23/2000	1.75	$50,000	$0	0	0
EDNA	03/30/2002	1	$10,000	$0	0	0
GANADO	03/30/2002	1.75	$20,000	$0	0	0
LOLITA	12/12/2002	1.75	$5,000	$0	0	0
LA WARD	12/12/2002	1.75	$5,000	$0	0	0
GANADO	12/12/2002	2.75	$15,000	$0	0	0
LA WARD	03/13/2003	1.75	$5,000	$0	0	0
MORALES	04/11/2004	1	$10,000	$0	0	0
EDNA	05/10/2006	1	$15,000	$0	0	0
MATILDA	07/19/2009	1	$1,000	$1,000	0	0
GANADO	05/26/2011	2.5	$30,000	$0	0	0
GANADO	06/05/2011	1	$0	$0	0	0
EDNA	04/25/2015	1	$0	$0	0	0
EDNA	04/02/2017	1.75	$3,000	$0	0	0

Notes:
The table may list more events than are shown on related figures since some recorded events do not include specific geographic (GIS-enabled data) coordinates for precise graphical representation.
From NOAA Storm Events Database

Winds

High winds occur year-round in Jackson County and participating communities. In the spring and summer, which are generally warm and humid in Texas, high winds often accompany severe thunderstorms. The varying topography in the area has the potential for continuous and sudden high wind gusts. The northern winds are a fairly common wintertime phenomenon in Southern Texas. These winds develop in well-defined areas and can be quite strong with resulting drastic drops in air temperatures.

Atmospheric conditions are expected to continue unchanged with windstorms remaining a perennial occurrence. Winds of 0 to near 200 mph are possible in the planning area.

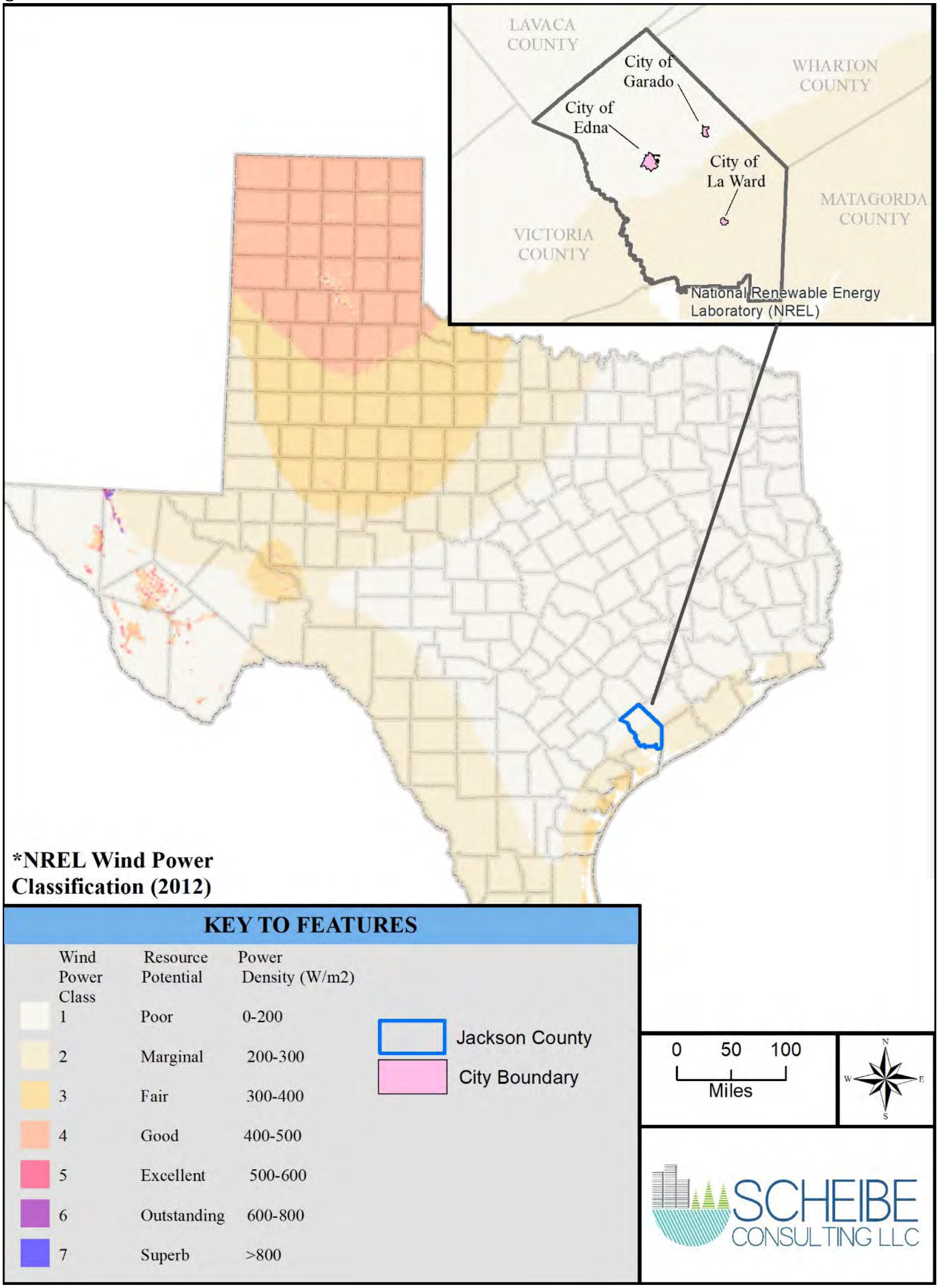
Although these high winds may not be life-threatening, they can disrupt daily activities, cause damage to buildings and structures, and increase the potential damage of other hazards. Wind resource information is shown in Figure 14-9 as a proxy for typical wind speeds. Wind resource information is estimated by the National Renewable Energy Laboratory (NREL) to identify areas that are suitable for wind energy applications. The wind resource is expressed in terms of wind power classes, ranging from Class 1 (lowest) to Class 7 (highest). Each class represents a range of mean wind power density or approximate mean wind speed at specified heights above the ground (in this case, 50 meters above the ground surface). Table 14-3 identifies the mean wind power density and speed associated with each classification. Figure 14-9 shows the wind power class potential density for Jackson County and participating communities classified as "Marginal."

TABLE 14-3.
WIND POWER CLASS AND SPEED

Rank	Wind Power Class	Wind Power Density at 50 meters (W/m^2)	Wind Speed at 50 meters (mph)
Poor	1	0-200	0-12.5
Marginal	2	200-300	12.5-14.3
Fair	3	300-400	14.3-15.7
Good	4	400-500	15.7-16.8
Excellent	5	500-600	16.8-17.9
Outstanding	6	600-800	17.9-19.7
Superb	7	800-2000	19.7-26.6

Note:
Mph Miles per hour
W/m^2 Watts per square meter
From National Renewable Energy Laboratory

Figure 14-9. Texas Wind Power



Note: From NREL National Wind Technology Center

Event Descriptions

Historical severe weather data from the NCDC Storm Events Database lists 48 thunderstorm wind events in Jackson County and participating communities between 1950 and 2021 as shown in Table 14-4. This table was supplemented with local knowledge and news articles of events affecting the participating communities. Events listed as Jackson County, Jackson, Countywide, or County in Table 14-4 affected large portions of the HMP update area. Large systems may have affected additional jurisdictions. There were several documented tornadoes in Jackson County and participating communities in the 1950 to 2021 time period. These tornadoes are discussed in Chapter 15.

Significant wind events for Jackson County and participating communities are highlighted below. None of these events resulted in injuries or deaths.

City of Edna – The City of Edna had 9 significant events from 1950 to 2021. Three significant events are described below.

- On May 11, 2004, trees were reported down in the town of Edna.
- On October 1, 2009, power poles were blown down and a roof was blown off on County Road 228.
- On June 19, 2016, an early morning severe thunderstorm downed some trees and power lines and damaged a building.

City of Ganado – The City of Ganado had 4 significant events from 1950 to 2021. Three significant events are described below.

- On May 31, 1997, thunderstorm winds were reported by local law enforcement at 69 mph and had $10,000 in reported damages.
- On August 4, 2008, thunderstorm winds downed a power pole.
- On April 7, 2019, a storm system moved across the area during the day and produced large hail which caused some roof and tree damage.

City of La Ward – The City of La Ward had 2 significant events from 1950 to 2021. One significant event is described below.

- On May 16, 2015, a passing southwestern shortwave disturbance created a very moist and unstable southeastern. Numerous severe thunderstorms resulted.

Jackson County (Unincorporated Areas) - Jackson County Unincorporated Areas had 33 significant events from 1950 to 2021. Three significant events are described below.

- On May 11, 2004, large tree limbs down from winds in Morales.
- On May 10, 2007, trees were blown down in the town of Lolita.
- On April 17, 2015 wind gusts were estimated at 50 to 60 mph downed trees on FM 283 near Morales.

TABLE 14-4.
HISTORIC WIND-RELATED EVENTS IN JACKSON COUNTY AND PARTICIPATING COMMUNITIES
(1950-2021)

Location	Date	Peak Wind Speed (knots)	Estimated Damage Cost		Injuries	Deaths
			Property	Crops		
Jackson County	10/03/1956	75	$0	$0	0	0
Jackson County	05/08/1975	61	$0	$0	0	0
Jackson County	04/22/1978	52	$0	$0	0	0
Jackson County	04/05/1991	52	$0	$0	0	0
Lake Livingston	06/11/1995	69	$20,000	$0	0	0
Ganado	05/31/1997	60	$10,000	$0	0	0
Cordele	05/28/1999	52	$25,000	$0	0	0
Jackson (Zone)	07/14/2003	N/A	$594,000	$0	2	0
Morales	05/11/2004	55	$9,000	$0	0	0
Edna	05/11/2004	60	$30,000	$0	0	0
Morales	11/23/2004	55	$4,500	$0	0	0
Lolita	05/10/2007	60	$0	$0	0	0
Edna	05/10/2007	63	$45,000	$0	0	0
Ganado	08/04/2008	52	$1,000	$0	0	0
Lake Texana Dam	01/09/2011	52	$0	$0	0	0
Lake Texana Dam	01/09/2011	52	$5,000	$0	0	0
Cordele	05/26/2011	50	$15,000	$0	0	0
Ganado	05/26/2011	61	$1,000	$0	0	0
Edna	05/26/2011	61	$1,000	$0	0	0
Edna	06/05/2011	56	$0	$0	0	0
Manson	06/06/2011	56	$3,000	$0	0	0
Vanderbilt	06/13/2012	56	$5,000	$0	0	0
Jackson County	10/03/1956	75	$0	$0	0	0
Jackson County	05/08/1975	61	$0	$0	0	0
Jackson County	04/22/1978	52	$0	$0	0	0
Jackson County	04/05/1991	52	$0	$0	0	0
Lake Livingston	06/11/1995	69	$20,000	$0	0	0
Ganado	05/31/1997	60	$10,000	$0	0	0
Cordele	05/28/1999	52	$25,000	$0	0	0
Jackson (Zone)	07/14/2003	N/A	$594,000	$0	2	0

TABLE 14-4. HISTORIC WIND-RELATED EVENTS IN JACKSON COUNTY AND PARTICIPATING COMMUNITIES (1950-2021)						
Location	Date	Peak Wind Speed (knots)	Estimated Damage Cost		Injuries	Deaths
			Property	Crops		
Morales	05/11/2004	55	$9,000	$0	0	0
Edna	05/11/2004	60	$30,000	$0	0	0
Morales	11/23/2004	55	$4,500	$0	0	0
Lolita	05/10/2007	60	$0	$0	0	0
Edna	05/10/2007	63	$45,000	$0	0	0
Ganado	08/04/2008	52	$1,000	$0	0	0
Lake Texana Dam	01/09/2011	52	$0	$0	0	0
Lake Texana Dam	01/09/2011	52	$5,000	$0	0	0
Cordele	05/26/2011	50	$15,000	$0	0	0
Ganado	05/26/2011	61	$1,000	$0	0	0
Edna	05/26/2011	61	$1,000	$0	0	0
Edna	06/05/2011	56	$0	$0	0	0
Manson	06/06/2011	56	$3,000	$0	0	0
Vanderbilt	06/13/2012	56	$5,000	$0	0	0
Weedhaven	04/16/2015	56	$0	$0	0	0
La Ward	04/16/2015	56	$0	$0	0	0
Morales	04/17/2015	52	$0	$2,000	0	0
Edna	05/24/2015	55	$0	$0	0	0
Edna	06/19/2016	51	$0	$0	0	0
Ganado	04/07/2019	56	$9,000	$2,000	0	0

Notes:
The table may list more events than are shown on related figures since some recorded events do not include specific geographic (GIS-enabled data) coordinates for precise graphical representation.
From NCDC Storm Event Database

14.2.2 Location

Severe weather events have the potential to happen anywhere in the planning area. Figure 6-6 shows the distribution of average precipitation over the planning area.

Lightning

The entire extent of Jackson County and participating communities are exposed to some degree of lightning hazard, though exposed points of high elevation have a significantly higher frequency of occurrence. Since lightning can occur at any location, all of the communities could experience lightning events throughout their respective jurisdictions. There were no lightning damage events recorded by the NOAA Storm Events Database from 1996 to 2020 in the HMP update area.

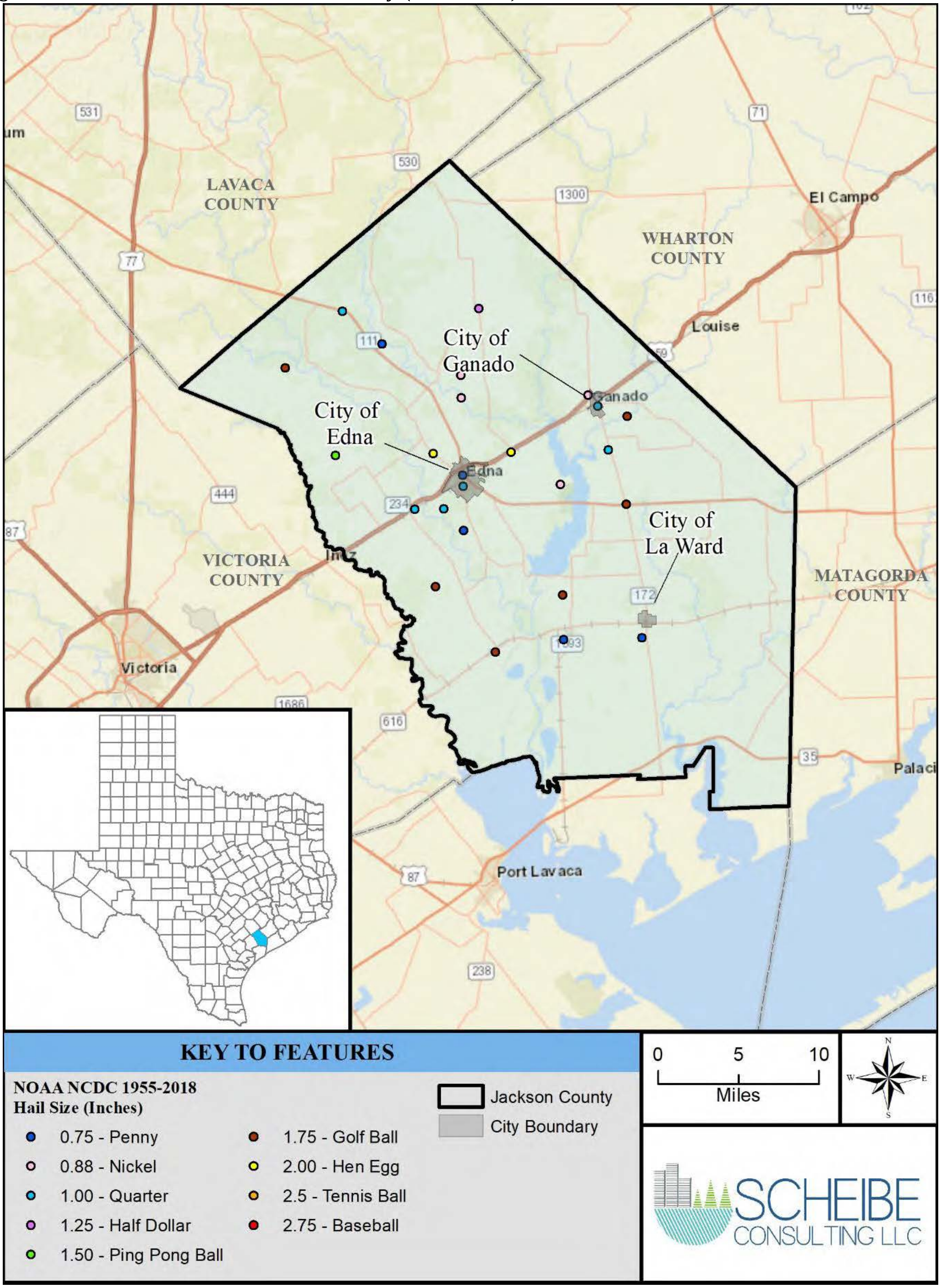
Hail

The entire extent of Jackson County and participating communities are exposed to the hailstorm hazard. Previous instances of hail events in the county are shown in Figure 14-10. Figure 14-10 does not show all hail events shown in Table 14-2 because not all tabular data had geographic locations. Only events listed with GIS data were mapped. Non-GIS-supported events were included in the table to provide more data for participating communities.

Winds

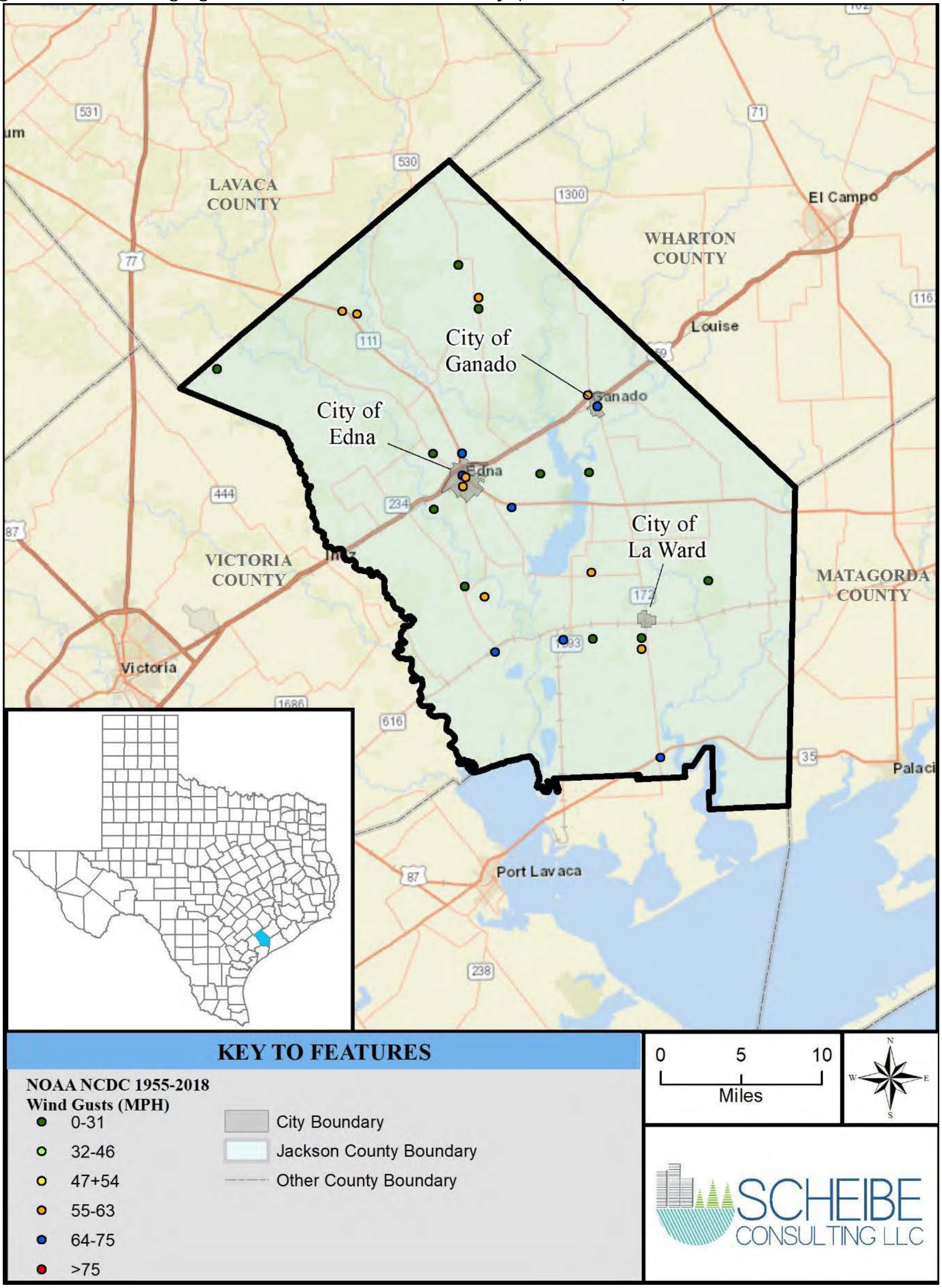
The entire extent of Jackson County and participating communities are exposed to high winds. They have the ability to cause damage over 100 miles from the center of storm activity. Wind events are most damaging to heavily wooded areas. Winds impacting walls, doors, windows, and roofs, may cause structural components to fail. Previous occurrences of damaging high winds and the locations that they occurred are shown in Figure 14-11. Figure 14-11 does not show all wind events on Table 14-4 because not all tabular data had geographic coordinates. Only events listed with GIS data were mapped. Non-GIS-supported events were included in the table to provide more data for participating communities.

Figure 14-10. Hail Events in Jackson County (1950-2021)



Note: From NOAA/NWS Storm Prediction Center

Figure 14-11. Damaging Wind Events in Jackson County (1950-2021)



Note: From NOAA/NWS Storm Prediction Center

14.2.3 Frequency

Lightning

To date, there have been no reported lightning strikes resulting in property damage in Jackson County and participating communities. Texas ranks as second of the highest in lightning fatalities in the nation. Jackson County and all participating communities have approximately 32 to 64 events per km2 per year. This frequency statistics applies to all Jackson County and participating communities. Although the frequency of lightning events in the planning area is high, that being said, events rarely cause damage.

Hail

Based on a record of 52 hailstorm events over a 65-year period, significant hail (>1") occurs approximately every other year on average and is considered likely. Since hail events can happen anywhere throughout the HMP update area, each participating community has the same frequency and probability for future events (once every 1 to two years). Based on historical records, the City of Edna can expect future events to have hail up to 1.75" in diameter hail. Based on historical records, the City of Ganado can expect future events up to 2.75" in diameter hail. Based on historical records, the City of La Ward can expect future events up to 1.75" in diameter hail. Based on historical records, Jackson County Unincorporated area can expect hail up to 2" in diameter. All participating jurisdictions can expect an event every 1 to 2 years in the future.

Winds

Based on 27 events in 71 years, a damaging high-wind (< 50 MPH) event occurs approximately every other year on average in Jackson County and participating communities and is considered likely. Since wind events can happen anywhere throughout the HMP update area, each participating community has the same frequency and probability for future events (once every one to two years).

14.2.4 Severity

Lightning

Based on the information in this hazard profile, the risk of a lightning event in Jackson County and participating communities is likely, but the magnitude/severity of thunderstorms is limited. The number of reported injuries from lightning is likely to be low, and county infrastructure losses are expected to be limited each year. The probability of a lightning event affecting Jackson County and participating communities is considered possible but unlikely.

Hail

Severe hailstorms can be quite destructive. In the United States hail related insured losses between 2000 and 2019 averaged between $8 billion and $14 billion a year. Within Texas, over the last 55 years, there's been $1.8 billion damage to property and crops. Between 2017-2019 there were a total of 192,988 hail loss claims. The property damage can be as minimal as a few broken shingles to the total destruction of buildings.

The top five states generating hail damage claims were Texas (637,977 claims); Colorado (380,066 claims); Nebraska (161,374 claims); Minnesota (150,673 claims) and Illinois (150,416 claims). Much of the damage inflicted by hail is to crops. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings and homes, and landscaping are the other things most commonly damaged by hail. Hail has been known to cause injury to humans and occasionally has been fatal.

High Winds

High winds, often accompanying severe thunderstorms, can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss. Wind storms in Jackson County participating communities are rarely life-threatening but do disrupt daily activities, cause damage to buildings, and structures, and increase the potential for other hazards, such as wildfires. Winter winds can result in damage and close highways due to ice and blowing snow. Winds can also cause trees to fall, particularly those killed by insects or wildfire, creating a hazard to property or those outdoors. Based on the information in this hazard profile, the magnitude/severity of high winds is considered limited. The overall significance of the hazard is considered low, with minimal potential impact.

14.2.5 Warning Time

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

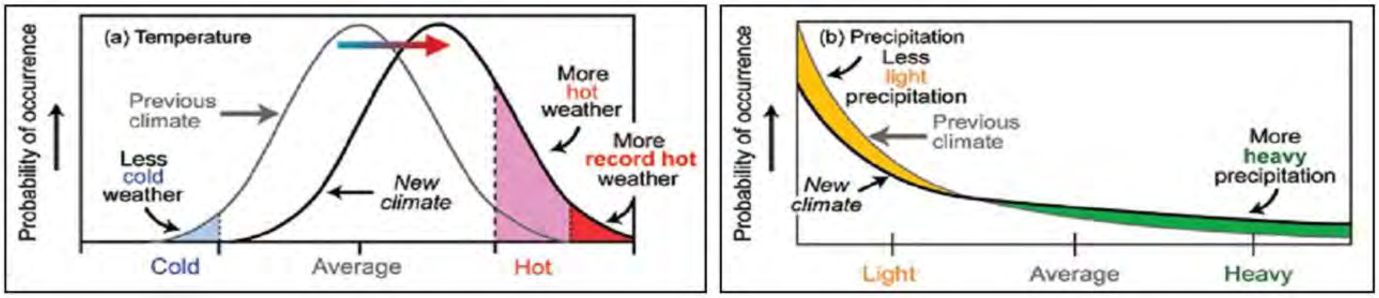
14.3 SECONDARY HAZARDS

The most significant secondary hazards associated with severe local storms are floods, falling and downed trees, landslides, and downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Erosion can occur when the soil on slopes becomes oversaturated and fails. Fires can occur as a result of lightning strikes. Many locations in the region have minimal vegetative ground cover and the high winds can create a large dust storm, which becomes a hazard for travelers and a disruption for local services. High winds in the winter can turn a small amount of snow into a complete whiteout and create drifts in roadways. Debris carried by high winds can also result in injury or damage to property. Wildland fires can be accelerated and rendered unpredictable by high winds, which creates a dangerous environment for firefighters.

14.4 CLIMATE CHANGE IMPACTS

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. The number of weather-related disasters during the 1990s was four times that of the 1950s and cost 14 times as much in economic losses. Historical data shows that the probability of severe weather events increases in a warmer climate (see Figure 14-12). The changing hydrograph caused by climate change could have a significant impact on the intensity, duration, and frequency of storm events. All of these impacts could have significant economic consequences.

Figure 14-12. Severe Weather Probabilities in Warmer Climates



14.5 EXPOSURE

The primary data source was the HAZUS-MH inventory data (updated with 2010 Census Data and 2018 RS Means Square Foot Costs), augmented with state and federal data sets, NOAA National Climatic Data Center Storm Event Database, as well as data from local sources.

14.5.1 Population

It can be assumed that the entire planning area is exposed to some extent to thunderstorms, lightning, high wind, and hail events. Certain areas are more exposed due to geographic location and local weather patterns. Populations with large stands of trees or overhead power lines may be more susceptible to wind damage and blackout, while populations in low-lying areas are at risk for possible flooding. It is not uncommon for residents living in more remote areas of the county to be isolated after such events.

14.5.2 Property

According to the HAZUS-MH inventory data (updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs), there are 6,626 buildings within the census blocks that define the planning area with an asset replaceable value of $1.4 billion (excluding contents). About 93% of these buildings (and 79% of the building value) are associated with residential housing. The total value including contents is $2.4 billion. Other types of buildings in this report include agricultural, education, religious, and governmental structures. See Table 14-5 below.

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

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

TABLE 14-5 EXPOSED STRUCTURES AND POPULATION					
Jurisdiction	Residential	Commercial	Other *	**Total Structures**	**Total Population**
City of Edna	2,143	133	100	**2,376**	**5,499**
City of Ganado	657	34	17	**708**	**2,003**
City of La Ward	88	6	6	**100**	**213**
Unincorporated Area	3,256	82	104	**3,442**	**6,360**
Jackson County Total	**6,144**	**255**	**227**	**6,626**	**14,075**

Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.

14.5.3 Critical Facilities and Infrastructure

All critical facilities within the planning area are exposed to lightning, high winds, and hail. Those facilities within the floodplain (Chapter 12) are exposed to flooding associated with thunderstorms. Additional facilities on higher ground may be particularly exposed to wind damage, lightning, or damage from falling trees. The most common problems associated with these weather events are the loss of utilities. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to secondary hazards such as flooding.

14.5.4 Environment

The environment is highly exposed to lightning, high winds, and hail. Natural habitats such as streams and trees risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure. Flooding events can produce river channel migration or damage riparian habitat. Lightning can start wildfires, particularly during a drought.

14.6 VULNERABILITY

Because lightning, hail, and wind cannot be directly modeled in HAZUS-MH, annualized losses were estimated using GIS-based analysis, historical data analysis, and statistical risk assessment methodology. Event frequency, severity indicators, expert opinions, and historical local knowledge of the region were used for this assessment.

14.6.1 Population

Vulnerable populations are the elderly, low-income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life-threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure during thunderstorm, wind, and hail events and could suffer more secondary effects of the hazard. Outdoor recreational users in the area may also be more vulnerable to severe weather events. Table 14-6 shows vulnerable populations per participating jurisdiction.

TABLE 14-6 MOST VULNERABLE POPULATION						
Jurisdiction	Youth Population (< 16)	% of Total Population	Elderly Population (> 65)	% of Total Population	Economically Disadvantage (Income< $20,000)	% of Total Population
City of Edna	1,481	26.93%	876	15.93%	371	6.75%
City of Ganado	502	25.06%	270	13.48%	100	4.99%
City of La Ward	71	33.33%	24	11.27%	22	10.33%
Unincorporated Area	1,525	23.98%	1,143	17.97%	448	7.04%
Jackson County Total	**3,579**	**25.43%**	**2,313**	**16.43%**	**941**	**6.69%**

14.6.2 Property

All property is vulnerable during thunderstorm, lightning, wind, and hail events, but properties in poor condition or particularly vulnerable locations may risk the most damage. Generally, the damage is minimal and goes unreported. Those on hillsides and ridges may be more prone to wind damage. Those that are located under or near overhead lines or near large trees may be damaged in the event of a collapse.

Loss estimations for the lightning, wind, and hail hazards are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing projected damages (annualized loss) on reported damages and exposed values. Exposed values include total building and content values. Historical events, statistical analysis, and probability factors were applied to the counties and communities reported damages and exposed values to create an annualized Table 14-7 through Table 14-9 lists the property loss estimates for lightning, hail, and wind events. Annualized losses of ‘negligible’ are less than $50 annually. Negligible loss hazards are still included despite minimal annualized losses because of the potential for a high-value damaging event.

TABLE 14-7. LOSS ESTIMATES FOR HAIL EVENTS IN JACKSON COUNTY AND PARTICIPATING COMMUNITIES			
Jurisdiction	Exposed Value	Annualized Loss	Annualized Loss Percentage
City of Edna	$873,172,834	$1,000	<0.01
City of Ganado	$253,570,646	$1,800	<0.01
City of La Ward	$27,144,277	$329	<0.01
Unincorporated Area	$1,215,680,242	$1,157	<0.01
Jackson County Total	**$2,369,568,000**	**$4,286**	**<0.01**

TABLE 14-8. LOSS ESTIMATES FOR LIGHTNING EVENTS IN JACKSON COUNTY AND PARTICIPATING COMMUNITIES			
Jurisdiction	Exposed Value	Annualized Loss	Annualized Loss Percentage
City of Edna	$873,172,834	Negligible	<0.01
City of Ganado	$253,570,646	Negligible	<0.01
City of La Ward	$27,144,277	Negligible	<0.01
Unincorporated Area	$1,215,680,242	Negligible	<0.01
Jackson County Total	**$2,369,568,000**	**Negligible**	**<0.01**

TABLE 14-9. LOSS ESTIMATES FOR WIND EVENTS IN JACKSON COUNTY AND PARTICIPATING COMMUNITIES			
Jurisdiction	Exposed Value	Annualized Loss	Annualized Loss Percentage
City of Edna	$873,172,834	$2,056	<0.01
City of Ganado	$253,570,646	$295	<0.01
City of La Ward	$27,144,277	$70	<0.01
Unincorporated Area	$1,215,680,242	$2,777	<0.01
Jackson County Total	**$2,369,568,000**	**$4,866**	**<0.01**

Vulnerability Narrative

All participating communities are equally at risk of lightning, hail, and wind. Table 14-6 lists the vulnerable population per community. Table 14-7 to Table 14-9 lists the estimated annualized losses in dollars for each participating community. All participating communities are vulnerable to communication problems. This applies to both residents of the communities, such as Early Warning Systems, and between emergency personal.

City of Edna -

- *Lightning* – Properties with thick vegetation and large trees or those built under no or insufficient building codes are more susceptible to the negative impacts of a lightning event. Critical facilities without alternate sources of power supply increase this vulnerability as well.
- *Hail* – The maximum hail size recorded for the City was 1.75 inches (golf ball size hail). This hail size can cause damage to windows and glass roofs as well as the bodywork of cars and aircraft.

- *Wind* – Based on historical events, significant wind events have been recorded within the City of Edna at 51-63 mph. Approximately 9% of the of City's housing are manufactured homes. Older residential areas as well as manufactured home subdivisions, houses, and structures not securely anchored to foundations are most vulnerable to wind damages. Furthermore, areas with dead trees and vegetation that are not regularly cleared are more prone to wind damages. Both of these (loose structures and dead vegetation) can become flying/falling hazards in a wind event.

Community Perception of Vulnerability in the City of Edna

See the front page of the current chapter for a summary of hazard rankings for the City of Edna. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

City of Ganado -

- *Lightning* – Properties built without sufficient building codes or with large trees or thick brush are more vulnerable to a damaging lightning event. Residents unaware of the hazards associated with lightning are more at risk for damages.
- *Hail* – The maximum hail size recorded for Ganado was 2.75 inches (baseball size hail) and can cause significant structural damage to facades, metal cladding, and window frames as well as pose a serious risk of injury. Communities that do not provide shelter for vulnerable residents increase this risk. Cars left in the open are subject to damages from hail events as well.
- *Wind* – Based on historical events, the most significant wind events recorded for the City of Ganado were between 52-60 mph. Approximately 21% of the City's housing is manufactured homes. Older residential areas as well as manufactured home subdivisions, houses, and structures not securely anchored to foundations are most vulnerable to wind damages. Furthermore, areas with dead trees and vegetation that are not regularly cleared are more prone to wind damages. Both of these (loose structures and dead vegetation) can become flying/falling hazards in a wind event. This can impact critical facilities and infrastructure as well. Facilities not equipped with alternate power sources increase vulnerability as they would be unable to serve residents in the event of a wind-induced outage.

Community Perception of Vulnerability in the City of Ganado

See the front page of the current chapter for a summary of hazard rankings for the City of Ganado. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

City of La Ward

- *Lightning* – Properties with thick vegetation and large trees or those built under no or insufficient building codes are more susceptible to the negative impacts of a lightning event. Critical facilities without alternate sources of power supply increase this vulnerability as well.
- *Hail* – The maximum hail size recorded for the City was 1.75 inches (golf ball size hail). This hail size can cause damage to windows and glass roofs as well as the bodywork of cars and aircraft.
- *Wind* – Based on historical events, the most significant wind events recorded for the City of Ganado were approximately 54 mph. Roughly 34% of the City's housing is manufactured homes. Older residential areas as well as manufactured home subdivisions, houses, and structures not

securely anchored to foundations are most vulnerable to wind damages. Furthermore, areas with dead trees and vegetation that are not regularly cleared are more prone to wind damages. Both of these (loose structures and dead vegetation) can become flying/falling hazards in a wind event. This can impact critical facilities and infrastructure as well. Facilities not equipped with alternate power sources increase vulnerability as they would be unable to serve residents in the event of a wind-induced outage.

Community Perception of Vulnerability in the City of La Ward

See the front page of the current chapter for a summary of hazard rankings for the City of La Ward. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

Jackson County (Unincorporated Area) -

- *Lightning* – Emergency service facilities and infrastructures such as area schools, police and fire departments, and government buildings are vulnerable to lightning strikes. A power outage at one of these facilities could negatively impact residents and increase and complicate emergency response efforts. Rural areas are a greater distance from emergency responders and face longer response times. Properties with large trees and underbrush are also more vulnerable to lightning strikes and fires.
- *Hail* – The maximum hail size recorded for the Unincorporated Areas of Jackson County was 1.75 inches (golf ball size hail). This hail size can cause damage to windows and glass roofs as well as the bodywork of vehicles. Older structures may experience more damages as they have been exposed to the elements longer. Critical facilities, such as older government buildings, are at an increased risk.
- *Wind* **–** Based on historical events, the most significant wind events recorded for the Unincorporated Areas of Jackson County were between 52 and 75 mph. Approximately 23% of the HMP update area’s housing are manufactured homes. Jackson county rural areas may experience longer emergency response times if an event were to occur due to their distance from services. Older residential areas as well as manufactured home subdivisions, houses, and structures not securely anchored to foundations are most vulnerable to wind damages. Furthermore, areas with dead trees and vegetation that are not regularly cleared are more prone to wind damages. Both of these (loose structures and dead vegetation) can become flying/falling hazards in a wind event.

Community Perception of Vulnerability in Jackson County Unincorporated Areas

See the front page of the current chapter for a summary of hazard rankings for Jackson County and participating communities in this HMP update. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

14.6.3 Critical Facilities and Infrastructure

Incapacity and loss of roads are the primary transportation failures resulting from lightning, wind, and hail and are mostly associated with secondary hazards. Erosion caused by heavy prolonged rains can block roads. High winds can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress. Of particular concern are roads providing access to isolated areas and to the elderly. Prolonged obstruction of major routes due to debris or floodwaters can disrupt the shipment of goods and other commerce. Large, prolonged storms can have negative economic impacts on an entire region. Severe windstorms and downed trees can create serious impacts on power and above-ground communication lines. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance. Lightning events in the participating communities can have destructive effects on power and information systems. Failure of these systems would have cascading effects throughout the county and could possibly disrupt critical facility functions.

14.6.4 Environment

The vulnerability of the environment to severe weather is the same as the exposure, discussed in Section 14.5.4

14.7 FUTURE TRENDS IN DEVELOPMENT

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

14.8 SCENARIO

Although severe local storms are infrequent, impacts can be significant, particularly when secondary hazards of flood and erosion occur. A worst-case event would involve prolonged high winds, an intense hail event, and a lightning strike at a critical facility (such as an emergency service station) during a thunderstorm. Such an event would have both short-term and longer-term effects. Initially, schools and roads would be closed due to power outages caused by high winds and downed tree obstructions. In more rural areas, some subdivisions could experience limited ingress and egress. Prolonged rain could produce flooding, overtopped culverts with ponded water on roads, and landslides on steep slopes. Flooding could further obstruct roads and bridges, further isolating residents.

14.9 ISSUES

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

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

Chapter 15.
Tornado

TORNADO RANKING	
Jackson County	Medium
City of Edna	Medium
City of Ganado	High
City of La Ward	Medium

DEFINITIONS

Tornado A violently rotating column of air touching the ground, usually attached to the base of a thunderstorm. Winds of a tornado may reach 300 miles per hour and damage paths can be in excess of 1 mile wide and 50 miles long. Most are on the ground for less than 15 minutes. They are measured using the Fujita Scale (ranging from F0 to F5), or the Enhanced Fujita Scale.

15.1 GENERAL BACKGROUND

The visible sign of a tornado is the dust and debris that is caught in the rotating column made up of water droplets. Tornadoes are the most violent of all atmospheric storms. Tornadoes can be induced by hurricanes and thunderstorms. The following are common ingredients for tornado formation:

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

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

In 2007, NWS began rating tornadoes using the Enhanced Fujita Scale (EF-Scale). The EF-Scale is a set of wind estimates (not measurements) based on damage. It uses 3-second gusts estimated at the point of damage based on a judgment of 8 levels of damage to the 28 indicators listed in Table 15-1. These estimates vary with height and exposure. Standard measurements are taken by weather stations in openly exposed areas. Table 15-2 describes the EF-Scale ratings.

With a yearly average of 1,253 tornadoes, the U.S. experiences more tornadoes than any other country. The peak of the tornado season is April through June, with the highest concentration of tornadoes in the central U.S. Figure 15-1 shows the annual average number of tornadoes between 2000 and 2019. Texas experienced an average of 133 tornado events annually in that period. Texas ranks first among the 50 states in both the frequency of tornadoes and the number of lethal tornadoes. When these statistics are compared to other states by the frequency per 10,000 square miles, Texas ranks tenth in the U.S. “Tornado Alley” is a nickname given to an area in the southern plains of the central United States that consistently experiences a high frequency of tornadoes each year. Tornadoes in this region typically happen in late spring and occasionally the early fall. The Gulf Coast area has a separate tornado region nicknamed "Dixie Alley" with a relatively high frequency of tornadoes occurring in the late fall (October through December).

NOAA’s NSSL used historical data to estimate the daily probability of tornado occurrences across the U.S., regardless of tornado magnitude. Figure 15-2 shows the estimates. The density per 25 square miles in the map’s legend indicates the probable number of tornadoes for each 25 square mile cell within the contoured zone that can be expected over a similar period of record. This density number does NOT indicate the number of events that can be expected across the entire zone on the map.

TABLE 15-1.
ENHANCED FUJITA SCALE DAMAGE INDICATORS

No.	Damage Indicator	No.	Damage Indicator
1	Small barns, farm outbuildings	15	School – one-story elementary (interior or exterior halls)
2	One or two-family residences	16	School – junior or senior high school
3	Single-wide mobile home	17	Low-rise (1-4 story) building
4	Double-wide mobile home	18	Mid-rise (5-20) building
5	Apartment, condo, townhouse (3 stories or less)	19	High-rise (over 20 stories) building
6	Motel	20	Institutional building (hospital, government, or university)
7	Masonry apartment or motel	21	Metal building system
8	Small retail building (fast food)	22	Service station canopy
9	Small professional (doctor office, bank)	23	Warehouse (tilt-up walls or heavy timber)
10	Strip mall	24	Transmission line tower
11	Large shopping mall	25	Free-standing tower
12	Large, isolated (big box) retail building	26	Free standing pole (light, flag, luminary)
13	Automobile showroom	27	Tree – hardwood
14	Automobile service building	28	Tree – softwood

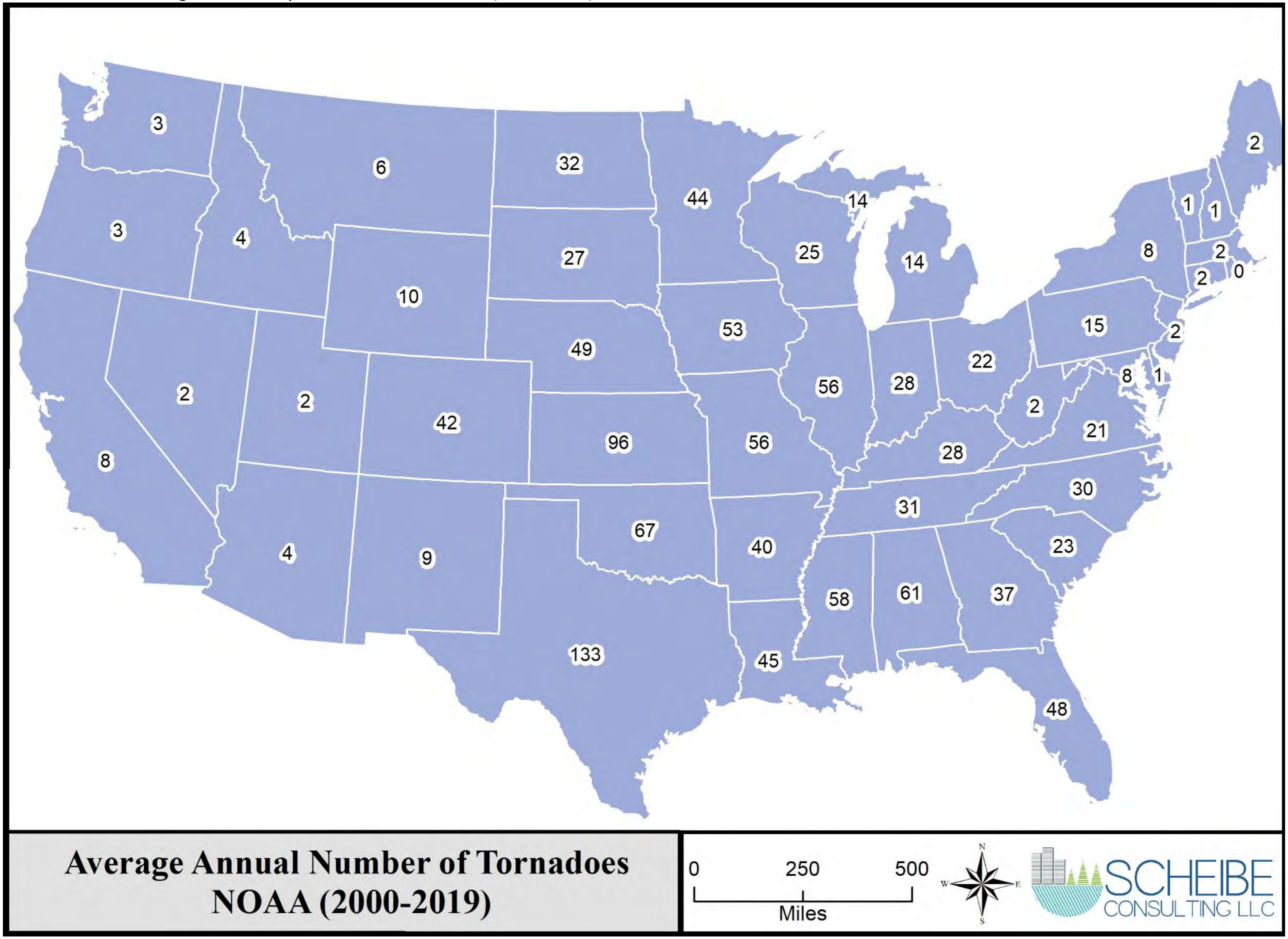
Note: From NOAA-NWS

TABLE 15-2.
THE FUJITA SCALE AND ENHANCED FUJITA SCALE

Fujita (F) Scale			Derived		Operational Enhanced Fujita (EF) Scale	
F Number	**Fastest ¼ mile (mph)**	**3-second gust (mph)**	**EF Number**	**3-second gust (mph)**	**EF Number**	**3-second gusts (mph)**
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

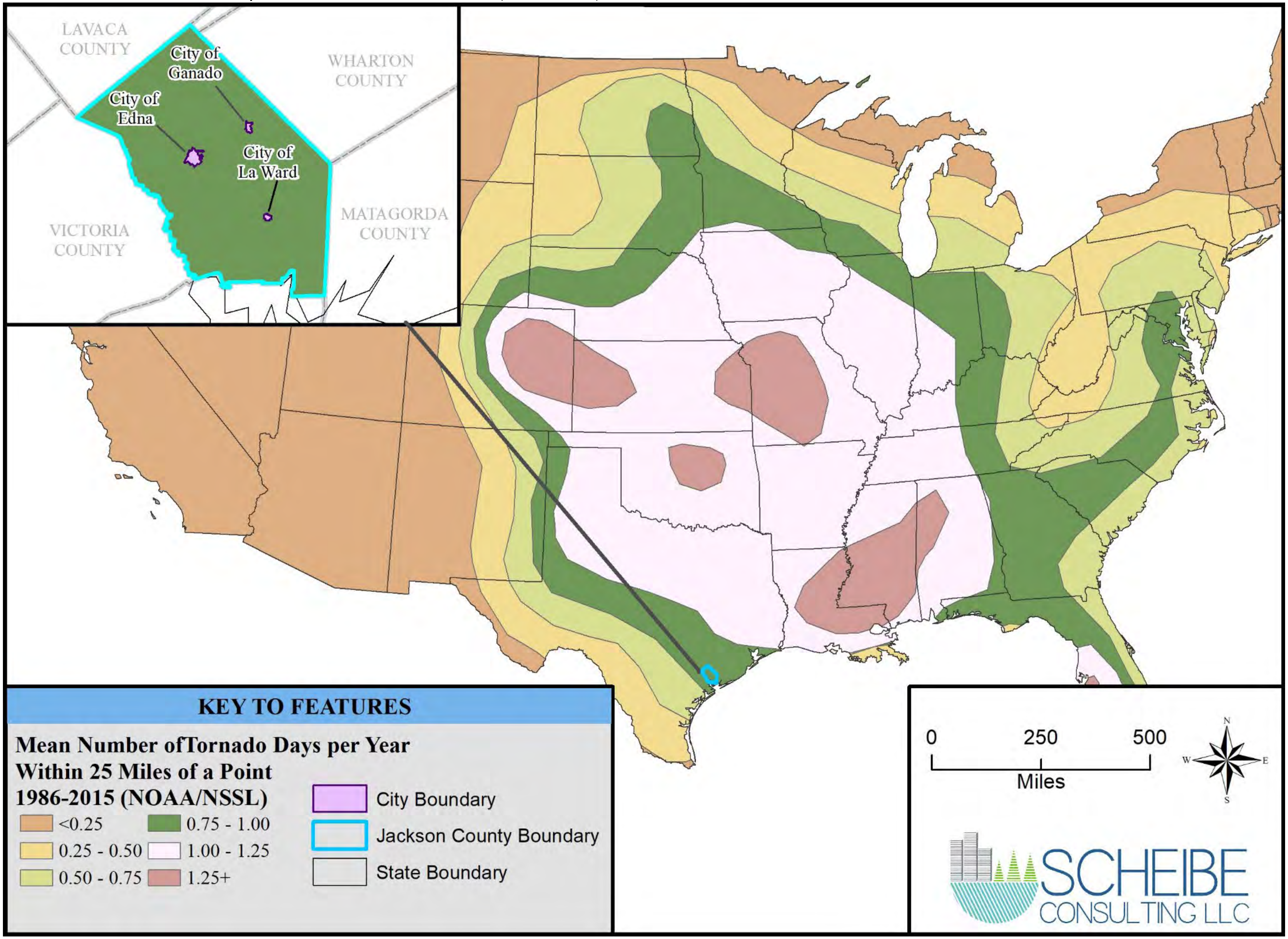
Note: From NOAA-NWS

Figure 15-1. Annual Average Number of Tornadoes in the U.S. (2000-2019)



Note: From NOAA/NWS Storm Events Database

Figure 15-2. Total Annual Threat of Tornado Events in the U.S. (1986-2015)



Note: From NOAA/NWS Storm Prediction Center WCM

15.2 HAZARD PROFILE

15.2.1 Past Events

Table 15-3 lists 48 tornadoes in Jackson County recorded by the NOAA Storm Events Center from 1950 to 2021. Figure 15-3 shows the location of NOAA documented tornado paths between 1950 and 2019. As can be seen from the map, most of the tornadoes occur in the spring season, with a few in the fall.

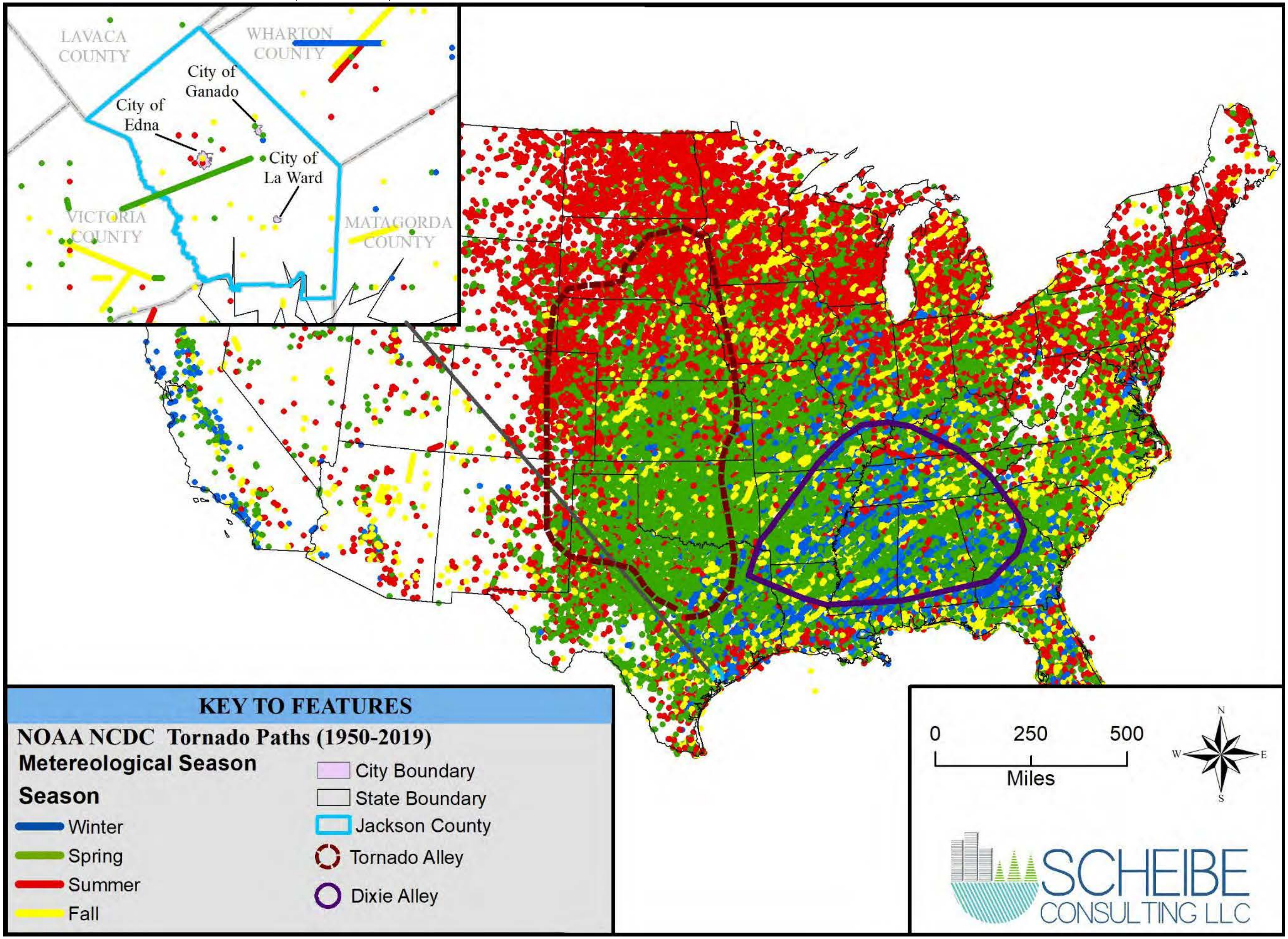
**TABLE 15-3.
HISTORIC TORNADO EVENTS IN JACKSON COUNTY
(1950-2021)**

Location	Date	Category	Deaths	Injuries	Estimated Property Damage
Jackson County	5/23/1959	F0	0	0	$0
Ganado	5/23/1961	F1	0	0	$2,500
Jackson County	9/11/1961	F3	3	0	$25,000
Edna	2/9/1966	F3	0	0	$25,000
Jackson County	9/20/1967	F0	0	0	$25,000
Jackson County	9/20/1967	F0	0	0	$25,000
Jackson County	9/20/1967	F0	0	0	$0
Jackson County	9/20/1967	F0	0	0	$2,500
Jackson County	9/20/1967	F0	1	0	$25,000
Jackson County	9/20/1967	F0	0	0	$250
Jackson County	9/20/1967	F0	0	0	$250
Jackson County	9/20/1967	F0	0	0	$250
Jackson County	9/20/1967	F0	1	0	$25,000
Jackson County	9/20/1967	F3	3	0	$0
Ganado	9/21/1967	F1	0	0	$2,500
Jackson County	5/7/1972	F1	0	0	$25,000
Jackson County	4/30/1974	F0	0	0	$250
Ganado	4/30/1974	F1	0	0	$250
Jackson County	12/24/1975	F3	0	0	$0
Jackson County	5/7/1976	F1	0	0	$25,000
Ganado	4/22/1978	F1	0	0	$25,000
Jackson County	6/21/1980	F1	0	0	$25,000
Jackson County	6/21/1980	F1	0	0	$25,000
Jackson County	5/19/1984	F0	1	0	$250,000
Jackson County	6/16/1991	F0	0	0	$0
Jackson County	6/16/1991	F0	0	0	$2,500
Jackson County	6/16/1991	F0	2	0	$25,000
Jackson County	10/1/1991	F1	0	0	$250,000
Jackson County	6/6/1992	F1	0	0	$25,000

TABLE 15-3.
HISTORIC TORNADO EVENTS IN JACKSON COUNTY
(1950-2021)

Location	Date	Category	Deaths	Injuries	Estimated Property Damage
Edna	10/8/1994	F0	0	0	$50,000
La Ward	10/18/1994	F0	0	0	$0
Jackson County	4/4/1995	F0	0	0	$2,000
Edna	6/20/1996	F0	0	0	$5,000
Speaks	8/12/1996	F0	0	0	$0
Edna	6/21/1997	F0	0	0	$20,000
La Salle	1/21/1998	F0	0	0	$0
Lolita	5/12/2001	N/A	0	0	$0
Ganado	7/23/2003	N/A	0	0	$0
La Salle	7/28/2003	F0	0	0	$1,000
Edna	7/28/2003	N/A	0	0	$0
Vanderbilt	7/28/2003	N/A	0	0	$0
Vanderbilt	4/6/2004	F0	0	0	$0
Edna	4/6/2004	N/A	0	0	$0
Morales	5/11/2004	F0	0	0	$8,000
La Ward	10/12/2006	N/A	0	0	$0
Matilda	6/21/2008	EF0	0	0	$20,000
Morales	6/21/2008	N/A	0	0	$0
Edna Jackson County Airport	10/3/2009	EF0	0	0	$3,000

Figure 15-3. Tornado Paths in the U.S. (1950-2019)

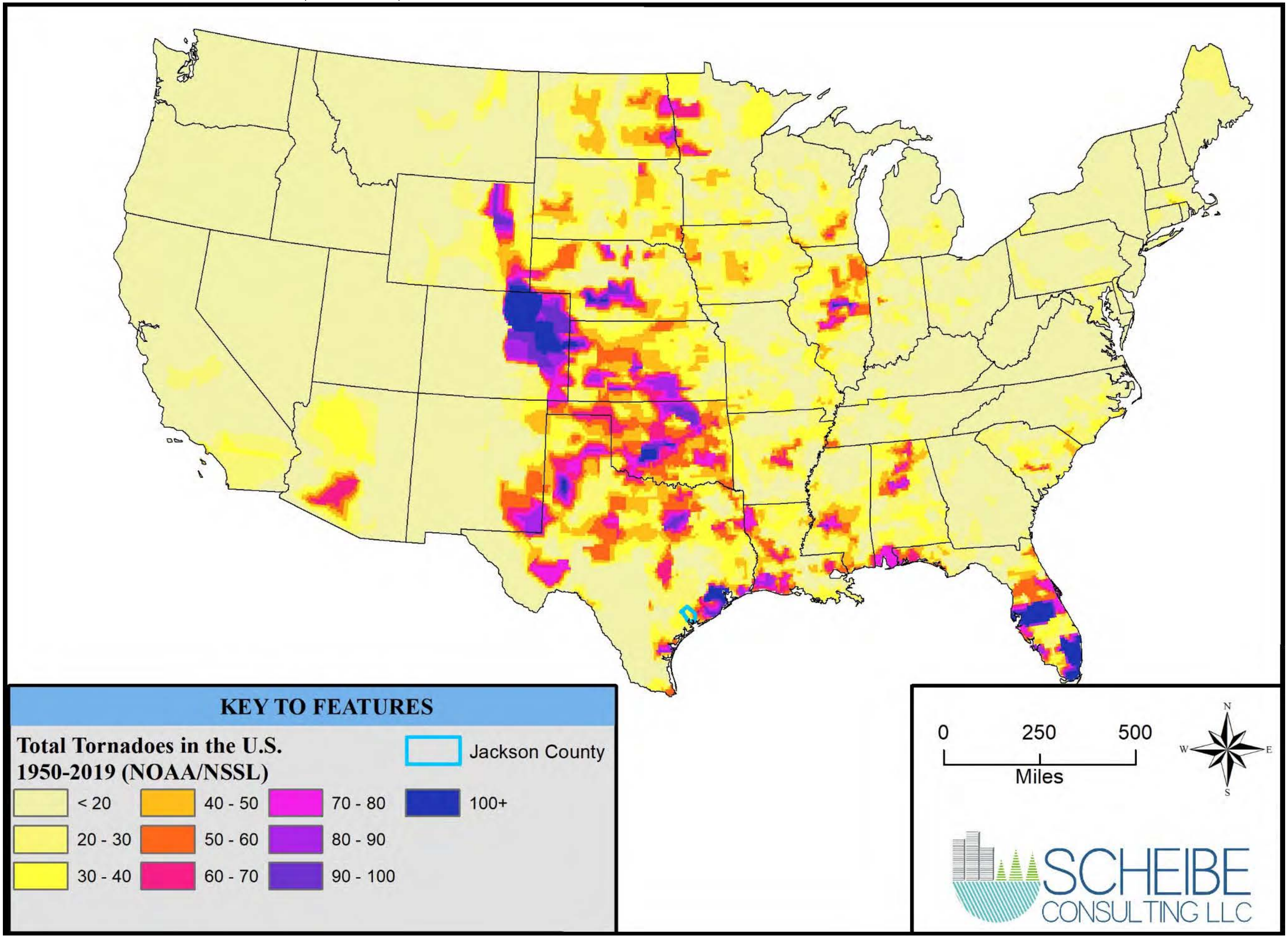


Note: From NOAA/NWS Storm Prediction Center

15.2.2 Location

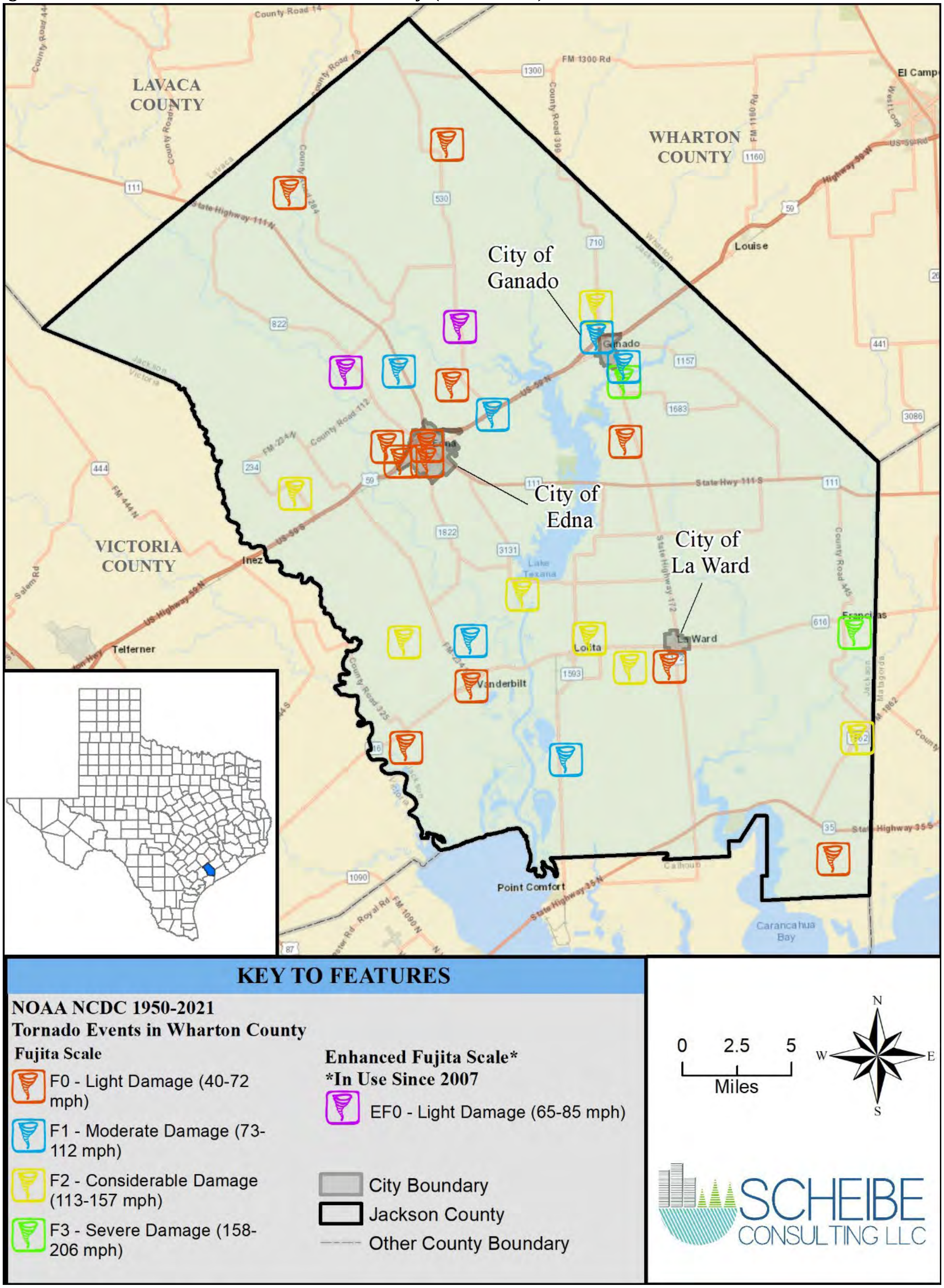
Recorded tornadoes in the planning area are typically average-sized and short-lived. They can occur anywhere in Jackson County and participating communities. Figure 15-4 shows tornado activity documented by NOAA from 1950-2019. Figure 15-5 shows the location of previous tornado events in Jackson County and participating communities. Not all tornado locations are displayed in Figure 15-5 as exact geographic coordinate information was not obtained for all events.

Figure 15-4. Total Tornadoes in the U.S (1950-2019)



Note: From NOAA/NWS Storm Events Database

Figure 15-5. Tornado Events in Jackson County (1950-2021)



Note: From NOAA/NWS Storm Prediction Center

15.2.3 Frequency

Tornadoes may occur in any month and at any hour of the day, but they occur with the greatest frequency during the late spring and early summer months, and between the hours of 4:00 pm and 8:00 pm. From 1950 to 2021, nearly 47.9% of all Jackson County tornadoes occurred within the three-month period of April, May, and June.

Table 15-3 lists 14 recorded tornadoes rated F1 or higher between 1950 and 2021. Therefore, on average, a significant tornado occurs in the HMP update area once every five years. Since tornado events can occur anywhere throughout the HMP update area, each participating community has the same frequency and probability of future events (once every five years).

15.2.4 Severity

Tornadoes are potentially the most dangerous of local storms. If a major tornado were to strike within the populated areas of Jackson County and the participating communities, the damage could be widespread. Businesses could be forced to close for an extended period or permanently, fatalities could be high, many people could be homeless for an extended period, and routine services such as telephone or power could be disrupted. Buildings may be damaged or destroyed. Historically, tornadoes have not typically been severe or caused damage in the planning area. However, if an event were to occur in the planning area, the strength and magnitude can be expected to be in line with previous events (as listed in Table 15-3).

15.2.5 Warning Time

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

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

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

15.3 SECONDARY HAZARDS

Tornadoes may cause loss of power if utility service is disrupted. Additionally, fires may result from damages to natural gas infrastructure. Hazardous materials may be released if a structure is damaged that houses such materials or if such material is in transport.

15.4 CLIMATE CHANGE IMPACTS

Climate change impacts on the frequency and severity of tornadoes are unclear. According to the Center for Climate Change and Energy Solutions, “Researchers are working to better understand how the building blocks for tornadoes – atmospheric instability and wind shear – will respond to global warming. It is likely that a warmer, moister world would allow for more frequent instability. However, it is also likely that a warmer world would lessen the chances for wind shear. Recent trends for these quantities in the Midwest during the spring are inconclusive. It is also possible that these changes could shift the timing of tornadoes or regions that are most likely to be hit".

15.5 EXPOSURE

Because tornadoes cannot be directly modeled in HAZUS-MH, annualized losses were estimated using GIS-based analysis, historical data analysis, and statistical risk assessment methodology. Event frequency, severity indicators, expert opinions, and historical knowledge of the region were used for this assessment. The primary data source was the updated HAZUS-MH inventory data (updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs) augmented with state and federal data sets as well as the NOAA National Climatic Data Center Storm Event Database.

15.5.1 Population

It can be assumed that the entire planning area is exposed to tornadoes to some extent. Certain areas are more exposed due to geographic location (rural areas of the county) and local weather patterns.

15.5.2 Property

According to the HAZUS-MH inventory data (updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs), there are 6,626 buildings within the census blocks that define the planning area with an asset replaceable value of $1.4 billion (excluding contents). About 93% of these buildings (and 79% of the building value) are associated with residential housing. The total value including contents is $2.4 billion. Other types of buildings in this report include agricultural, education, religious, and governmental structures. See hazard loss tables for community-specific total assessed numbers (e.g. Table 15-6).

Properties at lower elevations are more likely to be exposed to tornadoes. Table 15-4 list the exposed structures and population for each participating community.

TABLE 15-4
EXPOSED STRUCTURES AND POPULATION

Jurisdiction	Residential	Commercial	Other *	**Total Structures**	**Total Population**
City of Edna	2,143	133	100	**2,376**	**5,499**
City of Ganado	657	34	17	**708**	**2,003**
City of La Ward	88	6	6	**100**	**213**
Unincorporated Area	3,256	82	104	**3,442**	**6,360**
Jackson County Total	**6,144**	**255**	**227**	**6,626**	**14,075**

Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.

15.5.3 Critical Facilities and Infrastructure

All critical facilities (see Figure 6-8 and Figure 6-9) are likely vulnerable to tornadoes. The most common problems associated with this hazard are utility loss. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to downed trees or other debris.

15.5.4 Environment

Environmental features are exposed to tornado risk, although damages are generally localized to the path of the tornado.

15.6 VULNERABILITY

15.6.1 Population

Vulnerable populations are the elderly, low-income, or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life-threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure after tornado events and could suffer more secondary effects of the hazard.

Individuals caught in the path of a tornado who are unable to seek appropriate shelter are especially vulnerable. This may include individuals who are out in the open, in cars, or who do not have access to basements, cellars, or safe rooms. See Table 15-5 for the populations most vulnerable to tornado events per jurisdiction.

TABLE 15-5
MOST VULNERABLE POPULATION

Jurisdiction	Youth Population (< 16)	% of Total Population	Elderly Population (> 65)	% of Total Population	Economically Disadvantage (Income < $20,000)	% of Total Population
City of Edna	1,481	26.93%	876	15.93%	371	6.75%
City of Ganado	502	25.06%	270	13.48%	100	4.99%
City of La Ward	71	33.33%	24	11.27%	22	10.33%
Unincorporated Area	1,525	23.98%	1,143	17.97%	448	7.04%
Jackson County Total	**3,579**	**25.43%**	**2,313**	**16.43%**	**941**	**6.69%**

15.6.2 Property

All property is vulnerable during tornado events, but properties in poor condition or in particularly vulnerable locations (rural areas) may risk the most damage.

Loss estimations for tornadoes are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing projected damages (annualized loss) on historical events, statistical analysis, and probability factors. These were applied to the exposed value of the county and communities to create an annualized loss. Table 15-6 lists the loss estimates.

TABLE 15-6.
LOSS ESTIMATES FOR TORNADO EVENTS

Jurisdiction	Exposed Value	Annualized Loss	Annualized Loss Percentage
City of Edna	$873,172,834	$1,538	<0.01
City of Ganado	$253,570,646	$465	<0.01
City of La Ward	$27,144,277	Negligible	Negligible
Unincorporated Area	$1,215,680,242	$13,615	<0.01
Jackson County Total	**$2,369,568,000**	$15,619	**<0.01**

Vulnerability Narrative

The vulnerability of tornado events per jurisdiction is described below.

- **City of Edna -** Approximately 9% of the City of Edna's housing is manufactured homes. This type of housing is more vulnerable to a tornado event. Loose structures and non-secured objects (such as dead trees and thick underbrush) can become flying projectiles in an event. Older homes constructed without the use of building codes are at an increased risk as well as buildings with large spans. If an event were to impact critical facilities, such as police and fire stations, emergency services could be greatly limited and residents would be negatively impacted. Facilities that do not have an alternate power supply source, such as a generator, increase this risk.
- **City of Ganado -** Approximately 21% of the City of Ganado's housing is manufactured homes. Tornadoes can easily destroy poorly constructed buildings and mobile homes. Loose structures and non-secured objects (such as vehicles, dead trees, and thick underbrush) can become flying projectiles in an event. Older homes constructed without the use of building codes are vulnerable as well. If an event were to strike emergency service centers or key transportation routes, such as the local police and fire stations, emergency response times would be limited. Residents unaware of the threat of an event, such as with neighborhood alert systems, are more at risk as well.
- **City of La Ward -** Approximately 34% of the City of La Ward's housing is manufactured homes. Tornadoes can easily destroy poorly constructed buildings and mobile homes. Loose structures and non-secured objects (such as vehicles, dead trees, and thick underbrush) can become flying projectiles in an event. Older homes constructed without the use of building codes

are vulnerable as well. If an event were to strike emergency service centers or key transportation routes, such as the local police and fire stations, emergency response times would be limited. Residents unaware of the threat of an event, such as with neighborhood alert systems, are more at risk as well.

- **Jackson County (Unincorporated Area) -** Approximately 23% of Jackson County's Unincorporated Area's housing is manufactured homes. Tornadoes can easily destroy poorly constructed buildings and mobile homes. Dead trees, branches, and non-secured structures can become flying projectiles during a tornado, placing people and property at a greater risk. Response times to rural communities and residents would be greater if major thoroughfares (such as US 59 or TX 111), as well as emergency response facilities (such as police and fire departments), were impacted by an event. Community leaders who have not been trained in hazard planning and response techniques are less able to effectively respond to residents in an emergency situation and increase vulnerability.

Community Perception of Vulnerability

See the front page of the current chapter for a summary of hazard rankings for Jackson County and participating communities in this HMP update. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

15.6.3 Critical Facilities and Infrastructure

Tornadoes can cause significant damage to trees and power lines, block roads with debris, incapacitate transportation, isolate populations, and disrupt ingress and egress. Of particular concern are roads providing access to isolated areas and to the elderly. Any facility that is in the path of a tornado is likely to sustain damage.

15.6.4 Environment

Environmental vulnerability will typically be the same as exposure (discussed in Section 15.5.4); however, if tornadoes impact facilities that store hazardous material, areas impacted by material releases may be especially vulnerable.

15.7 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by tornadoes, particularly development that occurs at lower elevations. Development regulations that require safe rooms, basements, or other structures that reduce risk to people would decrease vulnerability. Tornadoes that cause damage are uncommon in the county, so mandatory regulations may not be cost-effective.

15.8 SCENARIO

If an F3 or higher tornado were to hit populated areas of the county, substantial damage to property and loss of life could result. The likelihood of injuries and fatalities would increase if warning time was limited before the event or if residents were unable to find adequate shelter. Damage to critical facilities and infrastructure would likely include loss of power, water, sewer, gas, and communications. Roads and bridges could be blocked by debris or otherwise damaged. The most serious damage would be seen in the direct path of the tornado, but secondary effects could impact the rest of the county through loss of government services and interruptions in the transportation network. Debris from the tornado would need to be collected and properly disposed of. Such an event would likely have substantial negative effects on the local economy.

15.9 ISSUES

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

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

Chapter 16.
Wildfire

WILDFIRE RISK RANKING	
Jackson County	Medium
City of Edna	Medium
City of Ganado	Low
City of La Ward	Low

DEFINITIONS	
Conflagration	A fire that grows beyond its original source area to engulf adjoining regions. Wind, extremely dry or hazardous weather conditions, excessive fuel buildup, and explosions are usually the elements behind a wildfire conflagration.
Interface Area	An area susceptible to wildfires and where wildland vegetation and urban or suburban development occur together. An example would be smaller urban areas and dispersed rural housing in forested areas.
Wildfire	Fires that result in uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property in non-urban areas. Because of their distance from firefighting resources, they can be difficult to contain and can cause a great deal of destruction.

16.1 GENERAL BACKGROUND

According to the *2000 National Fire Plan*, the wildland fire risk is now considered by authorities as "the most significant fire service problem of the Century."

A wildfire is any uncontrolled fire occurring on undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use, and arson.

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

Texas has seen a huge increase in the number of wildfires in the past 30 years. During the 15-year period between 2005 and 2020, Texas Forest Service (TFS) reported that over 150,00 wildfires have consumed more than nine million acres in Texas. More and more people are placing their homes in woodland settings in or near forests, rural areas, or remote mountain sites. Many of these homes are nestled along ridgelines, cliff-edges, and other classic fire-interface hazard zones. There, homeowners enjoy the beauty of the environment but they also face the very real danger of wildfire.

Years of fire suppression has significantly disturbed natural fire occurrences—nature's renewal process. The result has been the gradual accumulation of understory and canopy fuels to levels of density that can feed high-energy, intense wildfires and further increase hazards from and exposure to interface problems.

Fire Protection in Jackson County

Fire protection in Jackson County is divided between volunteer fire departments, TFS, Bureau of Land Management, and the United States Forest Service (USFS). More information about these divisions is provided in Table 16-1. The TFS administers the Community Wildfire Protection Plan (CWPP) to reduce related risks to life, property, and the environment. Its Fire Control Department provides leadership in wildland fire protection for state and private lands in Texas.

TABLE 16-1.
FIRE PROTECTION SERVICES IN JACKSON COUNTY AND PARTICIPATING COMMUNITIES

	Unincorporated Area	City of Edna	City of Ganado	City of La Ward
Local Volunteer Fire Department	Yes	Yes	Yes	Yes
National Park Service	Yes	No	No	No
Bureau of Land Management	Yes	No	No	No
Texas Commission on Environmental Quality	Yes	Yes	Yes	Yes
Texas Forest Service	Yes	Yes	Yes	Yes
AgriLife	Yes	Yes	Yes	Yes
Texas Parks and Wildlife Department	Yes	Yes	Yes	Yes
Texas Interagency Coordination Center	Yes	Yes	Yes	Yes
U.S. Fish and Wildlife Service	Yes	No	No	No
U.S. Forest Service	Yes	No	No	No

Vegetation Classes in Jackson County

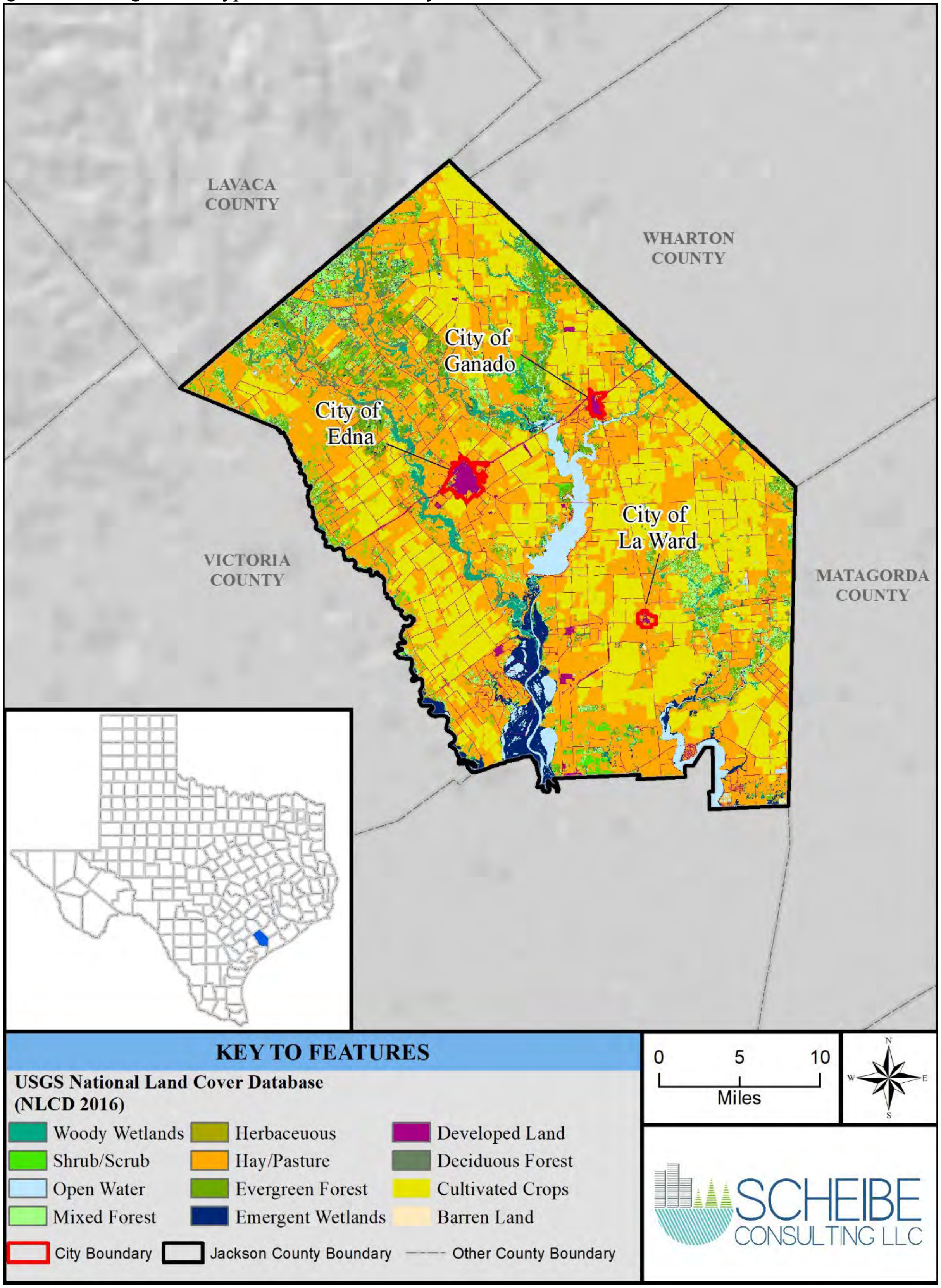
General vegetation for Jackson County and Participating Communities is described in Table 16-2 and Figure 16-1. The most common vegetation class in the county is Planted/Cultivated (comprising approximately 72% of the acreage in the county).

TABLE 16-2.
VEGETATION CLASSES IN JACKSON COUNTY AND PARTICIPATING COMMUNITIES

Class	Area (acres)	% of Total Land Area
Barren Land (Rock/Sandy/Clay)	561	0.1
Forest (Deciduous, Mixed, and Evergreen)	68,555	12.5
Developed Land (High, Medium, Low Intensity, and Open Spaces)	19,839	3.6
Planted/Cultivated (Hay/Pasture and Cultivated Crops)	29,282	72.0
Grassland (Herbaceous and Shrubland)	16,877	3.1
Wetlands (Emergent Herbaceous and Woody)	29,011	5.3
Water	18,779	3.4
Total	**548,650**	**100**

Source: U.S. Geological Survey: National Land Cover Database

Figure 16-1. Vegetation Types in Jackson County



Note: From U.S. Geological Survey: National Land Cover Database

16.2 HAZARD PROFILE

16.2.1 Past Events

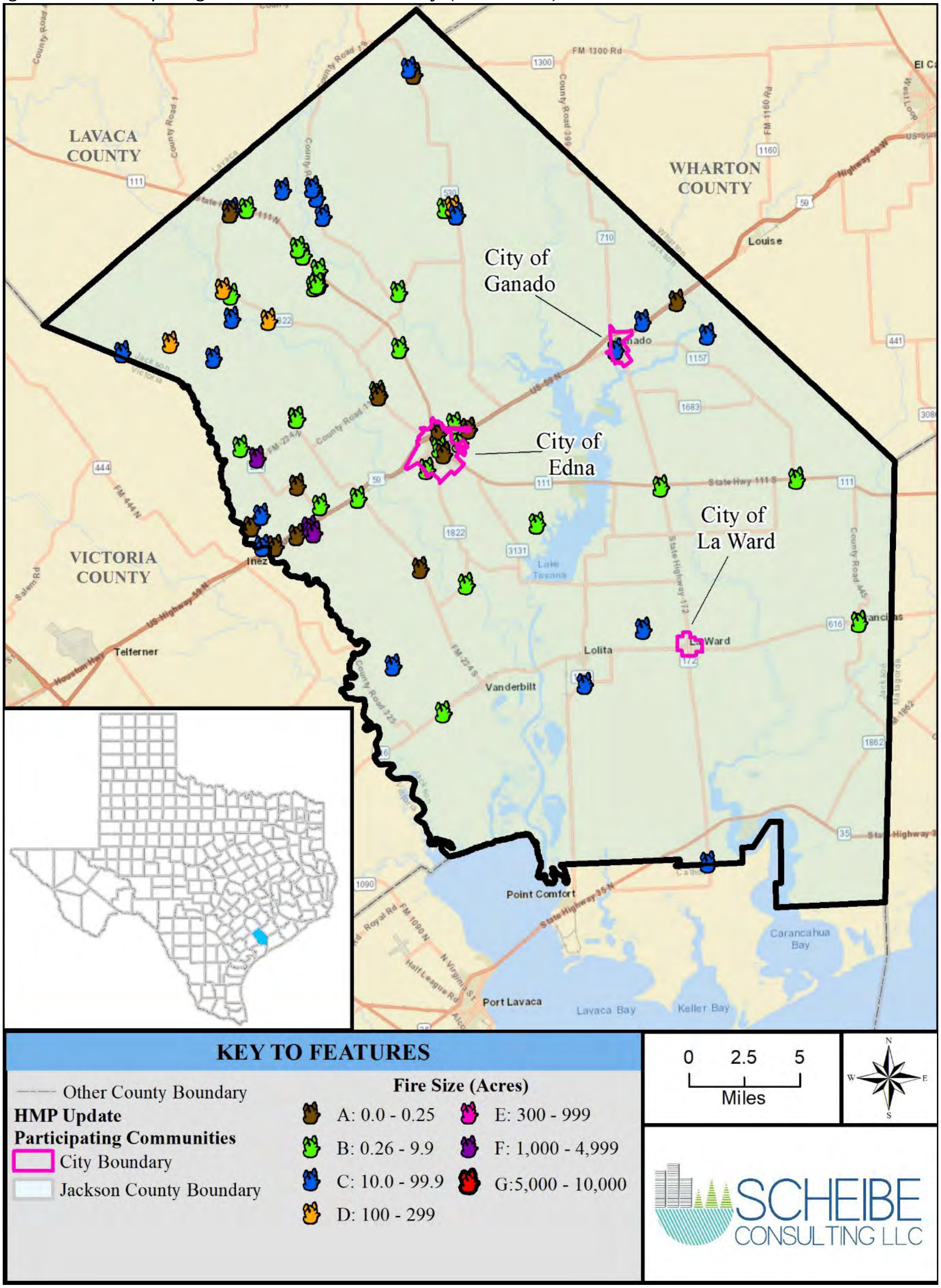
Figure 16-2 shows the locations of wildfire recorded by state and local fire department records from 2005 to 2015 collected by the Texas Wildlife Risk Assessment Portal (TxWRAP). Fires larger than fifty acres are listed in Table 16-3. The locations of past wildfires in each partner community are shown in Figure 16-3 through Figure 16-5. No detailed descriptions of the wildfire events in Jackson County and participating communities were available.

**TABLE 16-3.
HISTORIC WILDFIRE EVENTS IN JACKSON COUNTY AND PARTICIPATING COMMUNITIES
(50+ ACRES) (2005-2015)**

Fire ID	Name	Cause	Start Date	Acres
2415	822 Fire	Debris burning	8/8/2014	63
486360	CR 101	Debris burning	2/25/2013	50
370409	CR127	Equipment use	12/13/2011	100
372009	FM 127 & FM 822	Debris burning	12/13/2011	100
363587	FM 822	Power Lines	8/26/2011	100
363545	CR 426 FIRE	Power Lines	8/9/2011	80
343862	CR 285	Miscellaneous	5/9/2011	50
313511	Cordele	Power Lines	5/1/2011	120
299574	FM 234 & CR 105	Miscellaneous	2/28/2011	3500
302461	CR 284	Debris burning	2/26/2011	50
185872	El Torro	Miscellaneous	2/28/2009	1000
192021	Hwy 59/Jackson Co. CR 317	Miscellaneous	2/28/2009	2000

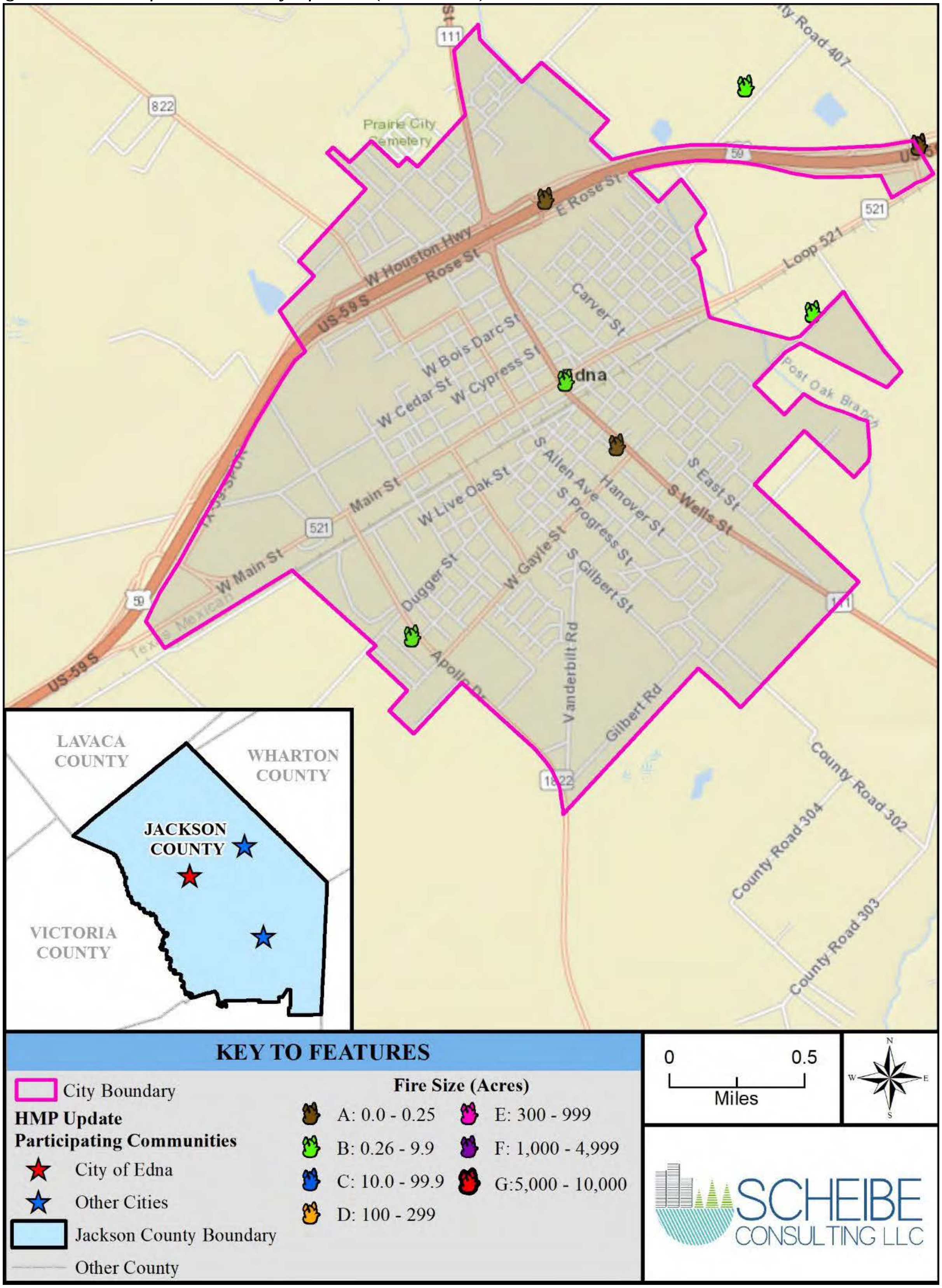
Note: From TFS-TxWRAP

Figure 16-2. Wildfire Ignitions in Jackson County (2005-2015)



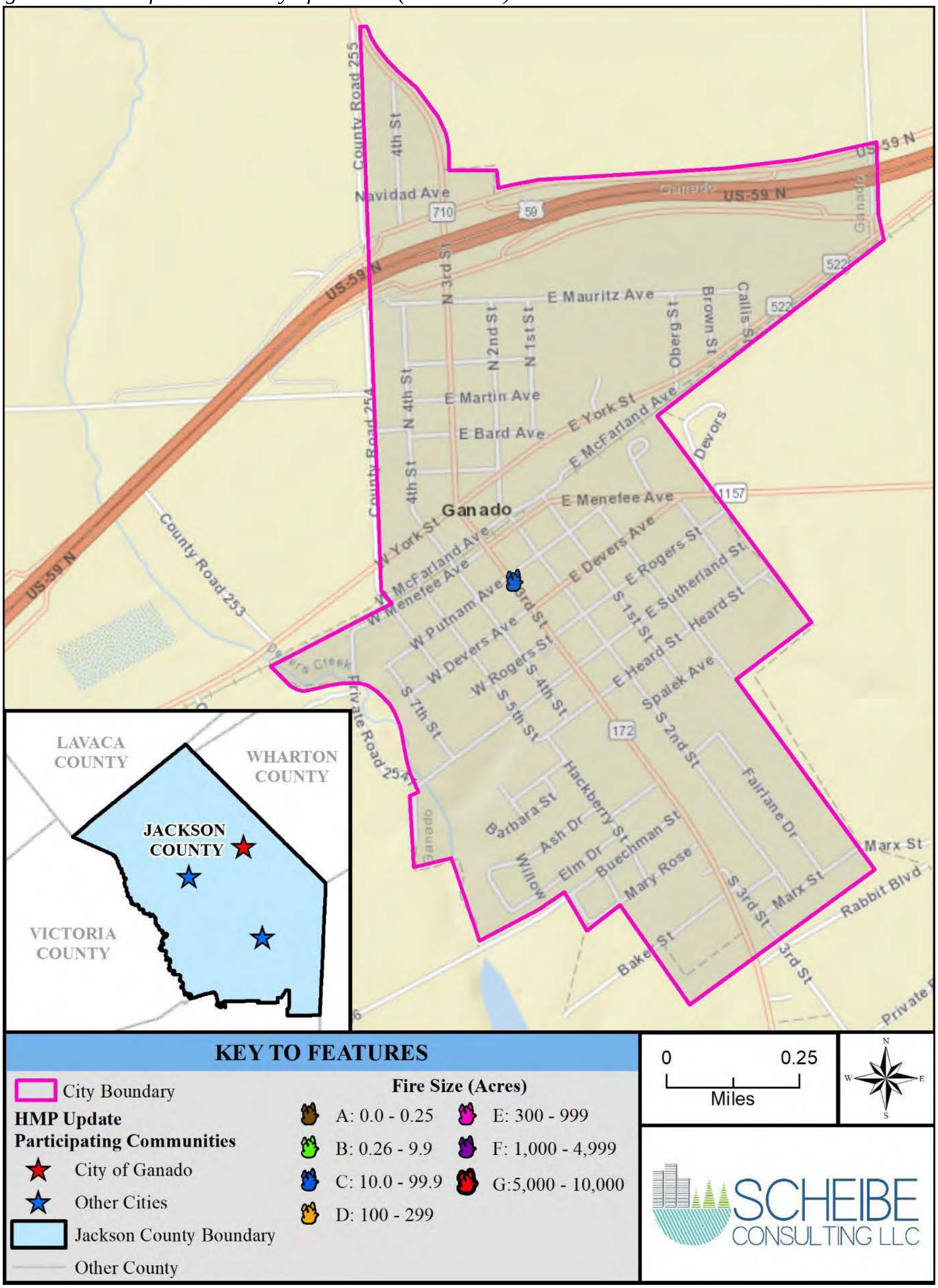
Note: From TFS-TxWRAP

Figure 16-3. Wildfires in the City of Edna (2005-2015)



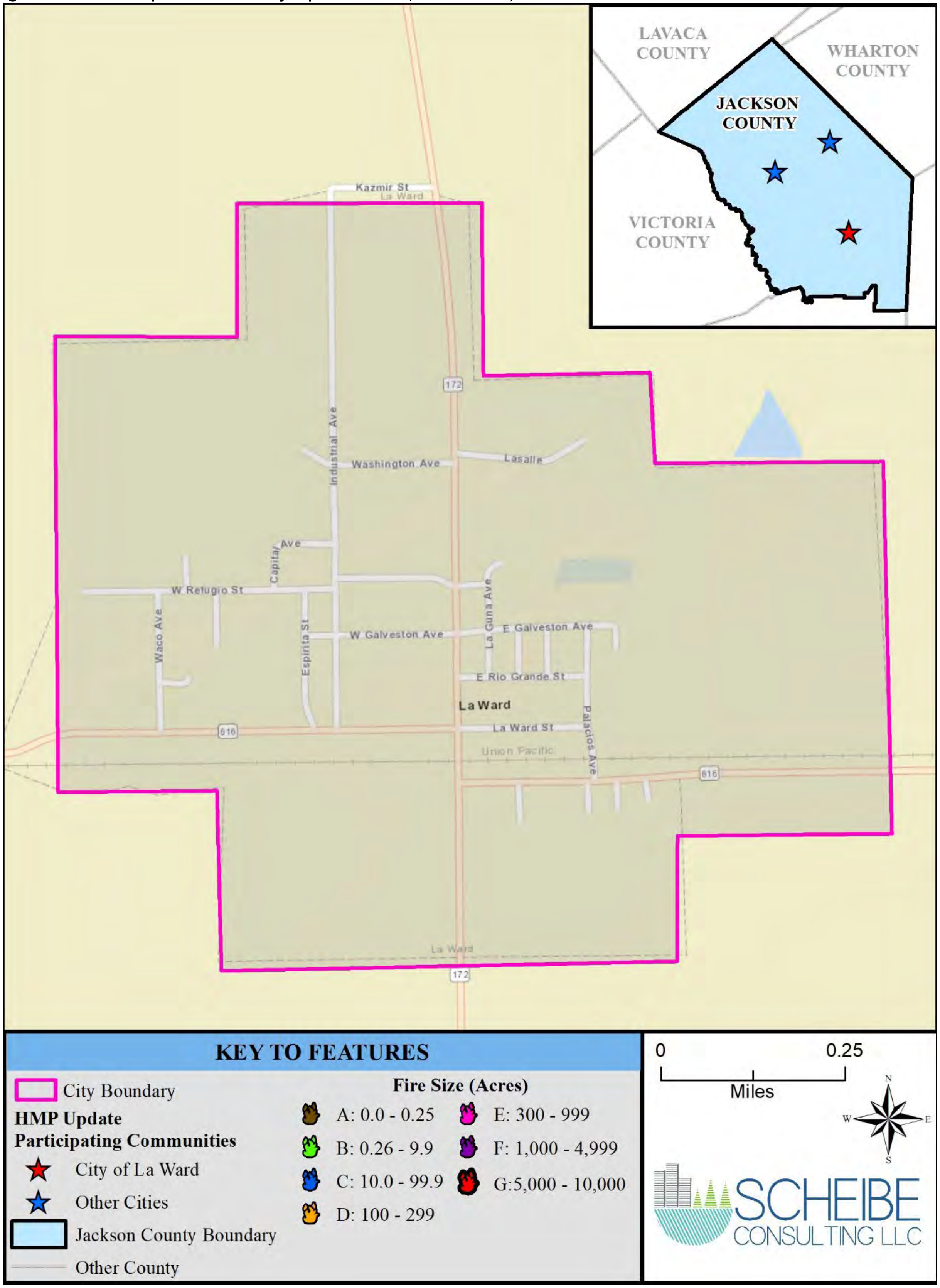
Note: From TFS-TxWRAP

Figure 16-4. Wildfires in the City of Ganado (2005-2015)



Note: From TFS-TxWRAP

Figure 16-5. Wildfires in the City of La Ward (2005-2015)



Note: From TFS-TxWRAP

16.2.2 Location

According to the TFS CWPP, 80% of wildfires in Texas occur within two miles of a community. These wildfires pose a threat to life and property. There are approximately 14,000 communities in Texas that have been identified as "at risk" for potentially devastating fires.

Wildfire Ignition Density is the likelihood of a wildfire starting based on historical ignition patterns. Figure 16-6 shows the wildfire ignition density in Jackson County.

Texas is one of the fastest growing states in the nation. Much of this growth is occurring in the WUI area, where structures and other human improvements meet and mix with undeveloped wildland or vegetative fuels. Population growth within the WUI substantially increases the risk of wildfires. For Jackson County, based on TxWRAP data and 2010 Census data from HAZUS-MH, an estimated 7,237 people or 51% of the total county population (14,075) live within the WUI. The WUI layer reflects housing density depicting where humans and their structures meet or intermix with wildland fuels. Figure 16-7 Shows the Jackson County housing density within the WUI.

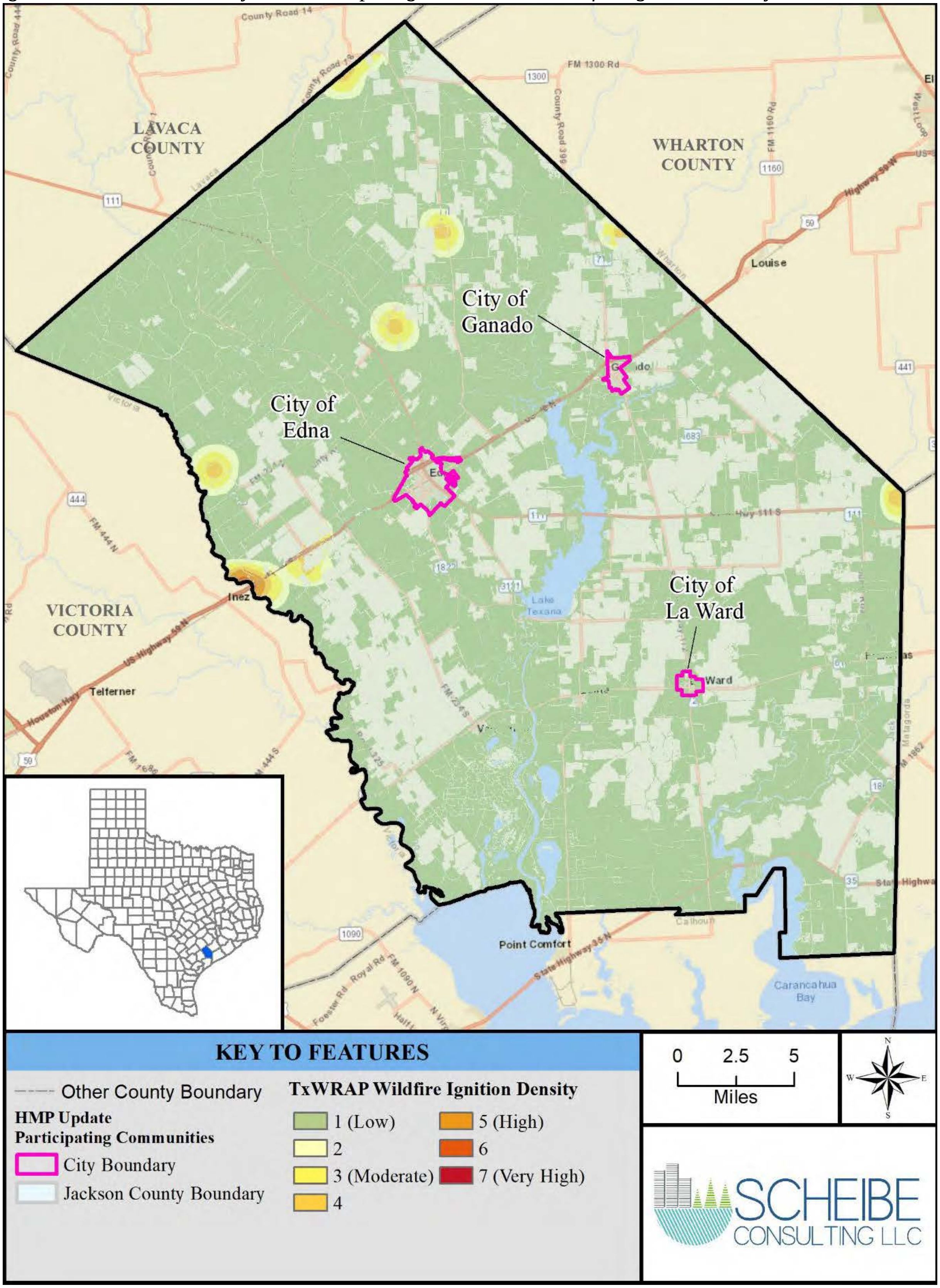
The TxWRAP report for Jackson County and the participating communities map the WUI Response Index, which is a rating of the potential impact of a wildfire on people and their homes. The key input, WUI, reflects housing density (houses per acre) consistent with Federal Register National standards. The TxWRAP report states that the location of people living in the WUI and rural areas is essential for defining potential wildfire impacts on people and homes. Figure 16-8 shows the WUI Response Index for Jackson County.

According to the TxWRAP report for Jackson County, the wildfire Values Response Index (VRI) layer reflects a rating of the potential impact of a wildfire on values or assets. The VRI is an overall rating that combines the impact ratings for WUI (housing density) and Pine Plantations (pine age) into a single measure. VRI combines the likelihood of a fire occurring (threat) with those areas of most concern that are adversely impacted by fire to derive a single overall measure of wildfire risk. Figure 16-9 shows the VRI for Jackson County.

The TxWRAP report for Jackson County maps the Community Protection Zones (CPZ), which represent those areas considered the highest priority for mitigation planning activities. CPZs are based on an analysis of the "Where People Live" housing density data and surrounding fire behavior potential. "Rate of Spread" data is used to determine the areas of concern around populated areas that are within a 2-hour fire spread distance. Figure 16-10 shows the demarcation of CPZs in Jackson County and the participating communities.

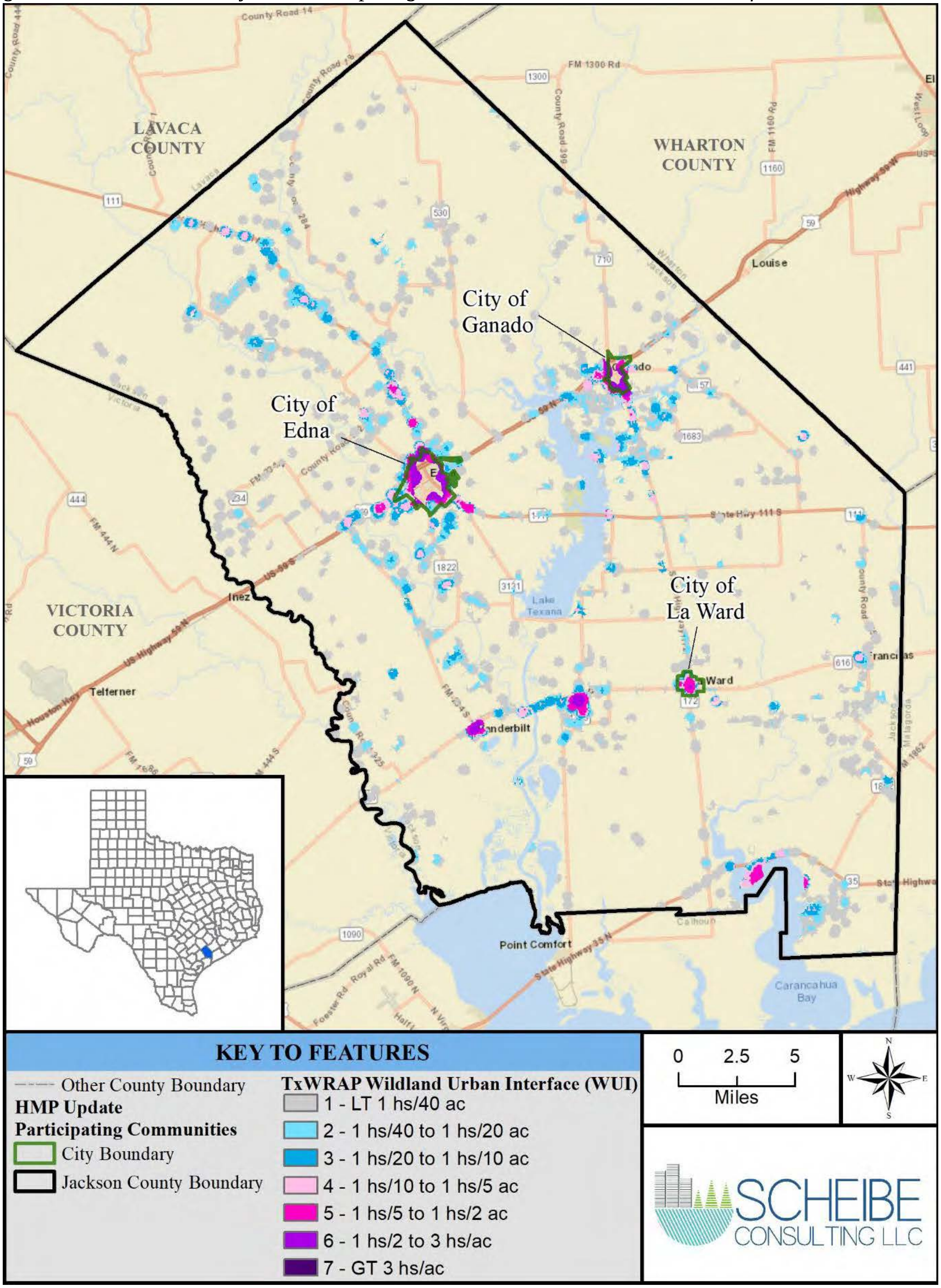
Finally, wildfire threat or Wildfire Hazard Potential (WHP) is the likelihood of a wildfire occurring or burning into an area. The threat is calculated by combining multiple landscape characteristics including surface and canopy fuels, fire behavior, historical fire occurrences, weather observations, terrain conditions, and other factors. Figure 16-11 through Figure 16-14 maps the WHP for Jackson County and the participating communities and each partner community as identified in the Wildfire Hazard Potential for the United States (270-m), Version 2020 (3rd Edition), containing data from 1992 to 2015. On its own, WHP is not an explicit map of wildfire threat or risk, but when paired with spatial data depicting highly valued resources and assets such as structures, it can approximate relative wildfire risk to those specific resources and assets. WHP is also not a forecast or wildfire outlook for any particular season, as it does not include any information on current or forecasted weather or fuel moisture conditions. It is instead intended for long-term strategic fuels management and is appropriate for regional, county, or local protection mitigation or prevention planning.

Figure 16-6. Jackson County and Participating Communities Wildfire Ignition Density



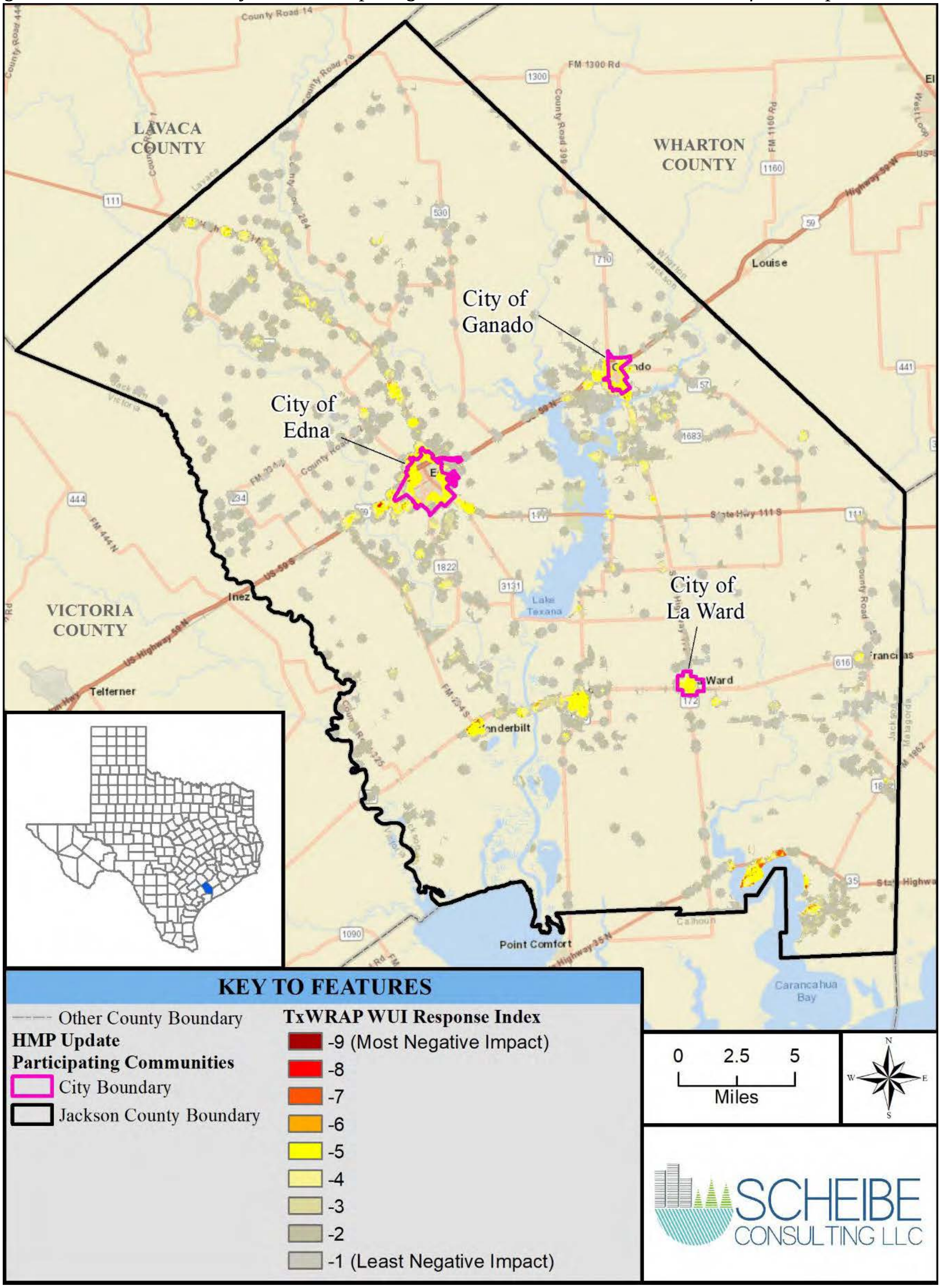
Note: From TFS -TxWRAP

Figure 16-7. Jackson County and Participating Communities Wildland Urban Interface



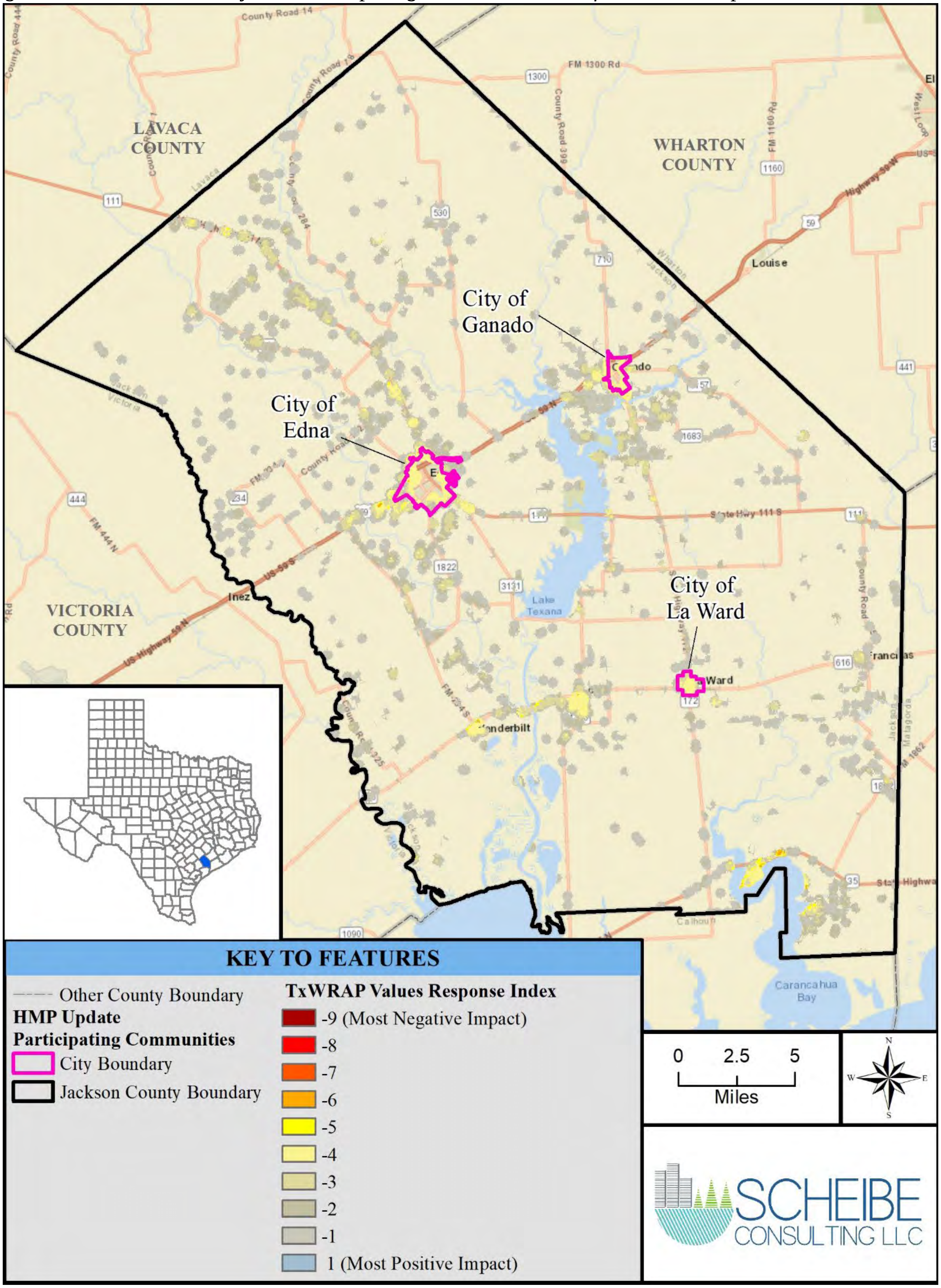
Note: From TFS-TxWRAP

Figure 16-8. Jackson County and Participating Communities Wildland Urban Interface Response Index



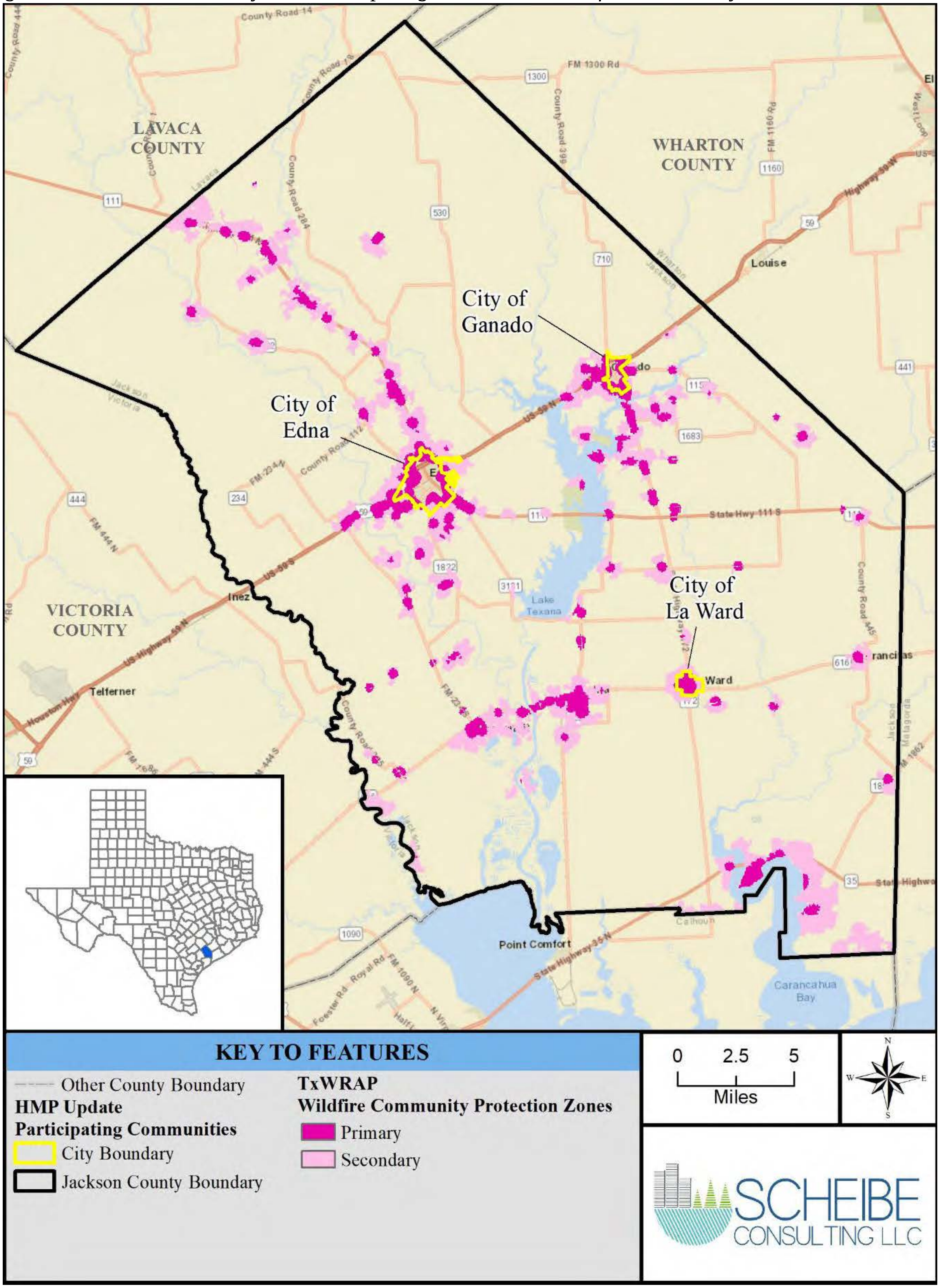
Note: From Source: TFS-TxWRAP

Figure 16-9. Jackson County and Participating Communities Wildfire Values Response Index



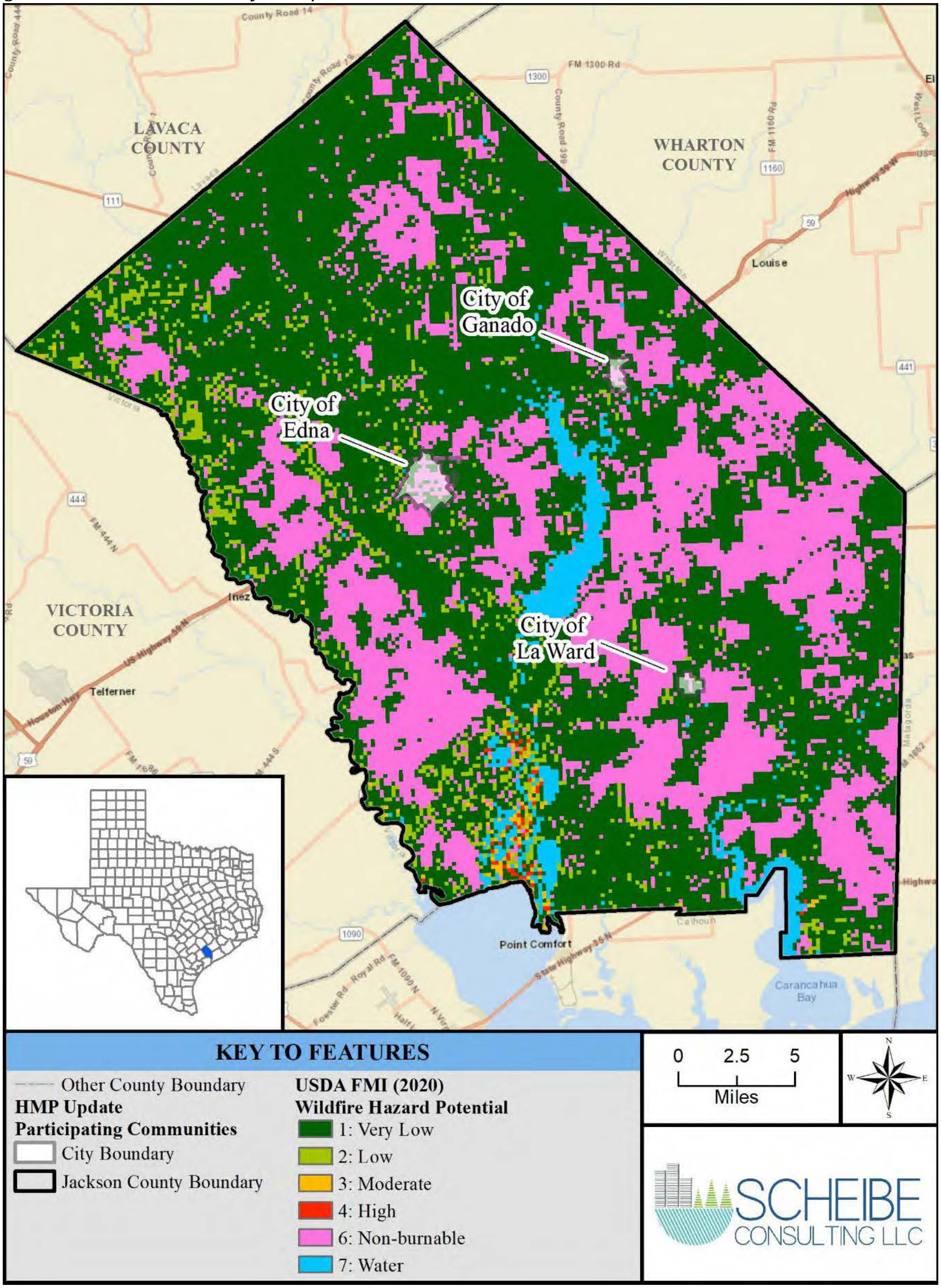
Note: From TFS-TxWRAP

Figure 16-10. Jackson County and Participating CommunitiesWildfire Community Protection Zones



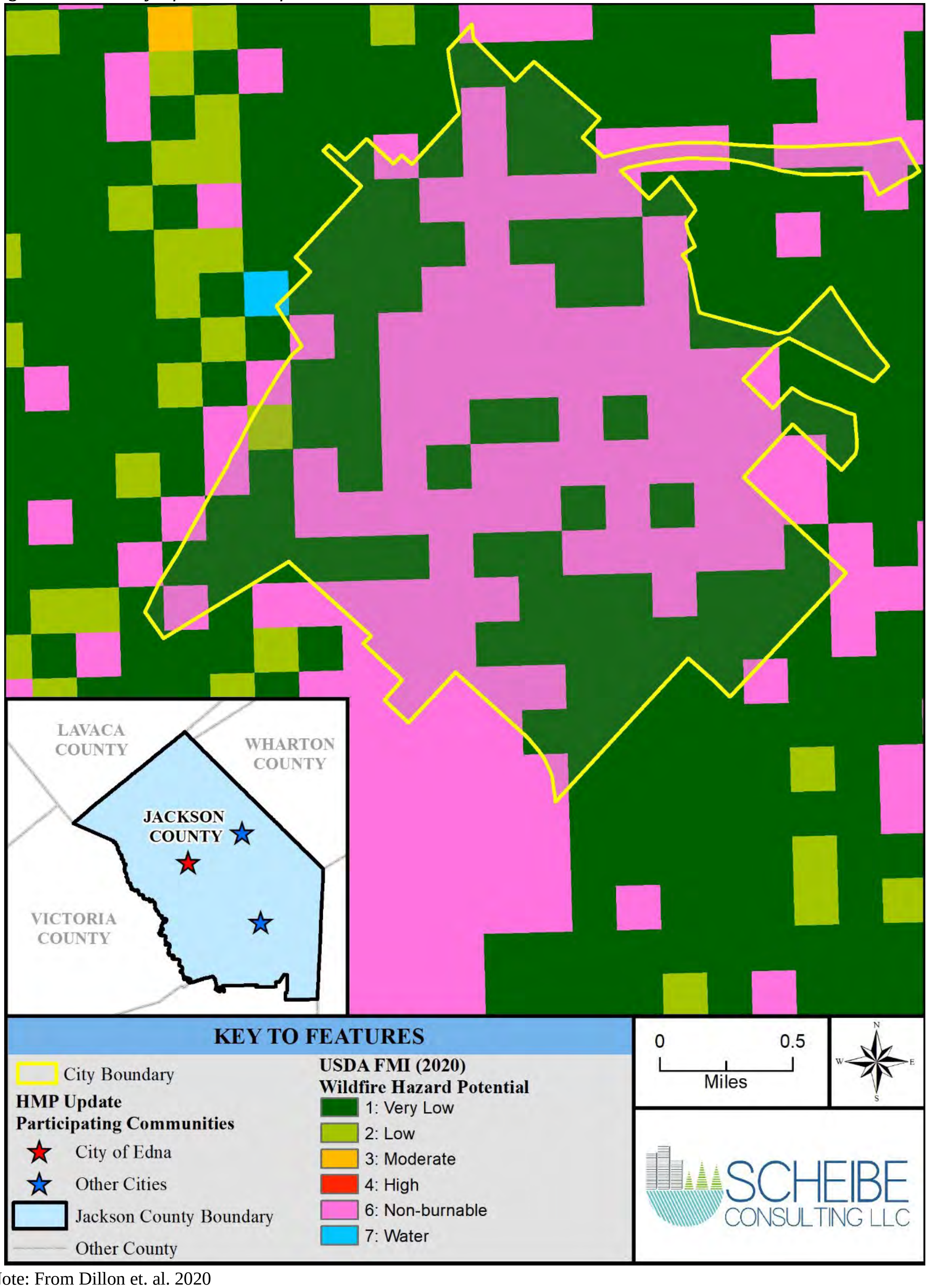
Note: From TFS-TxWRAP

Figure 16-11. Jackson County Wildfire Hazard Potential



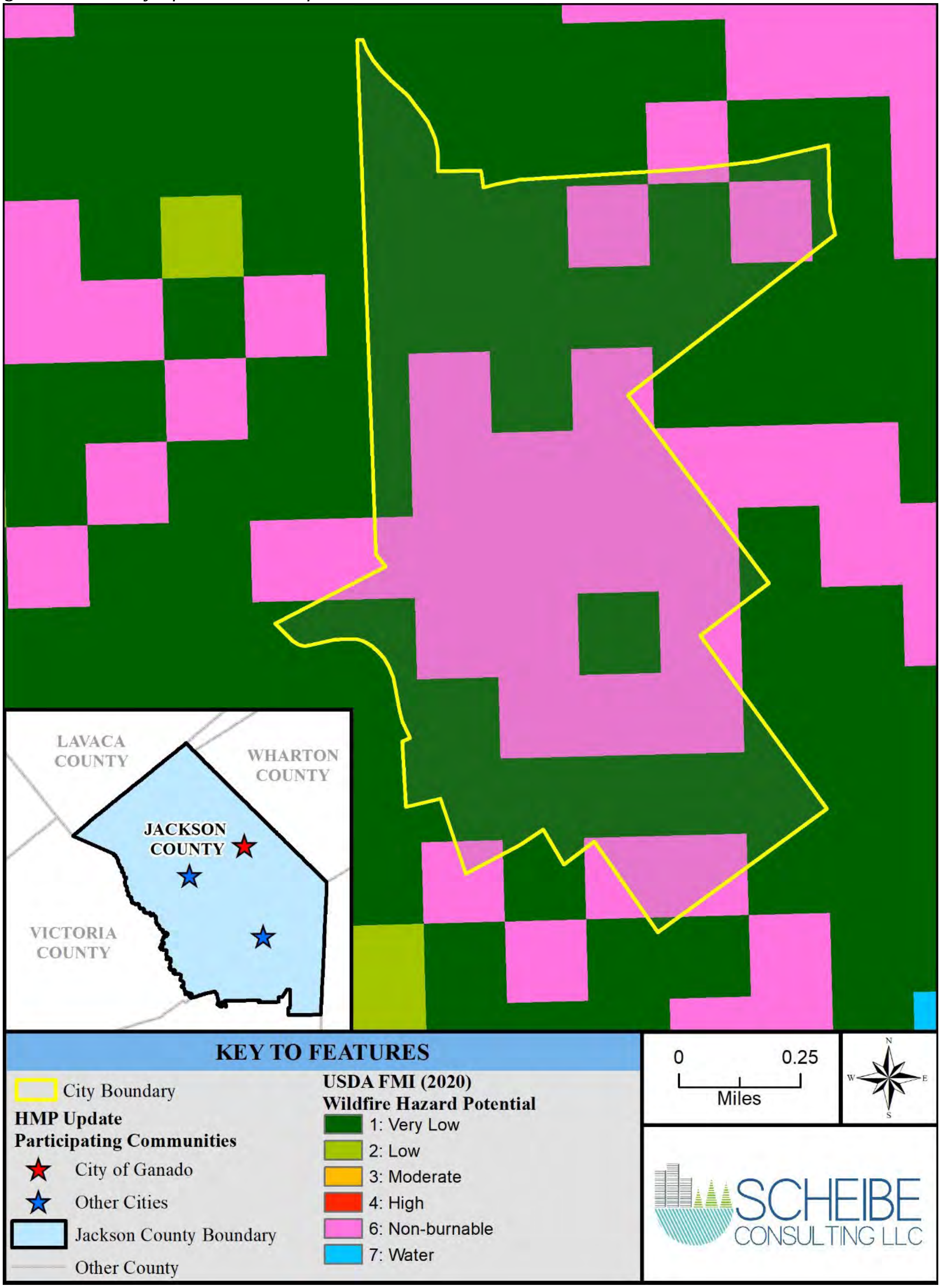
Note: From Dillon et. al. 2020

Figure 16-12. City of Edna Wildfire Hazard Potential



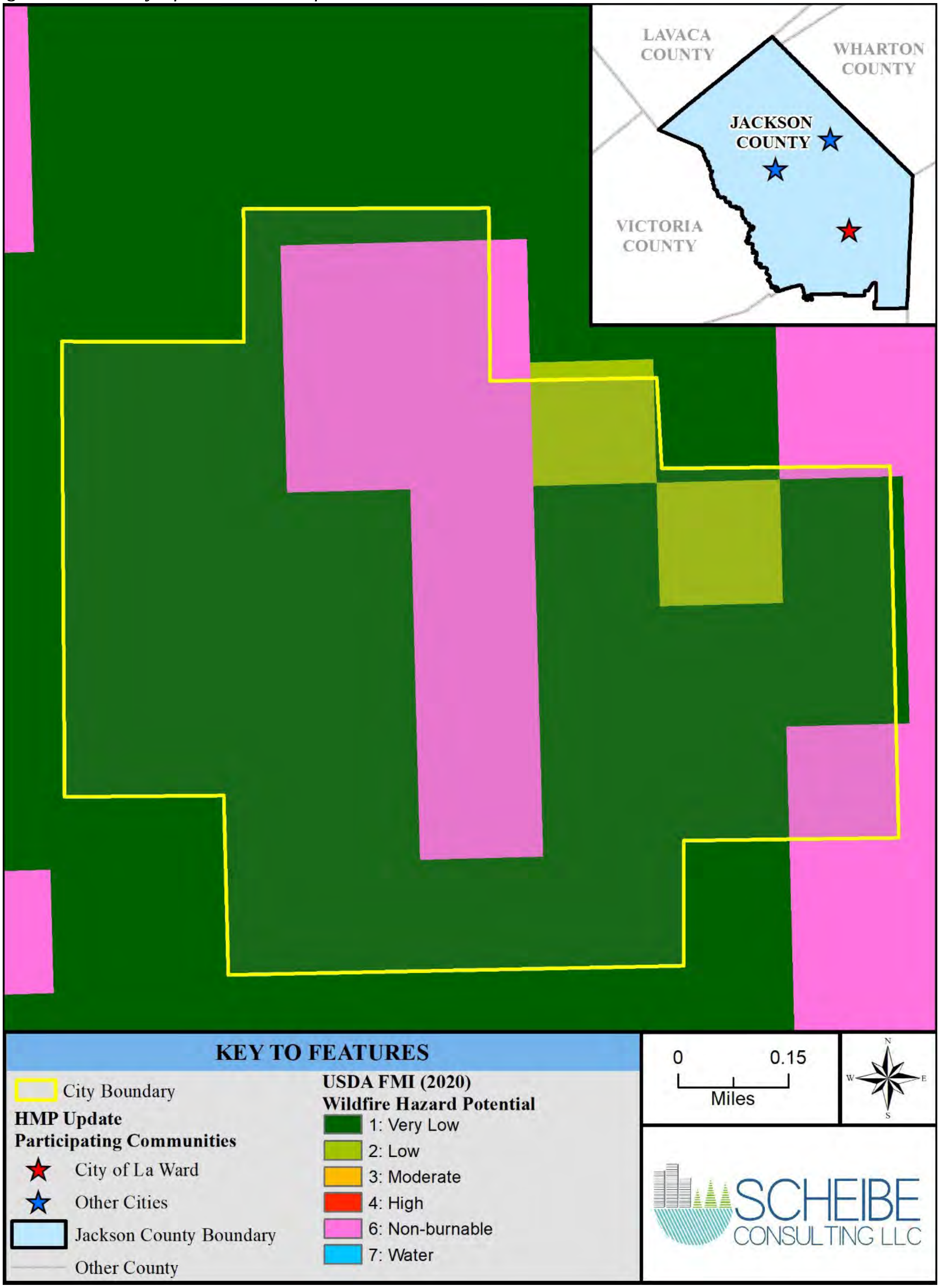
Note: From Dillon et. al. 2020

Figure 16-13. City of Ganado Wildfire Hazard Potential



Note: From Dillon et. al. 2020

Figure 16-14. City of La Ward Wildfire Hazard Potential



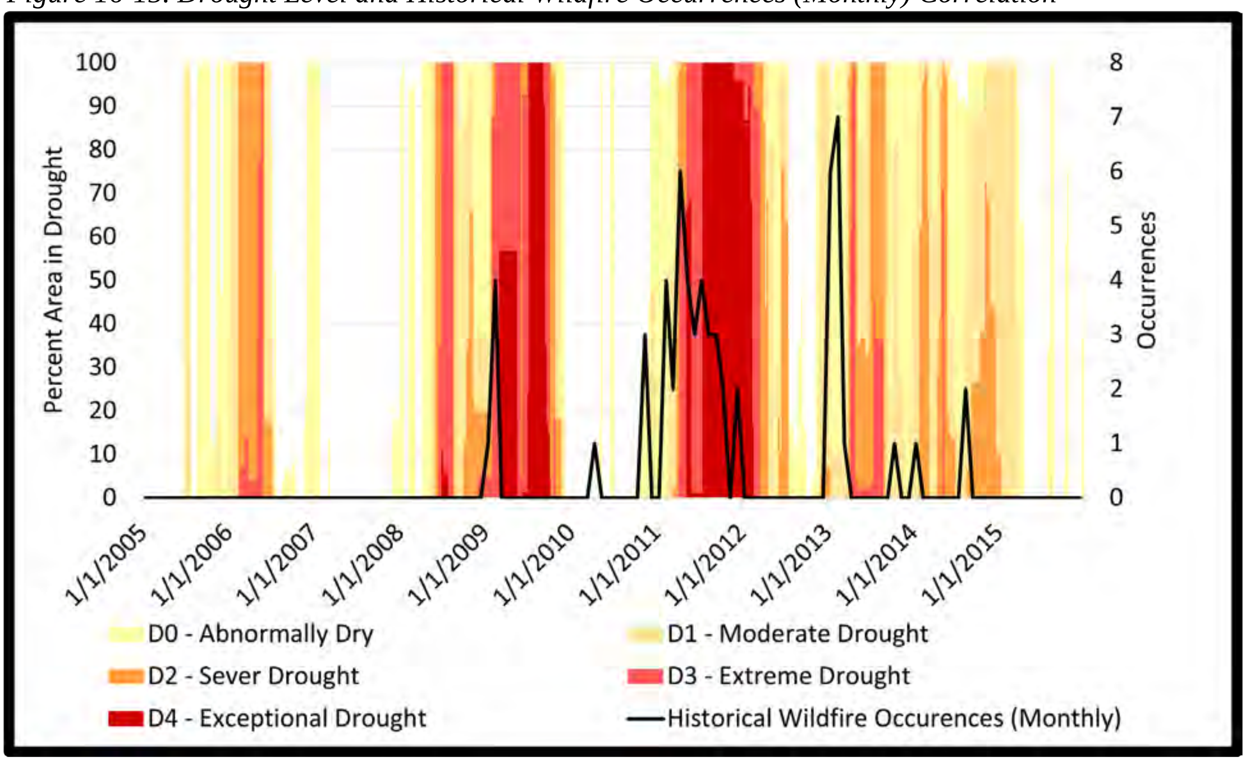
Note: From Dillon et. al. 2020

16.2.3 Frequency

Analysis of TFS data indicates there is a 90% chance that at least one wildfire will occur each year in Jackson County. Wildfires occur throughout the year and these fires are expected to be less than 50 acres in size based on locally reported historical data from 2005 to 2015. The overall probability of a wildfire in the Jackson County Unincorporated area is considered high (event possible in the next year). The probability of a wildfire in the City of Edna is considered moderate with events probable in the next 25 years. The probability of a wildfire in the City of Ganado and City of La Ward is considered low due to few previous occurrences.

The frequency of wildfire is closely related to drought behavior. As described by the National Integrated Drought Information System (NIDIS), the relationship is complex and has divergent impacts. The onset of a drought allows for the drying of fuels for wildfire after abundant growth, but prolonged drought can result in a lack of fuel due to the reduction of available fuels such as grasses. A correlation between drought and historical wildfire data following this pattern can be observed between the years 2011 to 2015 in Figure 16-15.

Figure 16-15. Drought Level and Historical Wildfire Occurrences (Monthly) Correlation



Note: From NIDIS and TFS-TxWRAP

16.2.4 Severity

Based on historical occurrences, a majority of wildfires in Jackson County have been small (under 50acres) and have resulted in no deaths or injuries. Future events are expected to follow this trend although there is a possibility a large fire can occur in Jackson County. Based on the information in this hazard profile, and the widespread impacts, the magnitude/severity of severe wildfires is considered moderate. Moderate impact indicates there are few deaths or injuries; limited property damage;

interruption of essential facilities and services; or economic impact of Jackson County and the participating communities

16.2.5 Warning Time

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

If a fire does break out and spreads rapidly, residents may need to evacuate within days or hours. A fire's peak burning period generally is between 10:00 a.m. and sundown according to the USDA Fire Service. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid spread of cellular and two-way radio communications in recent years has further contributed to a significant improvement in warning time.

16.3 SECONDARY HAZARDS

Wildfires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs, destroy transmission lines, and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding.

16.4 CLIMATE CHANGE IMPACTS

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

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

Climate scenarios project summer temperature increases between 2 and 5 degrees Celsius (°C) (35.6 to 41°F) and precipitation decreases of up to 15% by 2100. Such conditions would exacerbate summer drought and further promote wildfires, releasing stores of carbon and further contributing to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide – the so-called "fertilization effect" – could also contribute to more tree growth and thus more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown. High carbon dioxide levels should enhance tree recovery after fire and young forest regrowth, as long as sufficient nutrients and soil moisture are available, although the latter is in question for many parts of the western United States because of climate change.

16.5 EXPOSURE

Since wildfire cannot be directly modeled in HAZUS-MH, annualized losses were estimated using GIS-based analysis and historical data analysis. Event frequency, severity indicators, and historical knowledge of the region were used for this assessment. The primary data source was the updated HAZUS-MH inventory data (updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs), augmented with TxWRAP and the USDA WHP data. Information for the exposure analyses provided in the sections below was based on data sources above.

16.5.1 Population

Population estimates within the WHP areas are shown in Table 16-4.

TABLE 16-4.
POPULATION WITHIN WILDFIRE RISK AREAS

Jurisdiction	Non-Burnable*	Very Low	Low	Moderate	High	Very High	**Total in Risk Area**
City of Edna	3,542	1,858	4	0	0	0	**1,862**
City of Ganado	900	929	0	0	0	0	**929**
City of La Ward	54	152	6	0	0	0	**158**
Unincorporated Area	2,109	4,321	156	3	0	0	**4,480**
Jackson County Total	**6,605**	**7,260**	**166**	**3**	**0**	**0**	**7,429**

Note:
* Non-Burnable classification includes developed lands, non-burnable agricultural fields, perennial snow or ice, bare ground, and permanent water areas

16.5.2 Property

Property damage from wildfires can be severe and can significantly alter entire communities. Table 16-5 through Table 16-9 display the number of structures in the various wildfire hazard zones within the planning area and their values. For all tables, property data are from the HAZUS-MH data inventory (updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs).

TABLE 16-5. EXPOSURE AND VALUE OF STRUCTURES IN VERY LOW AREAS					
Jurisdiction	Exposed Buildings	Value Exposed ($)			% of Total Assessed Value
		Structure	Contents	**Total**	
City of Edna	817	167,107,866	95,059,475	**262,167,341**	30.02%
City of Ganado	344	69,818,226	40,587,658	**110,405,884**	43.54%
City of La Ward	73	12,705,758	7,073,815	**19,779,574**	72.87%
Unincorporated Area	2,235	457,280,978	289,294,213	**746,575,191**	61.41%
Jackson County Total	**3,469**	**706,912,829**	**432,015,161**	**1,138,927,990**	**48.06%**

TABLE 16-6. EXPOSURE AND VALUE OF STRUCTURES IN LOW WILDFIRE RISK AREAS					
Jurisdiction	Exposed Buildings	Value Exposed ($)			% of Total Assessed Value
		Structure	Contents	**Total**	
City of Edna	2	372,040	283,571	**655,611**	0.08%
City of Ganado	0	0	0	**0**	0.00%
City of La Ward	2	386,809	206,093	**592,902**	2.18%
Unincorporated Area	85	16,769,704	8,913,520	**25,683,224**	2.11%
Jackson County Total	**89**	**17,528,553**	**9,403,183**	**26,931,736**	**1.14%**

TABLE 16-7. EXPOSURE AND VALUE OF STRUCTURES IN MODERATE WILDFIRE RISK AREAS					
Jurisdiction	Exposed Buildings	Value Exposed ($)			% of Total Assessed Value
		Structure	Contents	Total	
City of Edna	0	0	0	**0**	0.00%
City of Ganado	0	0	0	**0**	0.00%
City of La Ward	0	0	0	**0**	0.00%
Unincorporated Area	2	409,784	209,632	**619,416**	0.05%
Jackson County Total	**2**	**409,784**	**209,632**	**619,416**	**0.03%**

TABLE 16-8. EXPOSURE AND VALUE OF STRUCTURES IN HIGH WILDFIRE RISK AREAS					
Jurisdiction	Exposed Buildings	Value Exposed ($)			% of Total Assessed Value
		Structure	Contents	Total	
City of Edna	0	0	0	**0**	0.00%
City of Ganado	0	0	0	**0**	0.00%
City of La Ward	0	0	0	**0**	0.00%
Unincorporated Area	1	37,406	18,719	**56,125**	Negligible
Jackson County Total	**1**	**37,406**	**18,719**	**56,125**	**Negligible**

TABLE 16-9. EXPOSURE AND VALUE OF STRUCTURES IN VERY HIGH WILDFIRE RISK AREAS					
Jurisdiction	Exposed Buildings	Value Exposed ($)			% of Total Assessed Value
		Structure	Contents	Total	
City of Edna	0	0	0	**0**	0
City of Ganado	0	0	0	**0**	0
City of La Ward	0	0	0	**0**	0
Unincorporated Area	0	0	0	**0**	0
Jackson County Total	**0**	**0**	**0**	**0**	**0**

Present Land Use

Present land cover for each wildfire risk area is described in Table 16-10.

TABLE 16-10.
LAND COVERAGE FOR JACKSON COUNTY PER WILDFIRE RISK CLASS

Present Land Cover Class	Wildfire Risk Class and Area (acres)				
	Very Low	Low	Moderate	High	Very High
Barren Land (Rock/Sandy/Clay)	245	7	2	4	0
Forest (Deciduous, Mixed, and Evergreen)	61,702	4,410	161	1	0
Developed Land (High, Medium, Low Intensity, and Open Spaces)	10,216	628	35	11	0
Planted/Cultivated (Hay/Pasture and Cultivated Crops)	222,363	11,324	311	6	0
Grassland (Herbaceous and Shrubland)	13,919	1,257	71	0	0
Wetlands (Emergent Herbaceous and Woody)	21,344	2,174	1,288	909	0
Open Water	2,710	264	256	158	0

Note: From U.S. Geological Survey: National Land Cover Database

16.5.3 Critical Facilities and Infrastructure

Table 16-11 identifies critical facilities exposed to the wildfire hazard in the county.

TABLE 16-11.
CRITICAL FACILITIES AND INFRASTRUCTURE PER WILDFIRE RISK CLASS

	Critical Facilities and Infrastructure per Wildfire Risk Class				
	Very Low	Low	Moderate	High	Very High
Medical and Health	0	0	0	0	0
Government Functions	0	0	0	0	0
Protective Functions	3	0	0	0	0
Schools	1	0	0	0	0
Hazardous Materials	7	0	0	0	0
Bridges	84	4	0	0	0
Water Storage	0	0	0	0	0
Wastewater	8	0	0	0	0
Power	0	0	0	0	0
Communications	4	0	0	0	0
Transportation	1	0	0	0	0
Dams	1	0	0	0	0

Note: *Protective includes, Police, Fire Safety, and Emergency Operations Centers

16.5.4 Environment

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

- **Soil Erosion** – The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.
- **Spread of Invasive Plant Species** – Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.

- **Disease and Insect Infestations** – Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.
- **Destroyed Endangered Species Habitat** – Catastrophic fires can have devastating consequences for endangered species.
- **Soil Sterilization** – Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.

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

16.6 VULNERABILITY

Structures, above-ground infrastructure, critical facilities, agricultural areas (crops and structures), and natural environments are all vulnerable to the wildfire hazard. There is currently no validated damage function available to support wildfire mitigation planning. Except as discussed in this section, vulnerable populations, property, infrastructure, and environment are assumed to be the same as described in the section on exposure.

16.6.1 Population

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly, and those with respiratory and cardiovascular diseases. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility.

Wildfires may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

The increasing demand for outdoor recreation places more people outside and in higher wildfire risk areas during holidays, weekends, and vacation periods.

16.6.2 Property

Loss estimations for wildfire hazards are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing projected damages (annualized loss) on historical events, statistical analysis, and probability factors. These were applied to the exposed values of the county and communities to create an annualized loss. Table 16-12 lists the loss estimates for the general building stock and contents for jurisdictions that have exposure to a wildfire risk category.

TABLE 16-12. ANNUALIZED LOSS ESTIMATES FOR WILDFIRE EVENTS			
Jurisdiction	Exposed Value	Annualized Loss	Annualized Loss Percentage
City of Edna	$873,172,834	$32,573	<0.1
City of Ganado	$253,570,646	Negligible	Negligible
City of La Ward	$27,144,277	Negligible	Negligible
Unincorporated Area	$1,215,680,242	$220,090	<0.1
Jackson County Total	**$2,369,568,000**	**$252,662**	**<0.1**

Community Perception of Vulnerability

See the front page of the current chapter for a summary of hazard rankings for Jackson County and participating communities in this HMP update. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

16.6.3 Critical Facilities and Infrastructure

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

16.6.4 Environment

Environmental vulnerability will typically be the same as exposure (as discussed in Section 16.5).

16.7 FUTURE TRENDS IN DEVELOPMENT

The threat of wildfire is a constant in Texas. From the East Texas Piney Woods to the Davis Mountains of West Texas, wildfires burn thousands, if not millions, of acres each year. Wildfires become especially dangerous when wildland vegetation begins to intermix with homes.

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

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

The Texas CWPP calls for communities to:

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

16.8 SCENARIO

A major conflagration in the planning area might begin with a wet spring, adding to fuels already present on the forest floor. Flash fuels would build throughout the spring. The summer could see the onset of insect infestation. A dry summer could follow the wet spring, exacerbated by dry hot winds. Carelessness with combustible materials or a tossed lit cigarette, or a sudden lightning storm could trigger a multitude of small isolated fires.

The embers from these smaller fires could be carried miles by hot, dry winds. The deposition zone for these embers would be deep in the forests and interface zones. Fires that start in flat areas move slower, but the wind still pushes them. It is not unusual for a wildfire pushed by the wind to burn the ground fuel and later climb into the crown and reverse its track. This is one of many ways that fires can escape containment, typically during periods when response capabilities are overwhelmed. These new small fires would most likely merge. Suppression resources would be redirected from protecting the natural resources to saving more remote subdivisions.

The worst-case scenario would include an active fire season throughout Texas, spreading resources thin. Firefighting teams would be exhausted or unavailable. Many federal assets would be responding to other fires that started earlier in the season. While local fire districts would be extremely useful in the urban interface areas, they have limited wildfire capabilities or experience, and they would have a difficult time responding to the ignition zones. Even though the existence and spread of the fire is known, it may not be possible to respond to it adequately, so an initially manageable fire can become out of control before resources are dispatched.

To further complicate the problem, heavy rains could follow, causing flooding and landslides, and releasing tons of sediment into the Lavaca and Navidad rivers and associated creeks. This in turn could permanently change floodplains and damage sensitive habitat and riparian areas. Such a fire followed by rain could release millions of cubic yards of sediment into streams for years, creating new floodplains and changing existing ones. With the forests removed from the watershed, stream flows could easily double. Floods that could be expected every 50 years may occur every couple of years. With the streambeds unable to carry the increased discharge because of increased sediment, the floodplains and floodplain elevations would increase.

16.9 ISSUES

The major issues for wildfire are the following:

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

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

Chapter 17.
Winter/Ice Storm

WINTER WEATHER RANKING	
Jackson County	Medium
City of Edna	Medium
City of Ganado	High
City of La Ward	High

DEFINITIONS	
Freezing Rain	The result of rain occurring when the temperature is below the freezing point. The rain freezes on impact, resulting in a layer of glaze ice up to an inch thick. In a severe ice storm, an evergreen tree 60 feet high and 30 feet wide can be burdened with up to 6 tons of ice, creating a threat to power and telephone lines and transportation routes
Severe Local Storm	Small-scale atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms, and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.
Winter Storm	A storm having significant snowfall, ice, or freezing rain; the quantity of precipitation varies by elevation.

17.1 GENERAL BACKGROUND

Winter and ice storms can include heavy snow, ice, and blizzard conditions. Heavy winter/ice storms can immobilize a region, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse roofs and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. The cost of snow removal, damage repair, and business losses can have a tremendous impact on cities and towns.

Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days until the damage can be repaired. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians.

Some winter storms are accompanied by strong winds, creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chills. Strong winds with these intense storms and cold fronts can knock down trees, utility poles, and power lines. Blowing snow can reduce visibility to only a few feet in areas where there are no trees or buildings. Serious vehicle accidents can result in injuries and deaths.

Winter and ice storms in Jackson County, including strong winds and ice conditions, can result in property damage, localized power and phone outages, and closures of streets, highways, schools, businesses, and nonessential government operations. People can also become isolated from essential services in their homes and vehicles. A winter/ice storm can escalate, creating life-threatening situations when emergency response is limited by severe winter conditions. Other issues associated with severe winter weather include hypothermia and the threat of physical overexertion that may lead to heart attacks or strokes. Snow and ice prevention as well as removal costs can impact budgets significantly.

17.1.1 Extreme Cold

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

In 2001, the NWS implemented an updated wind chill temperature index (see Figure 17-1). This index describes the relative discomfort or danger resulting from the combination of wind and temperature. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

Figure 17-1. National Weather Service Wind Chill Chart

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

Frostbite Times: 30 minutes / 10 minutes / 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Note: From Source: NOAA, NWS

A wind chill watch is issued by the NWS when wind chill warning criteria are possible in the following 12 to 36 hours. A wind chill warning is issued for wind chills of at least -25°F on plains and -35°F in mountains and foothills.

Table 17-1 contains temperature summaries related to extreme cold for Jackson County recorded by the Palacios Municipal Airport weather station. Jackson County does not contain a weather station with continuous data, so the nearest weather station was chosen as the source for climate data for the planning area. NOAA weather station climate data consists of information collected from February 1943 to August 2021. These temperatures are experienced throughout the entire planning area (City of Edna, City of Ganado, City of La Ward, and Jackson County Unincorporated Areas).

TABLE 17-1. MINIMUM TEMPERATURE DATA SUMMARIES													
Statistic	Years	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Record Low Minimum	1943-2021	13	13	22	32	37	56	63	60	49	30	25	9
Record Low Maximum	1943-2021	26	24	38	53	65	74	76	74	65	49	39	26
Average Minimum	1943-2021	44.8	48.1	54.3	62.0	69.6	75.4	77.6	76.7	71.5	62.4	53.4	46.8
Average Days with a minimum 32 or Below	1943-2021	3.5	1.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	2.2
Notes: Temperatures are in degrees Fahrenheit From NOAA Weather Station Climate Data (February 1968 – August 2021)													

Few areas of Texas escape freezing weather in any winter. Jackson County and the participating communities receive little to no snow accumulations. More often than not, snow falling in the southern half of the state melts and does not stick to the surface; snow stays on the ground only once or twice every decade. Snowfall occurs at least once every winter in the northern half of Texas.

17.2 HAZARD PROFILE

17.2.1 Past Events

The National Climatic Data Center lists 6 winter weather events that impacted Jackson County between 1950 and 2021. These events and estimated damage costs are outlined in Table 17-2. Jackson County does not experience severe winter weather events consistently, but winter and ice storms can affect the HMP update area. Preliminary data on the historic winter storms that occurred in 2021 is included in this chapter. Since the winter events for Jackson County and participating communities occur on a zonal and regional scale, the winter events can be applied to all participating communities.

TABLE 17-2. HISTORIC WINTER WEATHER EVENTS IN JACKSON COUNTY						
Location	Date	Event Type	Estimated Damage Cost		Injuries	Deaths
			Property	Crops		
Jackson (Zone)	01/12/1997	Ice Storm	$0	$0	0	3
Jackson (Zone)	12/24/2004	Winter Storm	$0	$0	0	0
Jackson (Zone)	12/04/2009	Winter Storm	$0	$0	0	0
Coastal Jackson (Zone)	02/03/2011	Ice Storm	$0	$0	0	0
Inland Jackson (Zone)	02/12/2021	Ice Storm	$133,000	$0	0	0
Inland Jackson (Zone)	02/14/2021	Winter Storm	$133,000	$0	0	0

Notes:
From NOAA Storm Events

Winter Storm Outbreak 2021

In February 2021 three storm systems progressed through the United States. On Sunday, February 14, 2021, a strong Arctic cold front progressing through the country reached Southeast Texas. This Arctic cold front brought snow, sleet, and freezing rain into the area. This cold front was the turning point in what would unfold into a historic winter event. For the next week, the state of Texas remained under a winter storm warning with the last hard freeze warning lifted on Saturday, February 20, 2021. The subfreezing temperatures affected the state’s electricity infrastructure and left millions without power in dangerous conditions.

The historic winter temperatures created hazardous road conditions, caused at least 111 fatalities (as of April 13, 2021), overwhelmed the Texas power grid, and stressed state water supplies with many cities experiencing water outages, low pressure, and boil water notices.

Jackson and Participating Communities

Jackson county experienced below-freezing temperatures from February 14 to February 20. The lowest recorded temperature for Jackson and its participating communities was 13 F°. There were hazardous road conditions and road closures throughout the remainder of the week.

On February 15, 2021, approximately 30% of Jackson County residents experienced a power outage. As of April 13, 2021, there were no confirmed fatalities in the County due to the inclement weather. Jackson County did not issue a boil water notice and only experienced low water pressure. Long-term analysis of this event and how it will affect hazard mitigation in the State of Texas will remain to be seen as data continues to be gathered.

17.2.2 Location

Jackson County and the participating communities are susceptible to severe winter storms; although severe winter weather or blizzard conditions are primarily in the form of freezing rain, sleet, or ice. Ice accumulation becomes a hazard by creating dangerous travel conditions. State Highways 35, 60, 71, and 111 are important corridors to move people, supplies, and equipment into the region and to reach medical facilities outside of the counties. An accident on these roads can cause a major disruption in the flow of goods and services to the area.

The record lows for Texas occur during October through March. According to data recorded by NWS between 1897 and 2020, the planning area experiences an average of 8.8 days with minimum temperatures of 32 F° and below. The average first freeze in the HMP update area usually occurs in late November to early December and the last freeze occurs in late February to early March. The coldest recorded winter for the area was in 1979, with a mean temperature of about 46.2°F. Figure 6-4 shows the annual average minimum temperature distribution in Texas.

17.2.3 Frequency

Table 17-2 lists 6 winter storms from 1997 to 2021. Therefore, on average a winter storm occurs in the county and participating communities once every 4 years. In this region, the first autumn freeze ordinarily occurs in early December, and the last frost date occurs in mid-March. On average cities in South Texas experience 10 to 20 freeze days. Winter events are usually zonal events and affect a large area, each participating community has the same frequency and probability of future events (once every 12 years). The strength and severity of future events will be likely in line with previous records as listed in Table 17-1 and Table 17-2. The strength and severity of the winter storm of 2021 was not in line with previous records and the likelihood of its recurrence requires future observations of similar events.

17.2.4 Severity

The magnitude and severity of severe winter weather in Jackson County and the participating communities is low, resulting in minor injuries and illnesses; minimal property damage that does not severely threaten structural stability; or interruption of essential facilities and services for less than 48 hours. The reoccurrence of an extreme winter event such as the one experienced in 2021 is possible but considered unlikely.

17.2.5 Warning Time

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

17.3 SECONDARY HAZARDS

The most significant secondary hazards associated with severe local storms are falling and downed trees, landslides, and downed power lines. There is also the threat of a disruption in the water supply distribution system and power outages. Heavy rain and icy conditions can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails. Additionally, the storms may result in closed highways and blocked roads. It is not unusual for motorists and residents to become stranded. Annually, icy conditions and frozen pipes cause damage to residences and businesses and extend to livestock. Late-season winter events will typically cause some plant and crop damage.

Prolonged ice coverage and power outages can cause crops to become heavily damaged or destroyed. When temperatures drop below freezing for a prolonged period, the water within a plant will freeze and can damage or destroy the crop. Losses of crops can take years to recover from financially due to the varying growth period for different crops (Schattenberg, 2021).

Heavy damage can also be experienced in the aquaculture industry during a winter/ice storm. Below freezing temperatures, for prolonged periods of time, can cause the death of many crops. Texas is the largest supplier of redfish in the United States. During a winter/ice storm, according to the Texas Farm Bureau, the state can suffer a 99% loss of the redfish supply due to adverse conditions (Tomascik, 2021).

17.4 CLIMATE CHANGE IMPACTS

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. Nationally, the number of weather-related disasters during the 1990s was four times that of the 1950s and cost 14 times as much in economic losses. Historical data shows that the probability of severe weather events increases in a warmer climate (see Figure 14-12). The changing hydrograph caused by climate change could have a significant impact on the intensity, duration, and frequency of storm events. All of these impacts could have significant economic consequences.

17.5 EXPOSURE

Because winter weather cannot be directly modeled in HAZUS-MH, annualized losses were estimated using GIS-based analysis, historical data analysis, and statistical risk assessment methodology. Event frequency, severity indicators, expert opinions, and historical knowledge of the region were used for this assessment. The primary data source was the updated HAZUS-MH inventory data (updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs) augmented with state and federal data sets as well as the NOAA National Climatic Data Center Storm Event Database.

17.5.1 Population

It can be assumed that the entire planning area is exposed to severe winter weather events to some extent. Certain areas are more exposed due to geographic location and local weather patterns.

17.5.2 Property

According to the HAZUS-MH inventory data (updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs), there are 6,626 buildings within the census blocks that define the planning area with an asset replaceable value of almost $1.4 billion (excluding contents). About 93% of these buildings (and 79% of the building value) are associated with residential housing. The total value including contents is $2.4 billion. Other types of buildings in this report include agricultural, education, religious, and governmental structures. See hazard loss tables for community-specific total assessed numbers (e.g. Table 17-5). Table 17-3 lists the exposed structures and population for the participating communities.

Residents within a city or municipality are governed by building codes and ordinances. Buildings and land in unincorporated areas of the county are not governed by building codes. Because of the less stringent regulations, all of these buildings are considered to be exposed to severe winter weather, but structures in poor condition or in particularly vulnerable locations (located on hilltops or exposed open areas) may risk the most damage. The frequency and degree of damage to a building will depend on specific locations.

TABLE 17-3 EXPOSED STRUCTURES AND POPULATION					
Jurisdiction	Residential	Commercial	Other *	**Total Structures**	**Total Population**
City of Edna	2,143	133	100	**2,376**	**5,499**
City of Ganado	657	34	17	**708**	**2,003**
City of La Ward	88	6	6	**100**	**213**
Unincorporated Area	3,256	82	104	**3,442**	**6,360**
Jackson County Total	**6,144**	**255**	**227**	**6,626**	**14,075**

Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.

17.5.3 Critical Facilities and Infrastructure

All critical facilities are likely exposed to winter weather events. The most common problems associated with this hazard are utility loss. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to ice or snow. Ice accumulation on roadways can create dangerous driving conditions. Several county roads are available to move people and supplies throughout the region.

17.5.4 Environment

The environment is highly exposed to severe weather events. Natural habitats such as streams and trees risk major damage and destruction. Flooding events caused by snowmelt can produce river channel migration or damage riparian habitat.

17.6 VULNERABILITY

Although winter/ice storms are a slow onset hazard with generally six to twelve hours of warning time, utility disruptions from winter storms can severely impact the delivery of services. Water pipes can freeze and crack in sub-freezing temperatures. Ice can build up on power lines and cause them to break under the weight or ice on trees can cause tree limbs to fall on the lines. These events can disrupt electric service for long periods.

The economic impact may be felt by increased consumption of heating fuel which can lead to energy shortages and higher prices. House fires and resulting deaths tend to occur more frequently from increased and improper use of alternative heating sources. Fires during winter storms also present a greater danger because water supplies may freeze and impede firefighting efforts.

All populations, buildings, critical facilities, and infrastructure in the planning area are vulnerable to severe winter events. People and animals are subject to health risks from extended exposure to cold air. Elderly people and economically disadvantaged populations in the planning area are at greater risk of death from hypothermia during these events. According to the U.S. Center for Disease Control, every year accidental primary hypothermia kills about 700 Americans, half of whom are 65 years of age or older.

17.6.1 Population

Vulnerable populations are the elderly, low-income, linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life-threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure during severe winter weather events and could suffer more secondary effects of the hazard. Commuters who are caught in storms may be particularly vulnerable. Stranded commuters may be vulnerable to carbon monoxide poisoning or hypothermia. Additionally, individuals engaged in outdoor recreation during a severe winter event may be difficult to locate and rescue. Table 17-4 contains more specific jurisdictional information.

TABLE 17-4
MOST VULNERABLE POPULATION

Jurisdiction	Youth Population (< 16)	% of Total Population	Elderly Population (> 65)	% of Total Population	Economically Disadvantage (Income < $20,000)	% of Total Population
City of Edna	1,481	26.93%	876	15.93%	371	6.75%
City of Ganado	502	25.06%	270	13.48%	100	4.99%
City of La Ward	71	33.33%	24	11.27%	22	10.33%
Unincorporated Area	1,525	23.98%	1,143	17.97%	448	7.04%
Jackson County Total	**3,579**	**25.43%**	**2,313**	**16.43%**	**941**	**6.69%**

17.6.2 Property

All property is vulnerable during severe winter weather events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Those that are located under or near overhead lines or near large trees may be vulnerable to falling ice or may be damaged in the event of a collapse.

Loss estimations for severe winter weather are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing projected damages (annualized loss) on historical events, statistical analysis, and probability factors. These were applied to the participating communities' reported event damages and exposed values for structures and content to create an annualized loss. Annualized losses of ‘negligible’ are less than $50 annually. The annualized loss estimated for winter and ice storm events is shown in Table 17-5.

TABLE 17-5. LOSS ESTIMATES FOR WINTER STORM EVENTS			
Jurisdiction	Exposed Value	Annualized Loss	Annualized Loss Percentage
City of Edna	$873,172,834	Negligible	Negligible
City of Ganado	$253,570,646	Negligible	Negligible
City of La Ward	$27,144,277	Negligible	Negligible
Unincorporated Area	$1,215,680,242	Negligible	Negligible
Jackson County Total	$2,369,568,000	**Negligible**	**Negligible**

Vulnerability Narrative

Each community's vulnerability to winter weather events is described below.

- **City of Edna** – Winter and ice storms in the City of Edna would expose the residents to high utility bills, severely impacting those who are elderly or economically disadvantaged. Roads become dangerous to travel on because of icy conditions. This can lead to schools and businesses being shut down for a day or two. Structures built without proper building codes could suffer from a lack of insulation and may experience deteriorating infrastructure, physical harm, and property damage from severe winter weather.
- **City of Ganado -** The City of Ganado is at risk of rolling blackouts during a winter weather event due to high usage. This can expose the elderly and economically disadvantaged residents to prolonged periods of cold without heating and high utility bills. Roads become dangerous to travel on because of icy conditions. This can lead to schools and businesses being shut down for a day or two. Community members unaware of the dangers associated with severe winter weather are more vulnerable. Critical facilities and infrastructure without alternate power supply sources, such as generators, increase risk as service to residents will be more challenging in the event of an outage.
- **City of La Ward -** The City of La Ward is at risk of rolling blackouts during a winter weather event due to high usage and damage to power lines. These outages could last for an extended period of time exposing the elderly and economically disadvantaged residents to prolonged periods of cold without heating. Roads become dangerous to travel on because of icy conditions. This can lead to schools and businesses being shut down for a day or two. Community members unaware of the dangers associated with severe winter weather are more vulnerable. Critical facilities and infrastructure without alternate power supply sources, such as generators, increase risk as service to residents will be more challenging in the event of an outage.
- **Jackson County (Unincorporated Area) -** Jackson County Unincorporated Areas are at a greater risk of rolling blackouts during a winter weather event due to high usage from other areas of the electrical grid. The more rural areas of Jackson County could experience longer wait times for emergency response actions. This could expose them to hazards such as prolonged periods of cold without heating. Also, this would have a greater effect on the young, elderly, and economically disadvantaged that may not have the means to respond to such an event. Critical

facilities, (emergency response facilities, government buildings, and area schools) without alternate power supply sources, such as generators, increase risk as service to residents will be more challenging in the event of an outage.

Community Perception of Vulnerability

See the front page of the current chapter for a summary of hazard rankings for Jackson County and participating communities in this HMP update. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

17.6.3 Critical Facilities and Infrastructure

Incapacity and loss of roads are the primary transportation failures resulting from winter weather, mostly associated with secondary hazards. Snowstorms can significantly impact the transportation system and the availability of public safety services. Of particular concern are roads providing access to isolated areas and to the elderly. Prolonged obstruction of major routes can disrupt the shipment of goods and other commerce. Large, prolonged storms can have negative economic impacts on an entire region.

Severe windstorms, downed trees, and ice can create serious impacts on power and above-ground communication lines. Freezing of power and communication lines can cause them to break, disrupting electricity and communication. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance.

17.6.4 Environment

The vulnerability of the environment to winter weather is the same as the exposure, discussed in Section 17.5.4.

17.7 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by winter and ice storms. The vulnerability of community assets to severe winter or ice storms is increasing over time as more people enter the planning area. The ability to withstand impacts lies in sound land-use practices and consistent enforcement of codes and regulations for new construction. The planning partners have adopted the International Building Code. This code is equipped to deal with the impacts of severe weather events. Land-use policies identified in general plans within the planning area also address many of the secondary impacts (flood and landslide) of the severe weather hazard. With these tools, the planning partnership is well equipped to deal with future growth and the associated impacts of severe weather.

17.8 SCENARIO

Although severe local storms are infrequent, impacts can be significant, particularly when secondary hazards, such as floods or erosion occur. A worst-case event would involve prolonged high winds during a winter storm accompanied by thunderstorms. Such an event would have both short-term and longer-term effects. Initially, schools and roads would be closed due to power outages caused by high winds and downed tree obstructions. In more rural areas, some subdivisions could experience limited ingress and egress. Prolonged rain could produce flooding, overtopping culverts, ponding water on roads, and eroding steep slopes. Flooding and landslides could further obstruct roads and bridges, further isolating residents.

17.9 ISSUES

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

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

Chapter 18.

Coastal Erosion

COASTAL EROSION RANKING	
Jackson County	Low
City of Edna	N/A
City of Ganado	N/A
City of La Ward	N/A

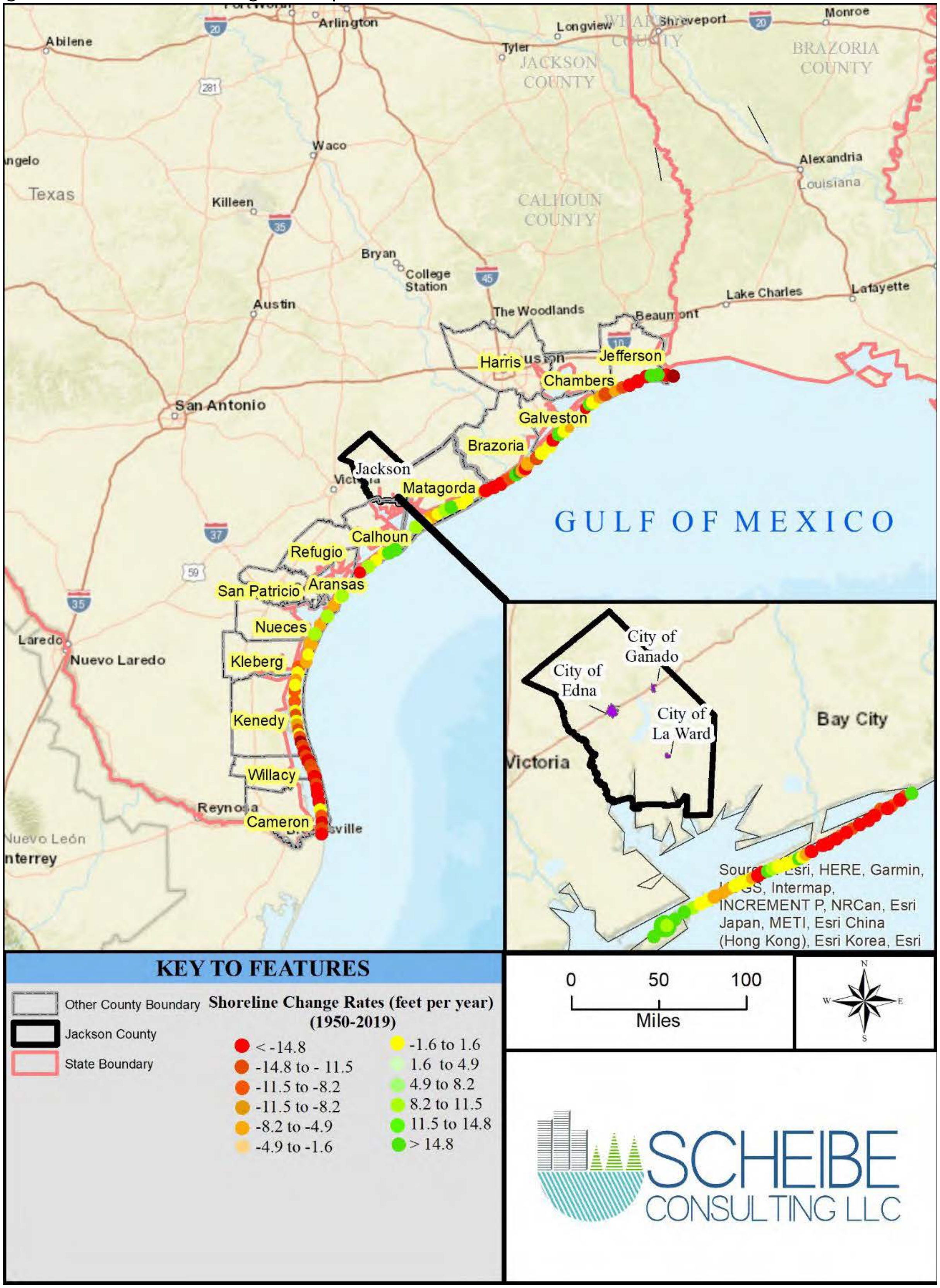
DEFINITIONS	
Ground Subsidence	Ground subsidence is the sinking of land over human-caused or natural underground voids and the settlement of native low-density soils.
Soil Erosion	The sudden rise in the incidence of a disease.
Deposition	Living organisms that can transmit infectious pathogens between humans, or from animals to humans

18.1 GENERAL BACKGROUND

The Texas Natural Resources Code §33.601 defines coastal erosion as "the loss of shoreline, beach and/or dune sediments and is caused by the lack of sediment delivered to the coast to balance the impacts ranging from man-made actions such as the damming of rivers, land subsidence from groundwater withdrawal, construction of seawalls, groins and jetties, diversion of rivers and streams, fast-moving motor craft and ship-generated wakes and many other factors to natural processes such as wave action from storms, tidal surges, wind, and loss of wetlands." An eroding area is defined by the General Land Office (GLO) of Texas as a portion of the shoreline that is experiencing a historical erosion rate greater than two feet per year based on data published by the University of Texas Bureau of Economic Geology (BEG.)

The Texas gulf-facing coast extends over 367 miles and is primarily composed of low-elevation sandy beaches that form a part of long, narrow barrier islands, barrier peninsulas, and delta headlands. According to the Coastal Erosion Planning and Response Act (CEPRA): A Report to the 86th Legislature 61% of this gulf-facing coast is classified as an eroding area. On average 235 acres of land is lost to erosion. Figure 18-1 shows the specific erosion rates along the Texas Coast. This figure shows the shoreline change rates due to erosion in feet per year from 1950 to 2019.

Figure 18-1. Shoreline Change Rates for the Texas Coast



Note: Data points from Paine et. al. 2021

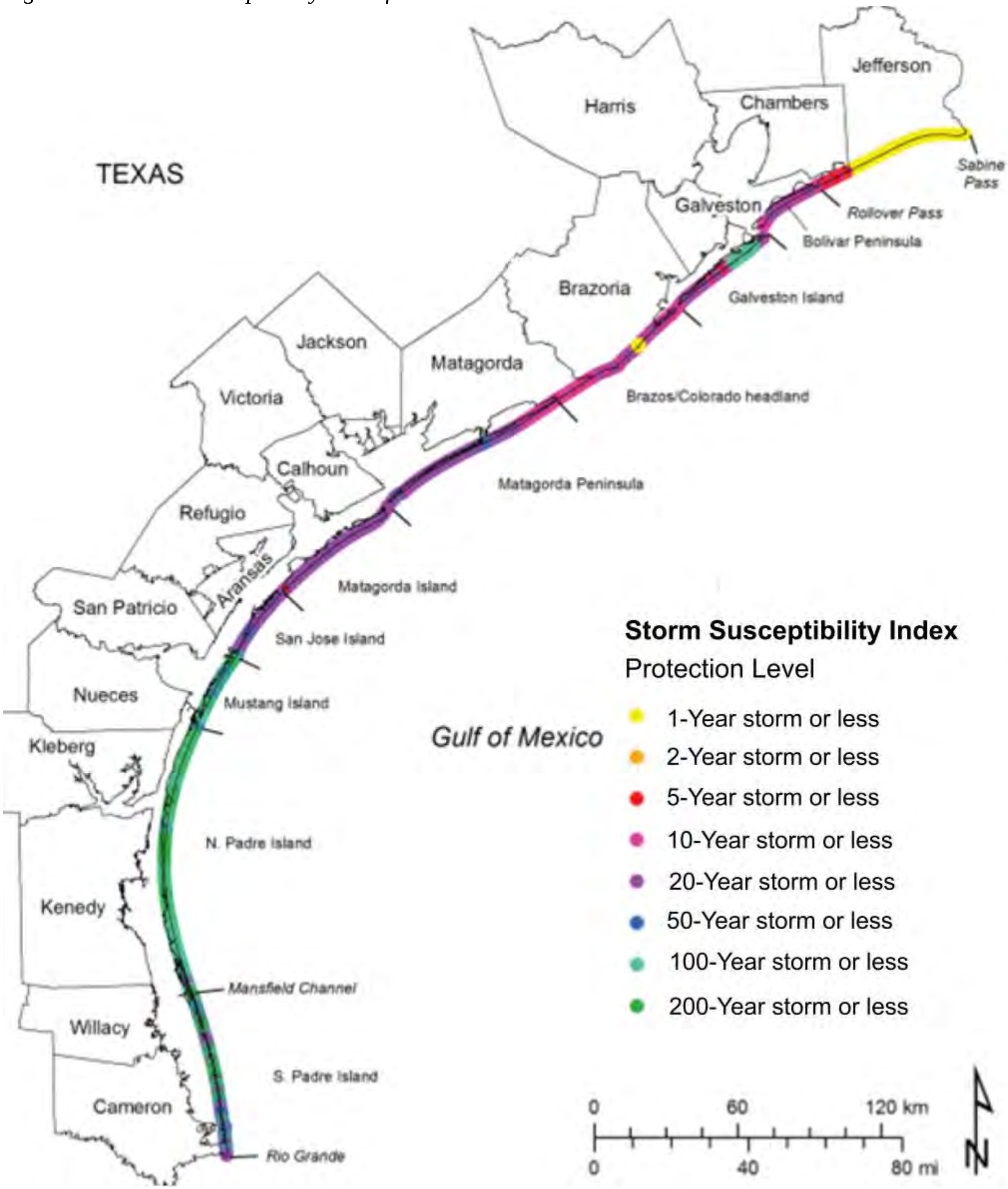
18.2 HAZARD PROFILE

18.2.1 Past Events

Coastal erosion is a problem along the Texas Coast. Jackson County is part of the Texas Coastal Bend and connects to the Texas Gulf Coast through Carancahua Bay and Lavaca Bay. Although it is exposed to some coastal shoreline erosion, Jackson County's location behind barrier islands reduces some of the effects of coastal erosion. Inland communities, such as the Cities of Edna, Ganado, and La Ward are not directly affected by coastal erosion.

Texas has a variety of shoreline types along its coastal bays and open Gulf of Mexico Coast that are constantly shifting and mostly retreating landward. This retreat results in the loss of private and public property and important natural habitats, such as beaches, dunes, and marshes. To address this problem, the Texas Legislature passed the Coastal Erosion Planning and Response Act in 1999. This act authorized the GLO to conduct a coastal erosion response program. In support of the program, coastal researchers are identifying and studying eroding areas along the Gulf of Mexico and coastal bay shorelines of Texas, quantifying data gleaned from research, and creating a comprehensive, digital database of historical shoreline positions and average annual rates of shoreline change. This data is available to the public through the internet. Figure 18-2 shows the Storm Susceptibility Index (SSI) Map for the Texas Coast developed by the BEG which indicates susceptibility to storm flooding, and erosion resistance, and recoverability. The SSI indicates the predicted protection level from storms at recurrence intervals of 1 to 200 years.

Figure 18-2. Storm Susceptibility Index for the Texas Coast



Note: Storm susceptibility map from a 2013 study published by the BEG at the University of Texas at Austin (Paine, 2013).

18.2.2 Location

Coastal Erosion

Coastal erosion is located primarily along the Texas Coast (Gulf of Mexico). Coastal erosion issues will affect both the Gulf and Bay side of barrier islands along the coast. Jackson County is affected by coastal shoreline erosion because of its coastal geography. Natural and human activities also cause seasonal soil erosion and deposition throughout the county and participating communities. Jackson County is affected by coastal shoreline erosion because of its coastal geography. Inland areas, including parts of the unincorporated area and the Cities of Edna, Ganado, and La Ward are not exposed, vulnerable, or affected by coastal erosion. Natural and human activities also cause seasonal soil erosion and deposition throughout the county. Figure 18-1 and Figure 18-2 show the location of coastal erosion along Jackson County and participating communities. Jackson County Unincorporated area has approximately 28 miles of bay shoreline.

18.2.3 Frequency

According to a study published in January 2020 by the University of Texas at Austin's BEG Coastal Studies group shoreline retreat occurred along 80 percent of the Texas Gulf shoreline with an estimated land loss of 16,375 acres since 1930. 60% of the coast is classified as an eroding area with 225 miles of the 367 miles of coast currently experiencing a shoreline erosion rate greater than 2 feet per year.

The Texas GLO and BEG Coastal Study, analyzing shoreline changes (as shown in Figure 18-1.) only assessed the Gulf of Mexico shoreline change rates. Jackson shoreline changes were not analyzed. The average rate of change in the Texas Gulf Coast is 4.2 feet per year (Paine, et.al., 2021).

Future Probability

The BEG coastal study found that short and long-term trends for shoreline retreat have similar values. It is probable that the average rate of shoreline retreat will likely be similar to the duration of this hazard mitigation plan. However, it is also likely that these individual yearly rates will fluctuate as these can be affected by severe weather events and sea-level rise which occur on a yearly basis. Accounting for sea-level rise the BEG has developed a relationship that can predict future coastal erosion rates under various sea-level rise scenarios.

18.2.4 Severity

According to the Texas Coastwide Erosion Response Plan (2018 Update), coastal erosion remains a continuing threat to the Texas Gulf and bay shorelines. Whether the erosion is caused by the lack of sediments to balance the long-term losses within the coastal compartments, or the episodic erosion brought on by storms or human activities, planning and implementation of erosion response and sediment management practices is essential to the sustainability of the shoreline and public beaches.

The severity of coastal erosion soils is largely related to the extent and location of areas that are impacted. Such events can cause property damage as well as loss of life. Since the coastline is home to many residential and commercial properties, as well as significant landscapes (such as wetlands) there is the potential for significant impact on people or property.

Structures exposed to erosion hazard areas may be undermined, resulting in damages. This may also result in the condemnation of a structure. Additionally, physical loss of land area may occur as a result of erosion.

18.2.5 Warning Time

Meteorologists can often predict the likelihood of weather events that can impact shoreline communities, and ultimately the shoreline. NOAA's National Weather Service monitors potential events, and provides forecasts and information, in advance of a storm through multiple means varying in system characteristics and time issued. The NWS provides early notification through its Hazardous Weather Outlook, which is a narrative statement produced and issued on a routine basis, to provide information regarding the potential of significant weather expected during the next 1 to 5 days (NWS, 2009). Additionally, for nor'easters the National Weather Service Issues Coastal Flood Advisories when minor flooding is possible, Coastal Flood Watches when flooding with significant impacts is possible, or Coastal Flood Warnings when flooding that will pose a serious threat to life and property is occurring, imminent, or highly likely (NWS, 2009). For tropical, subtropical, or post-tropical systems the National Weather Service will issue a Hurricane or Tropical Storm Warning 36 hours in advance of the anticipated onset of tropical storm-force winds or a Hurricane or Tropical Storm Watch 48 hours in advance of the anticipated onset of tropical-storm-force winds (NWS, 2013). The National Weather Service uses common terms like minor, moderate, major, and severe to categorize the severity of forecasted beach erosion in statements, advisories, watches, and warnings. Although commonly used, no formal definition exists within the National Weather Service Glossary for these descriptors. With shore structures and population increasing along the coastline, the shoreline becomes increasingly modified. The impact from weather incidents will continue to influence Jackson County and participating communities' coastal areas, intensifying and exacerbating the situation.

18.3 SECONDARY HAZARDS

Windstorm events can blow beach and dune sand overland into adjacent low-lying marshes, upland habitats, inland bays, and communities. Flooding from extreme rainfall events can scour and erode dunes as inland floodwaters return through the dunes and beach face into the ocean. Shore protection structures such as seawalls and revetments often are built to attempt to stabilize the upland property. However, typically, they eliminate natural wave run-up and sand deposition processes and can increase reflected wave action and currents at the waterline. Increase wave action can cause localized scour in front of structures and prevent settlement of suspended sediment.

18.4 CLIMATE CHANGE IMPACTS

According to the Environmental Protection Agency, coastal shores change constantly due to wind, waves, tides, sea-level fluctuation, seasonal and climatic variation, human alteration, and other factors that influence the movement of sand and material within a shoreline system. Climatic trends can change a beach from naturally accreting to eroding due to increased episodic erosion events caused by waves from an above-average number of storms and high tides, or the long-term effects of fluctuations in sea or lake level. The coastal zone is being severely impacted by erosion and flooding due in part to climate change and sea-level rise. The impact will likely increase in the future as sea levels continue to rise at the current rate or rise at an accelerated rate. Impacts of climate change can lead to shoreline erosion, coastal flooding, and water pollution, affecting man-made coastal infrastructure and coastal ecosystems. Coastal areas may be impacted by climate change in different ways. Coastal areas are sensitive to sea-level rise, changes in the frequency and intensity of storms, increase in precipitation, and warmer ocean temperatures. Additionally, oceans are absorbing more carbon dioxide, due to the rising atmospheric concentrations of the gas, and the oceans are becoming more acidic. This could have significant impacts on coastal and marine ecosystems.

18.5 EXPOSURE

The coastal communities (including people, structures, economy, culture, and property) are affected by coastal erosion, shoreline change, and sea-level rise. Healthy dunes, beaches, and banks are vital to these communities as they serve as a natural buffer against hurricanes, tropical storms, and tropical depressions. Events such as those previously listed can cause shoreline erosion or accretion.

18.5.1 Population

Because coastal erosion is driven by the action of waves, currents, and tides it can be assumed that areas within the FEMA designated Zone VE are directly impacted. Zone VE refers to zones within the 100-year floodplain that are at risk of additional hazards associated with storm-induced waves.

In the future, an increasing population may result in coastal erosion problems in metropolitan areas where damage from erosion will be great. These events may damage infrastructure and result in loss of life. Current growth trends could cause more county residents to be exposed to coastal erosion. Table 18-1 lists the exposed population.

18.5.2 Property

According to the Jackson County HAZUS-MH inventory data (updated with 2010 U.S. Census Data and 2018 RS Means Square Foot Costs), there are 6,826 buildings within the census blocks that define the planning area with an asset replaceable value of over $1.4 billion (excluding contents). About 93% of these buildings (and 79% of the building value) are associated with residential housing. Other types of buildings in this report include agricultural, education, religious, and governmental structures. See hazard loss tables for community-specific total assessed numbers (e.g. Table 18-2).

Structures and other improvements located in areas along the coast are most exposed to risk from this hazard. Additionally, deposition may result in damage to structures and property. Table 18-1 describes the vulnerable structures and population per participating community.

TABLE 18-1.
EXPOSED STRUCTURE AND POPULATION

Jurisdiction	Residential	Commercial	Other *	**Total Structures**	**Total Population**
City of Edna	0	0	0	**0**	**0**
City of Ganado	0	0	0	**0**	**0**
City of La Ward	0	0	0	**0**	**0**
Unincorporated Area	31	0	0	**31**	**30**
Jackson County Total	**32**	**0**	**0**	**31**	**30**

*Other includes industrial, agricultural, religious, governmental, and educational classifications.

18.5.3 Critical Facilities and Infrastructure

Any critical facilities or infrastructure that are located on or near the coast are exposed to risk from the hazard. Deposition may result in additional exposure. Critical Facilities and Infrastructure located closer to the coast are more exposed.

18.5.4 Environment

Coastal Erosion is a naturally occurring process, but can still cause damage to the natural environment. These processes and events can alter the natural environment where they occur.

18.6 VULNERABILITY

18.6.1 Population

The risk of injury or fatalities as a result of these hazards is limited but possible. Since the changes caused by coastal erosion are gradual, coastal erosion is not generally considered an imminent threat to the public. Spontaneous collapse is rare but still may occur resulting in death or injury to any people in the area at the time. Any such injuries would likely be highly localized to the area directly impacted by an event. Such drastic changes to the coast can be caused by an extreme event, such as a hurricane or tropical storm. The population exposed is considered vulnerable to this hazard (see Table 18-1).

18.6.2 Property

Property exposed to coastal erosion can sustain minor damages or can result in destruction. Structures may be condemned as a result of coastal erosion damage resulting in large losses. Additionally, physical loss of land area may occur as a result of erosion. All coastal property is vulnerable, but properties closer to the coast are at more immediate risk.

Loss estimates were developed representing projected damages (annualized loss) on historical events, statistical analysis, and probability factors. These were applied to the exposed value of the county and communities to create an annualized loss. Table 18-2 lists the loss estimate for coastal erosion.

TABLE 18-2.
LOSS ESTIMATES FOR COASTAL EROSION

Jurisdiction	Exposed Value ($)	Annualized Loss ($)	Annualized Loss (%)
City of Edna	0	0	0.00
City of Ganado	0	0	0.00
City of La Ward	0	0	0.00
Unincorporated Area	8,774,645	Negligible	<0.01
Jackson County Total	**8,774,645**	**Negligible**	**<0.01**

Vulnerability Narrative

The coastal communities are at greater risk of coastal erosion while inland communities are not at risk. Table 18-2 lists the estimated annualized losses in dollars for each participating community. Annualized losses of ‘negligible’ are less than $50 annually. Negligible loss hazards may still be included despite minimal annualized losses if the community perceives the hazard as a risk.

- **City of Edna** – The City of Edna is rated “No Exposure” due to its non-coastal, inland location, and local knowledge.
- **City of Ganado** – The City of Ganado is rated “No Exposure” due to its non-coastal, inland location, and local knowledge.
- **City of La Ward** – The City of La Ward is rated “No Exposure” due to its non-coastal, inland locational, and local knowledge.
- **Jackson County (Unincorporated Area)** – Jackson County Unincorporated Areas are at constant risk of coastal erosion. Coastal locations are subject to greater risks of structural damage and property loss. These damages can include foundation damage due to the loss of supporting material from wave action, drainage, winds, or tidal currents. Property damage can also be more severe, such as a complete loss in a more significant event, such as a hurricane, where the easily erodible, fine-grained material that dominates coastal areas are washed away due to a lack of vegetation in a significant or intense storm surge or flooding situation. The County’s Unincorporated Areas are also at risk for significant negative impacts to the environment such as destruction of wetlands and loss of habitat for birds, fish, and other species. Coastal erosion results in a loss of land area that is also a significant part of the County’s economy through tourism and fisheries. Communities who are not implementing mitigation measures, such as Beach Restoration Programs, are more vulnerable to these effects.

Community Perception of Vulnerability

See the front page of the current chapter for a summary of hazard rankings for Jackson County and participating communities in this HMP update. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

18.6.3 Critical Facilities and Infrastructure

Coastal erosion can result in serious structural damage to critical facilities and infrastructure such as roads, irrigation ditches, underground utilities, and pipelines. Large areas of erosion and displacements caused by coastal erosion can destroy roads and structures and alter surface drainage. Minor cracking and distress may result as the improvements respond to small adjustments in the ground beneath them. Erosion can also impact structures such as bridges and roads by undermining their foundations. Structures and underground utilities found in areas prone to subsidence or soil erosion can suffer from distress.

Even though coastal erosion causes enormous amounts of damage, the effects can occur slowly and may not be attributed to a specific event. Cracked foundations, floors, and basement walls, as well as damage to the upper floors of the building when the motion in the structure is significant, are typical types of damage done by erosion. Coastal Erosion can remove support from buildings or other structures and result in damaging subsidence.

18.6.4 Environment

Ecosystems that are exposed to increased sedimentation as a result of erosion and deposition degrades habitat. However, some erosion and disposition are required for healthful ecosystem functioning. Ecosystems that are already exposed to other pressures, such as encroaching development, may be more vulnerable to impacts from these hazards.

18.7 FUTURE TRENDS IN DEVELOPMENT

According to the *2013 State of Texas Hazard Mitigation Plan* (TDEM 2013):

> *Because of climate change, the Texas Coast is becoming exposed to increasing risk of inundation and coastal erosion over the coming decades. Sea level rise measured by Texas Coastal Ocean Observation Network tide gauges in the Galveston area measured a current rise of about 6 millimeters per year. At this current rate of rise, local sea levels in the Galveston area can be projected to be 0.6 meters (approximately 2 feet) by the year 2100. With current rates of coastal subsidence and with the majority of the Texas Gulf Coast being characterized by low-lying topography, in addition to a broad gently sloping outer continental shelf, this anticipated rise in sea level is important. A small rise in sea level along the Texas Coast can result in a significant shoreline retreat and an increased risk of inundation of wetlands, marshes, private property, and public infrastructure. Relative sea level rise increases the vulnerability of barrier islands and peninsulas along the Texas Coast to inundation from storm surge, even from smaller storms and coastal weather systems.*

As steward of the Texas coast, the Texas GLO is leading the fight against coastal erosion by:

- Implementing coastal erosion response projects and related studies through the CEPRA program and other grant programs at the GLO.
- Maximizing federal, state, and local resources. The GLO works with all coastal stakeholders to fight erosion where it makes economic sense to do so.

Jurisdictions in the planning area should ensure that known hazard areas are regulated under their planning and zoning programs. In areas where hazards may be present, permitting processes should require geotechnical investigations to access risk and vulnerability to hazard areas. Erosion issues generally do not impact land use except along river channels. Issues pertaining to land use in these areas are likely addressed through jurisdictional floodplain ordinances and regulations.

18.8 SCENARIO

A worst-case scenario would occur if a large storm effected Jackson County cause rapid and significant coastal erosion and loss near populated and economic areas. This situation could result in a number of injuries or fatalities and would cause extensive damage to the area directly impacted.

18.9 ISSUES

The major issues for coastal erosion deposition are the following:

- The onset of actual or observed subsidence in many cases is related to changes in land use. Land uses permitted in known hazard areas should be carefully evaluated.
- Knowledge of hydrologic factors is critical for evaluating most types of ground subsidence.

- Some housing developments have had subsidence hazard investigations completed before development. This practice should be reviewed and expanded as needed.
- Human activities greatly influence the rate and extent of erosion and deposition. Activities should be evaluated before proceeding.
- Riverine erosion can reduce water quality and impact aquatic habitat as well as impact private property and critical infrastructure.
- A more detailed analysis should be conducted for critical facilities and infrastructure exposed to hazard areas. This analysis should address how potential structural issues were addressed in facility design and construction.
- Evaluate how Texas should address sea-level rise and its causal effect on coastal subsidence and coastal erosion.

Chapter 19.
Pandemic

PANDEMIC RANKING	
Jackson County	High
City of Edna	High
City of Ganado	High
City of La Ward	Medium

DEFINITIONS	
Pandemic	An outbreak of a disease that occurs over a wide geographic area, such as multiple countries or continents and typically affects a significant proportion of the population.
Outbreak	The sudden rise in the incidence of a disease.
Vector	Living organisms that can transmit infectious pathogens between humans, or from animals to humans
Common Vehicle	Disease transmitted by a common inanimate vehicle resulting in multiple infections; most commonly food or water.

19.1 GENERAL BACKGROUND

Infectious disease outbreaks occur from the presence of a pathogenic microbial agent. The level of infection determines the classification of the event as either an endemic, epidemic, or pandemic. An endemic classifies infections disease which is present at all times, but a low frequency. An epidemic is the sudden outbreak of the disease in a specified area, such as a city, country, or region. A pandemic is a result of an epidemic becoming more widespread. More specifically, a pandemic is an outbreak of a disease that occurs over a wide geographic area, such as multiple countries or continents, and typically affects a significant proportion of the population.

Diseases can spread through a population in a multitude of ways such as contact (direct and/or indirect), droplet, airborne, vector, and common vehicle. According to FEMA, endemic and epidemic infectious diseases are the leading cause of death worldwide (FEMA, n.d.). As the world continues to become more interconnected via travel, the threat of a rapidly spreading disease increases. Growing populations contribute to more densely populated areas causing an increase in the risk of exposure and allowing for the rapid spread of a potentially infectious disease. This, coupled with the increase in travel, creates a system capable of facilitating a pandemic.

Although the direct effects of the infectious disease during a pandemic are of great significance to human health, the effects on the economy and society can be far-reaching as well, as seen by the recent COVID-19 pandemic (see 19.2.1). A pandemic can cause major disruptions to daily lives through issued quarantines, and lockdowns among other non-pharmaceutical measures to prevent the spread of the infectious disease. The healthcare industry can become overwhelmed causing supply issues, strained medical workers, and neglected patients with other diseases or health problems. Economically, manufacturing delays may cause supply chain disruptions, both national and international businesses can experience a downturn, and companies can experience a decrease in revenue growth creating a downward turn in the national and global economy. A society can also see far-reaching social implications such as the service sector being unable to operate, the disruption of cultural celebrations and religious festivities, as well as a rise in stress among the population (Haleem et. al., 2020).

19.2 HAZARD PROFILE

19.2.1 Past Events

Since the founding of Jackson County in 1836, there have been multiple pandemics that have occurred according to the Center for Disease Control (CDC). Although variants of the influenza virus have accounted for the majority of pandemics that have occurred in the United States, there have been other pandemics that have been caused by other infectious diseases. Some of these include the coronaviruses and human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS). Some of the more substantial pandemics which have affected the United States and therefore Jackson County since the founding are discussed below.

1918 Flu Pandemic

Considered one of the most severe pandemics in recent history, the flu pandemic of 1918 spread throughout the world from 1918 to 1919. Although the origin of the H1N1 influenza virus of the 1918 pandemic was never identified, the infection spread to the United States in the spring of 1918. At the time, no vaccine existed to guard the population from the rapidly spreading flu. This was accompanied by a lack of treatment options for secondary bacterial infections associated with flu infections. This resulted in limited control efforts such as isolation, quarantine, good personal hygiene, use of disinfectants, and limitation of public gatherings. By the end of the pandemic, it was estimated that approximately 500 million people, or one-third of the world's population at the time, had been infected with the virus resulting in 50 million deaths worldwide, 675,000 of which occurred in the United States (CDC, 2018). Texas accounted for approximately 2,100 of the deaths in the United States, of which most occurred during September and October of 1918. Major urban areas of the state, such as Houston, issued bans on gatherings to help mitigate the spread of the virus during this time.

2003 Severe Acute Respiratory Syndrome (SARS)

Often noted as the first pandemic of the 21st century, SARS was first reported in Asia in February of 2003. The coronavirus illness spread throughout more than two dozen countries, including the United States, and four continents before being contained. According to World Health Organization (WHO) data, in total 8,098 cases were reported, eight of which occurred in the United States. In each of the eight lab-confirmed cases in the United States, patients had traveled to locations where an outbreak was occurring. The pandemic resulted in 774 deaths, at a 9.6% mortality rate, none of which were in the United States. Since 2004 there have been no reported cases of SARS, but the six-month outbreak is estimated to have cost $40 billion globally (CDC, 2016).

2019-Present Coronavirus Disease (COVID-19)

The coronavirus disease 2019 (COVID-19) was first identified in Wuhan, China in December of 2019. This disease is also known as the novel (or new) coronavirus as it has not previously been seen in humans. Like the coronavirus which spread during the 2003 SARS pandemic, the COVID-19 virus is a respiratory disease caused by SARS-CoV-2. Since the virus was new when it first emerged, there were no available treatments or natural immunity to the pathogen resulting in a rapid spread from host to host.

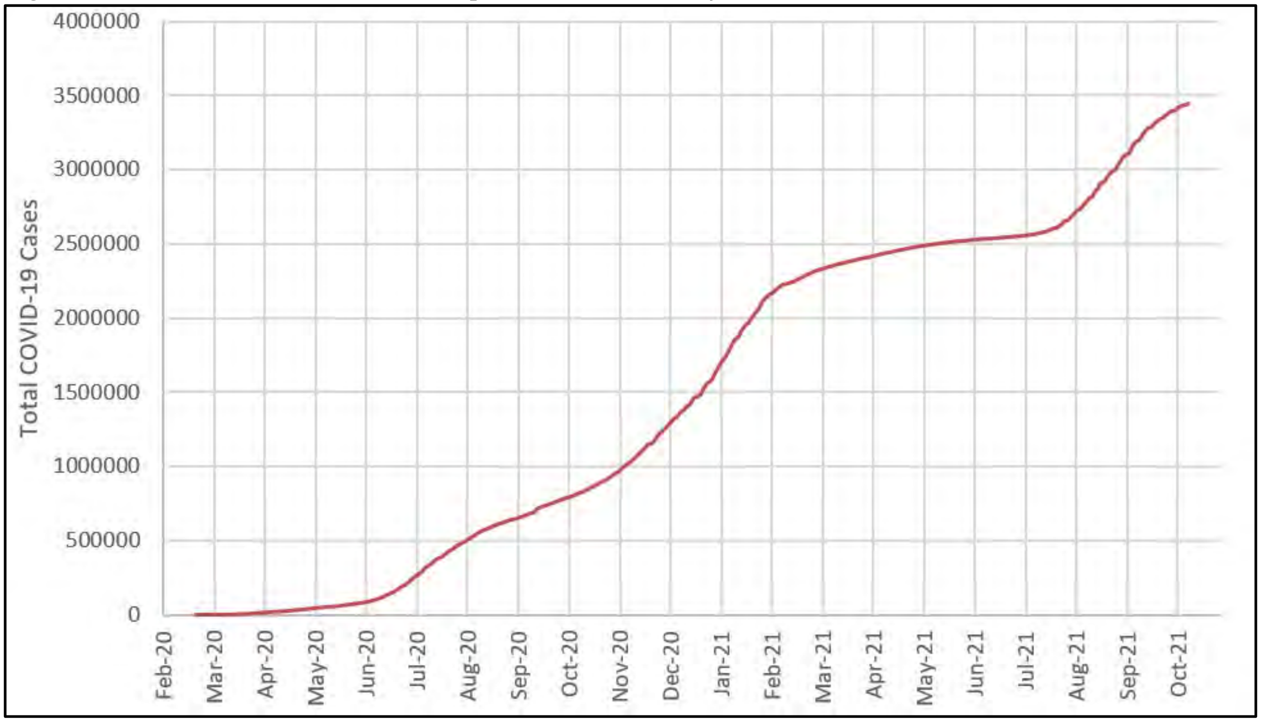
In the United States, the first confirmed case of COVID-19 occurred on January 21, 2020, in a person having recently traveled back to the U.S. from the epicenter, Wuhan, China. By January 31st the global number of cases hit 9,800 with more than 200 deaths causing WHO to issue a Global Health Emergency. This was soon followed by the U.S. declaring a public health emergency on February 3rd. The first major outbreak in the U.S. occurred on March 6th with 21 passengers on a California cruise ship testing positive for COVID-19. By March 11th, WHO had officially declared COVID-19 a pandemic closely followed by a National Emergency declaration being issued in the U.S. two days later (AMJC, 2021).

COVID-19 quickly spread to every state in the U.S. after the first outbreak reporting in March. Figure 19-1 and Figure 19-2 illustrate the reported number of cases in Texas and Jackson County, respectively, from the beginning of the pandemic in March 2020 to October 2021.

In an effort to reduce the spread of the virus, multiple non-pharmaceutical measures were put in place throughout the country while medical professionals worked to produce a vaccine. By March 11th, most universities in Texas had switched to online learning, and on March 13th Texas declared a statewide emergency. On March 19th the governor of Texas issued an executive order closing all bars, restaurants, and schools. Soon after many counties issued stay-at-home orders and elective medical procedures were halted in most major counties to help relieve stress on the healthcare system. In a little over two weeks from the first major outbreak and the first executive order, the number of Texans filing for unemployment jumped 860%. Over the coming months, the reopening of industries began in a phased approach accompanied by the issuing of a mask mandate on July 2nd. On December 14th, the first doses of the COVID-19 vaccine arrived in Texas.

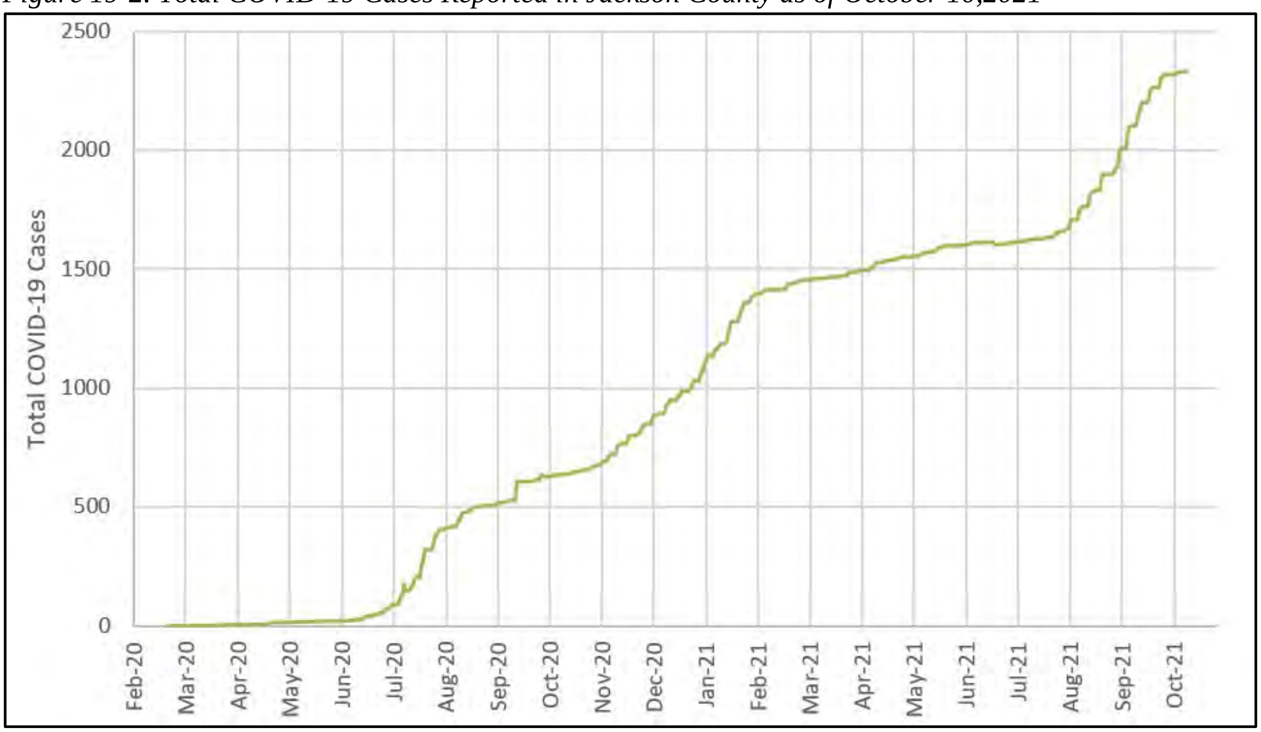
Over a year after the pandemic began, Texas officially reopened all businesses and lifted mask mandates on March 2, 2021. From March 3, 2020, to October 10, 2021, the Department of Health Services has reported 2,498,217 confirmed COVID-19 cases in Texas resulting in 66,676 deaths. Out of this Jackson County accounts for 2,333 cases and 50 deaths (Texas HHS, 2021). Confirmed cases of COVID-19 continue to occur throughout the country as the pandemic continues. As of October 10, 2021, there have been 237,655,302 confirmed cases of COVID-19 including 4,846,981 deaths with 6,364,021,792 vaccine doses administered worldwide (WHO, 2021). These numbers continue to rise as the COVID-19 pandemic continues into 2021 and variants begin to cause case spikes.

Figure 19-1. Total COVID-19 Cases Reported in Texas as of October 10,2021



Note: From Texas HHS

Figure 19-2. Total COVID-19 Cases Reported in Jackson County as of October 10,2021



Note: From Texas HHS

19.2.2 Location

The origin of pandemics is random. Although Jackson County might not be the origin of a pandemic, by definition, this hazard usually encompasses the entire globe or extensive portions of it. If a pandemic were to reach any part of the United States, it is highly likely that it would reach Jackson County due to the interconnectivity of the country, but is variable based on disease transmission type. The more densely populated areas, such as the cities of Edna, Ganado, and La Ward, would be at the greatest risk for initial transmission. Although the unincorporated areas of Jackson County are not as densely populated, the interconnectivity of the county's population both in industry and social gatherings would allow for further transmission. There are no distinct geographical boundaries for infectious diseases, therefore, they can occur throughout the planning area.

19.2.3 Frequency

The frequency of pandemics is unpredictable, but as noted by the Cleveland Clinic, intervals between pandemics are becoming shorter. A multitude of pandemics have been documented throughout human history at different severity levels. Since the turn of the 21st century, there have been multiple notable pandemics including but not limited to the 2003 SARS, 2009 Swine Flu, and COVID-19. It is expected that a pandemic will be experienced in the planning area within the next 10 years at some level of severity (see 19.2.4).

19.2.4 Severity

Pandemics have the potential to impact the planning area population as well as the economy at a variety of severity levels. From the population perspective, a pandemic can be evaluated based on the impact the disease has on those who have been infected, or the death toll to which is attributed to the pandemic. A common measure is the Pandemic Severity Index, which uses the case fatality ratio as the critical driver for categorizing the severity of a pandemic as shown in Table 19-1. This ranks a pandemic on Level 1 to Level 5, with Level 1 being least severe and Level 5 most severe. Based on the pandemic level of an area, varying non-pharmaceutical measures are suggested to mitigate transmission. These suggested measures could in turn have negative impacts on the economy such as those experienced during the start of the COVID-19 pandemic (Javaria, 2020).

TABLE 19-1.
PANDEMIC SEVERITY INDEX

Category	Case Fatality Ratio	Example
1	Less than 0.1%	Seasonal Flu
2	0.1 - <0.5%	Asian Flu and Hong Kong Flu
3	0.5 - <1%	Pandemic H1N1 (2009)
4	1.0 - <2.0%	Lassa Fever
5	2.0% or higher	1918 Flu Pandemic

Note: Data from Javaria 2020

19.2.5 Warning Time

Very little to no warning can occur during the outbreak of a pandemic. With a vastly connected globe, an infectious disease can travel throughout the world in a matter of hours.

19.3 SECONDARY HAZARDS

Beyond the actual risk of an infectious disease are many other impacts. Pandemics can cause an increase in morbidity and mortality within a population, especially for lower-income citizens. Mitigation measures can cause significant social and economic disruption leading to individual behavioral changes and negative economic growth. These hazards can have lasting implications on the society for which it affects (Madhav et al, 2017).

19.4 CLIMATE CHANGE IMPACTS

Although climate change does not have a direct impact on a pandemic, climate and natural disasters can play a role in the spread of infectious diseases. As climate change continues to increase the frequency of weather events such as hurricanes and droughts, the possibility of disease-spreading events increases. As described by Michaela Gack, Ph.D., Director, Cleveland Clinic's Florida Research and Innovation Center:

> *In some cases, it can displace certain animal species and thereby bring them in closer contact with humans, either directly with humans or via domestic animals, and this then facilitates cross-species transmission so that viruses can be transmitted from these wild animal species onto humans and thereby cause outbreaks.*

Specifically, Dr. Gack notes "in the past 20 years, several viral outbreaks have been linked to a combination of human and environmental factors, including SARS, MERS, and Ebola." (Cleveland Clinic, 2021).

19.5 EXPOSURE AND VULNERABILITY

While the entirety of the planning area is exposed to a pandemic hazard, potential loss estimates to the built environment are difficult to calculate. Generally, the most significant losses are experienced by the population and the healthcare network. The vulnerability of the population and critical facilities/infrastructure is unpredictable due to the varying nature of infectious diseases.

19.5.1 Population

It can be assumed that the entire planning area is exposed equally to the risk of a pandemic. Certain areas of higher population density have an increased risk of transmission throughout the community at a higher rate, but lower population density areas remain at equal risk of infection. The most vulnerable demographics during a pandemic will typically be the economically disadvantaged population areas, children under 16 years, and the elderly. Economically disadvantaged families and those living on a fixed income may not have the financial means to adequately deal with the effects of an event and not take the necessary steps to mitigate the spread of infectious diseases. The youth and elderly population may require further assistance as dependents if an event were to occur and tend to have weaker immune systems more susceptible to disease. Table 19-2 shows vulnerable populations per participating community.

TABLE 19-2 MOST VULNERABLE POPULATION						
Jurisdiction	Youth Population (< 16)	% of Total Population	Elderly Population (> 65)	% of Total Population	Economically Disadvantage (Income < $20,000)	% of Total Population
City of Edna	1,481	26.93%	876	15.93%	371	6.75%
City of Ganado	502	25.06%	270	13.48%	100	4.99%
City of La Ward	71	33.33%	24	11.27%	22	10.33%
Unincorporated Area	1,525	23.98%	1,143	17.97%	448	7.04%
Jackson County Total	**3,579**	25.43%	**2,313**	16.43%	**941**	6.69%

19.5.2 Critical Facilities and Infrastructure

Although all critical facilities and infrastructure in the planning area will be exposed equally to the risk of a pandemic, healthcare facilities will likely experience the greatest burden. If healthcare facilities and staff do not have the means to provide for the infected, a further loss can be experienced by the community. Other critical infrastructures may also be limited by an infectious disease event such as emergency services, utility services, water services, and telecommunications. This can be caused by a lack of staffing or supplies necessary to provide the services (Madhav et al, 2021).

19.6 FUTURE TRENDS IN DEVELOPMENT

As the population of Jackson County and its participating communities continues to increase so does the risk of transmission associate with an infectious disease. Although pandemics are unpredictable, keeping the community informed with the most up-to-date information during an event is key. One of the most cost-effective strategies for increasing pandemic preparedness is consistently investing in critical facilities and infrastructure. Creating a scalable contingency plan for future outbreaks of varying sizes and severity is ideal for planning for future pandemics.

19.7 SCENARIO

Although pandemics with lasting and extensive impacts are not common, they are possible in the planning area. A worst-case scenario would involve an extremely contagious infectious disease that infects a large portion of the planning area and world. If the disease has a high mortality rate, PSI level 5, the high death rate could cripple the local and global economy. This would in turn disrupt supply chains to the county potentially resulting in food and basic necessity shortages. Critical facilities and infrastructure could become overburden or fail. This level of event could result in lasting damage to the planning areas' population, economy, and social structure.

19.8 ISSUES

The major issues for a pandemic are the following:

- Pandemics are unpredictable and can spread fast leaving little time to react and mitigate an outbreak.
- An increase in population density and connection of population centers both economically and socially to other areas increase the possibility of transmission of an infectious disease if an outbreak occurs.
- The creation of scalable pandemic prevention and action plan for the county and participating communities is advised.

Chapter 20.
Land Subsidence

LAND SUBSIDENCE RANKING	
Jackson County	Low
City of Edna	Medium
City of Ganado	Low
City of La Ward	Medium

DEFINITIONS	
Land Subsidence	The gradual or sudden sinking of the Earth's surface due to the removal or displacement of subsurface earth materials
Sinkhole	Depression in the ground that has no natural external surface drainage – a type of land subsidence

20.1 GENERAL BACKGROUND

According to the USGS, land subsidence is the gradual or sudden sinking of the Earth's surface due to the removal or displacement of subsurface earth materials (USGS, n.d.). Land subsidence can be characterized by the gradual sinking of the Earth's surface over an extended period of time or by the sudden sinking of the Earth's surface. The two causes of subsidence are natural compression and human activity. USGS (2000) notes the following:

> *The principal causes (of land subsidence) are aquifer-system compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing permafrost (National Research Council, 1991). Three distinct processes account for most of the water-related subsidence--compaction of aquifer systems, drainage and subsequent oxidation of organic soils, and dissolution and collapse of susceptible rocks.*

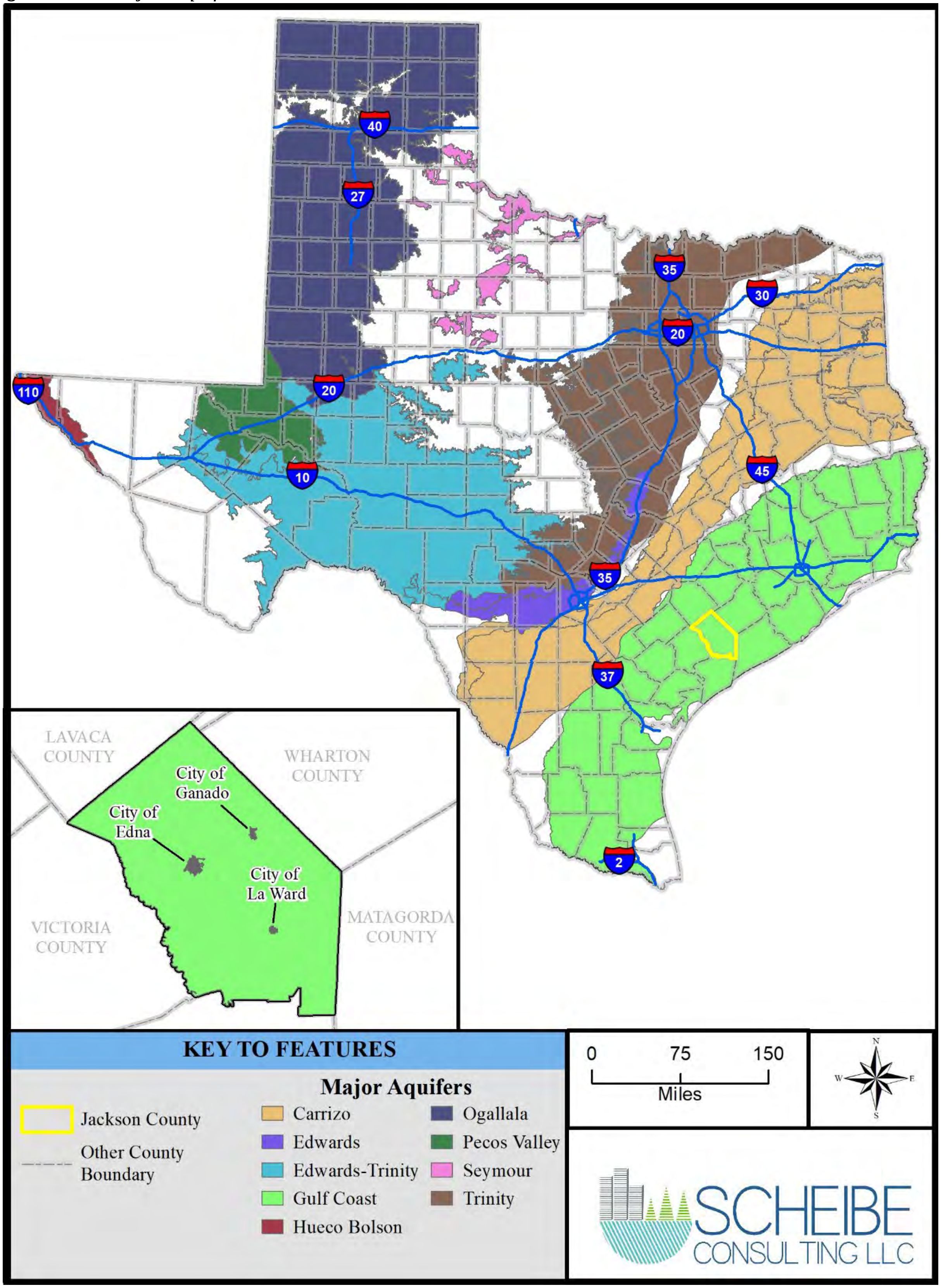
The pumping of groundwater remains the largest cause of subsidence in the United States. More than 80 percent of identified land subsidence occurrences in the United States have been caused by human interaction with subsurface water. Although aquifer systems have the ability to recharge, the excessive pumping of groundwater can lead to compaction which is largely unrecoverable (USGS, 2000). The level of depressurization that an aquifer might experience varies greatly depending on the distribution of clays and sands within an aquifer due to their grain structure (Young, et.al., 2020). Clay's compressibility is far greater than that of sand allowing for greater subsurface compression (Freeze & Cherry 1979; Domenico & Schwartz, 1990). Another attribute leading to greater subsidence levels when comparing clay and sand is the difference in porosity. Due to the higher porosity associated with clay at the time of deposition, clays can experience a greater overall reduction in porosity over time compared to sand deposits. This results in greater land subsidence in areas with large clay deposits (Young, et.al., 2020).

Another major contributor to land subsidence occurrences, specifically sinkholes, is the rock type of an area. As groundwater levels decrease from pumping and percolation increases, rock types susceptive to dissolution in water begin to form cavities. These rock cavities tend to be associated with two specific rock types: evaporites (salt, gypsum, and anhydrite) and carbonates (limestone and dolomite). Evaporites tend to form cavities in a relatively short time, a few days or years, when compared to carbonates that can take centuries to millennia to form. Approximately 40 percent of the contiguous United States (including Jackson County and participating communities) is underline with evaporites and approximately 40 percent of the United States east of Tulsa, Oklahoma consists of carbonate karst landscapes (USGS, 2000).

20.1.1 Texas Gulf Coast Aquifer

The Houston-Galveston region is one of the largest areas of land subsidence in the United States. Running parallel to the Gulf of Mexico coastline, the Texas coastal region contains the largest aquifer system in Texas stretching from the border of Louisiana to the border of Mexico. Figure 20-1 shows the Gulf Coast Aquifer expanding 41,970 square miles, encompassing 56 countries, including Jackson County (Texas Water Development Board, n.d.). Although Jackson is not affected to the extent of the Houston-Galveston metropolitan area, the county still experiences land subsidence due to the Texas Gulf Coast Aquifer.

Figure 20-1. Major Aquifers in Texas



Note: From Texas Water Development Board (n.d.)

20.2 HAZARD PROFILE

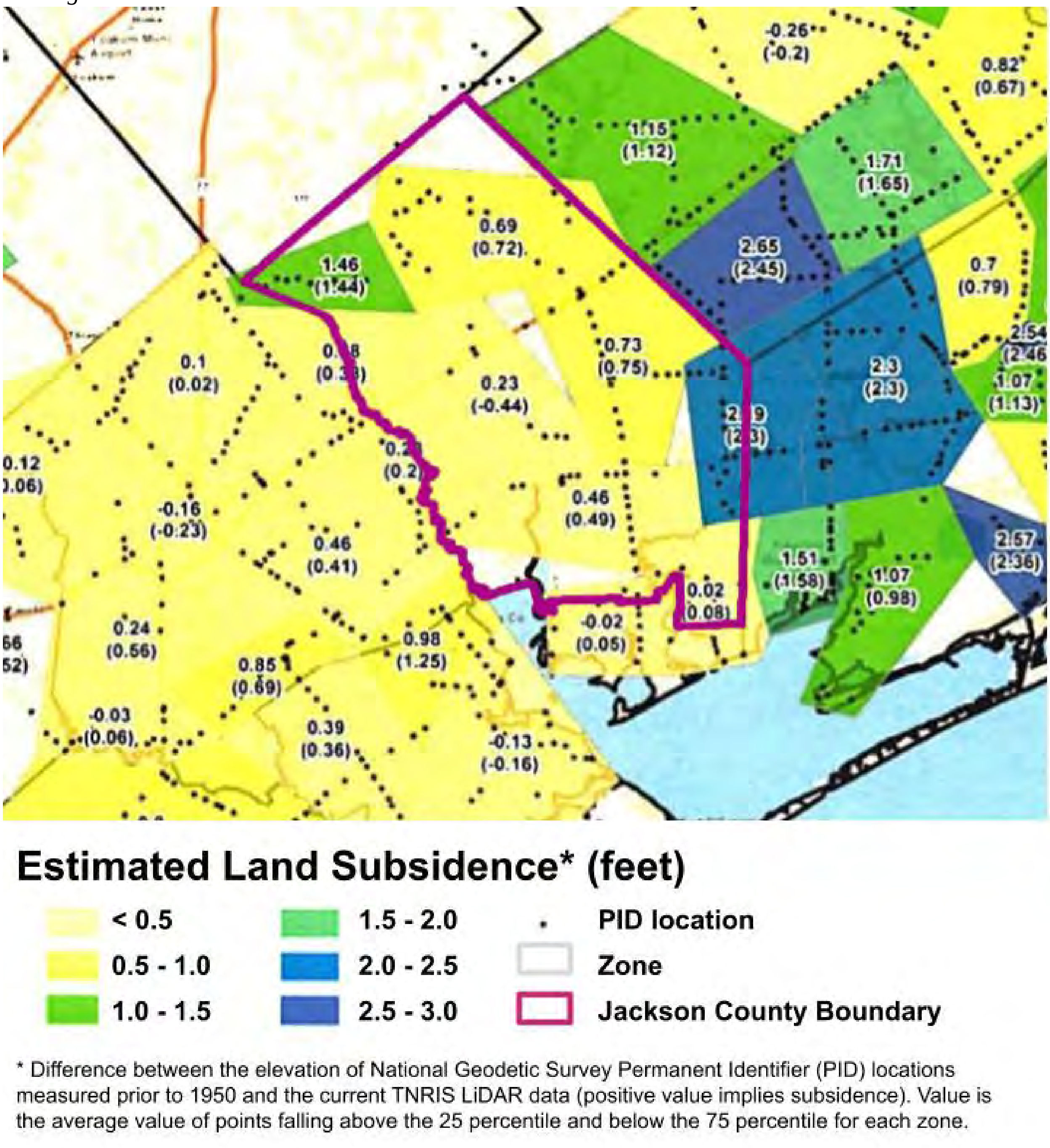
20.2.1 Land Subsidence Studies

Although land subsidence occurrences are recorded throughout the Texas Gulf Aquifer, very few studies have been conducted beyond the Houston-Galveston area. This is largely, in part, due to the level of difficulty and expense associated with these studies. One study by Ratzlaff (1982) noted land subsidence from 1918 to 1973 in Jackson County and neighboring counties as generally less than 0.5 ft or 0.15 m. In particular, Ratzlaff (1982) documented 1.5 feet or 0.46 meters of land subsidence had occurred in the southeastern portion of Jackson County from 1943 to 1973. Ratzlaff concluded that the main cause of land subsidence in this area was the result of groundwater withdrawals.

Another study concluded that approximately 2 feet of land subsidence had occurred in the town of Francitos near the eastern Jackson County border with Wharton County between 1935 and 1973, with 1.7 feet occurring between 1952 and 1973. This study noted the close relationship between the historical increases in groundwater pumping and land subsidence.

A study conducted by Young (2016) indicated at least 2 ft of land subsidence had occurred over a more than 50-year time period in Jackson County. This was determined when comparing photoionization detector (PID) data collected prior to 1950 and LIDAR surveys collated after 2006. Figure 20-2 displays the "estimated average land subsidence from before 1950 to after 2003 for specific polygons as determined by the difference between ground surface elevation from PIDs surveyed prior to 1950 and from LIDAR surveys after 2006 at the locations of the PIDs. Land subsidence values are expressed as averages and medians (in parenthesis) of the differences calculated at PIDs located inside the polygons. Positive values indicate lower ground surface elevation at a later time. Negative values indicate higher ground surface elevations at a later time" (Young, 2016).

Figure 20-2. Estimates of Land Subsidence Rates in Jackson County Based on the Analysis of Remote Sensing Data



Note: From Young (2016)

20.2.2 Location

Jackson County and the participating communities are susceptible to land subsidence. Although most of the land subsidence occurrence in Jackson County is characterized as a slow process and goes largely unnoticed, gradual land subsidence in Jackson County remains an issue.

20.2.3 Frequency

Gradual land subsidence remains an issue throughout Jackson County as it is a natural process that can be exasperated by human activity. As noted by Young (2016), concerns for continual land subsidence are warranted due to the high rate of annual groundwater pumping over the last 40 years. Also, it is likely more time is needed for the clay beds of the aquifers to respond to drawdown time and become consolidated therefore stabilizing. With documented land subsidence in Jackson County and participating communities since before 1950, the probability of future land subsidence in the planning area is high (probable in the next 10 years).

20.2.4 Severity

The magnitude and severity of land subsidence in Jackson County and the participating communities are largely related to the extent and location of the areas that are impacted. Although no sudden land subsidence events are documented these events can cause property damage as well as loss of life. Events may also occur in remote areas of the planning area where there is little to no impact on people or property. If subsurface conditions remain stable, future events can be assumed to be similar in extent and severity as previous events in the area.

20.2.5 Warning Time

Generally, land subsidence occurs over an extended period of time, going largely unnoticed; however, sudden land subsidence can occur with little to no warning. Although naturally occurring, these processes may be intensified as a result of human activities, mainly groundwater pumping. There is very little to no warning for land subsidence events.

20.3 SECONDARY HAZARDS

Events that cause damage to developed areas can result in secondary hazards, such as explosions from natural gas lines, loss of utilities, such as water and sewer due to shifting infrastructure, and potential failures of reservoir dams. Water and sewer damage can lead to groundwater contamination risking environmental health and safety. Over time land subsidence may cause changes in elevation and slope of waterways reducing or hindering drainage capacity of an area causing excessive flooding; damage public infrastructure such as roadways, bridges, and railways hindering emergency operations; and damage public and private buildings causing foundation issues or lowering finished floor elevations, resulting in higher flood hazards (Leake, 2016).

20.4 CLIMATE CHANGE IMPACTS

In areas where climate change results in less precipitation and reduced surface-water supplies, communities will pump more groundwater. Changes in precipitation events and the hydrological cycle may result in changes in the rate of subsidence. The reduction of surface water will likely coincide with a population increase and a rise in potable water supply demand. As groundwater pumping levels rise, land subsidence rates will likely increase due to the high correlation noted between groundwater pumping levels and land subsidence.

20.5 EXPOSURE

While all structures and populations are exposed to land subsidence in Jackson County, the extent of land subsidence varies. Table 20-1 lists the exposed population and structure count for each participating jurisdiction.

20.5.1 Population

It can be assumed that the entire planning area is exposed to some extent to land subsidence. Certain areas are more exposed due to geographic location and human activity. Current growth trends could cause more planning area residents to be exposed to land subsidence. Increased population will increase demands on structure development, as well as sub-surface water use which may lead to higher land subsidence rates.

20.5.2 Property

According to the HAZUS-MH inventory data (updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs), there are 6,626 buildings within the census blocks that define the planning area with an asset replaceable value of almost $1.4 billion (excluding contents). About 93% of these buildings (and 72% of the building value) are associated with residential housing. Other types of buildings in this report include agricultural, education, religious, and governmental structures. See hazard loss tables for community-specific total assessed numbers (e.g. Table 20-3). Table 20-1 lists the exposed structures and population for the participating communities. All structures within the planning area are considered to be exposed to land subsidence.

TABLE 20-1
EXPOSED STRUCTURES AND POPULATION

Jurisdiction	Residential	Commercial	Other *	**Total Structures**	**Total Population**
City of Edna	2,143	133	100	**2,376**	**5,499**
City of Ganado	657	34	17	**708**	**2,003**
City of La Ward	88	6	6	**100**	**213**
Unincorporated Area	3,256	82	104	**3,442**	**6,360**
Jackson County Total	**6,144**	**255**	**227**	**6,626**	**14,075**

Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.

20.5.3 Critical Facilities and Infrastructure

All critical facilities are considered exposed to land subsidence. Several major roads are available to move people and supplies throughout the region. Damage to these roads and other infrastructure could hinder emergency services and affect public health and safety.

20.5.4 Environment

The environment is highly exposed to land subsidence. Natural habitats can experience major damage and destruction during land subsidence events.

20.6 VULNERABILITY

Jackson County and participating communities have a high risk from land subsidence as studies have recorded continual subsidence in the area since the 1950s. For the specific rankings given to each entity, see ranking tables in chapter 22. Because land subsidence cannot be directly modeled in HAZUS-MH, annualized losses were estimated using GIS-based analysis, historical data analysis, and statistical risk assessment methodology. Event frequency, severity indicators, expert opinions, and historical local knowledge of the region were used for this assessment.

20.6.1 Population

The risk of injury or fatalities as a result of this hazard is limited but possible. The most vulnerable demographics will be the economically disadvantaged population areas, children under 16 years of age, and the elderly. Economically disadvantaged families and those living on a fixed income may not have the financial means to adequately deal with the effects of an event and make the necessary structural improvements. The youth and elderly population may require further assistance as dependents if an event were to occur. Table 20-2 shows all vulnerable populations per participating community.

TABLE 20-2
MOST VULNERABLE POPULATION

Jurisdiction	Youth Population (< 16)	% of Total Population	Elderly Population (> 65)	% of Total Population	Economically Disadvantage (Income< $20,000)	% of Total Population
City of Edna	1,481	26.93%	876	15.93%	371	6.75%
City of Ganado	502	25.06%	270	13.48%	100	4.99%
City of La Ward	71	33.33%	24	11.27%	22	10.33%
Unincorporated Area	1,525	23.98%	1,143	17.97%	448	7.04%
Jackson County Total	**3,579**	**25.43%**	**2,313**	**16.43%**	**941**	**6.69%**

20.6.2 Property

All properties are at some level of risk from land subsidence, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Generally, the damage is minimal and goes unreported.

Loss estimations for land subsidence hazards are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing projected damages (annualized loss) on exposed values. Historical events, statistical analysis, and probability factors were applied to the counties and communities exposed values to create an annualized loss. Table 20-3 lists the property loss estimates for each participating community compared to the exposed value including structure and content. Annualized losses of ‘negligible’ are less than $50 annually. The Negligible loss hazards are still included despite minimal annualized losses because of the potential for a high-value damaging event.

TABLE 20-3
LOSS ESTIMATES FOR LAND SUBSIDENCE EVENTS

Jurisdiction	Exposed Value	Annualized Loss	Annualized Loss Percentage
City of Edna	$873,172,834	Negligible	Negligible
City of Ganado	$253,570,646	Negligible	Negligible
City of La Ward	$27,144,277	Negligible	Negligible
Unincorporated Area	$1,215,680,242	Negligible	Negligible
Jackson County Total	**$2,369,568,000**	**Negligible**	**Negligible**

Vulnerability Narrative

All participating communities are at risk of land subsidence. Table 20-1 lists the exposed structures and population for each participating community. Table 20-2 lists the vulnerable population per community. As the population of the unincorporated areas of Jackson County continues to increase, vulnerability to land subsidence events will increase.

Community Perception of Vulnerability

See the front page of the current chapter for a summary of hazard rankings for Jackson County and participating communities in this HMP update. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

20.6.3 Critical Facilities and Infrastructure

Damage to roadways and structures poses the greatest issue for critical facilities and infrastructure operations. Of particular concern are roads providing access to vulnerable populations and critical facilities. Severe damage to major routes can disrupt the shipment of goods and other commerce as well as emergency functions. Damage to certain facilities could cause prolonged impacts on the planning area.

20.6.4 Environment

The vulnerability of the environment to land subsidence is the same as the exposure, discussed in Section 20.5.4.

20.7 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by land subsidence. The vulnerability of community assets to land subsidence is increasing over time as more people enter the planning area. The ability to withstand impacts lies in sound land-use practices. Future coordination with groundwater districts will help to monitor and mitigate the effects of land subsidence on new structures. This will allow the communities to deal with future growth and the associated impacts of land subsidence.

20.8 SCENARIO

Although sudden land subsidence events are infrequent, impacts can be significant. A worst-case event would involve a large, sudden land subsidence event in a populated area. Such an event could lead to the instantaneous loss of life and property. If a major roadway were to be involved in such an event, emergency operations and supply chains could be hindered rustling in further risks to public health and safety. Damage to subsurface infrastructure could hinder water, electric, sewer, and gas supply to portions of the planning area. Damage to this infrastructure could also lead to the contamination of the water supply resulting in long-lasting impacts.

20.9 ISSUES

Important issues associated with land subsidence in the planning area include the following:

- Rising rates of land subsidence are in many cases closely related to changes in groundwater pumping rates. Groundwater interaction (drawdown and recharge) should be closely monitored.
- A more detailed analysis should be conducted for critical facilities and infrastructure within the planning area regarding land subsidence. The analysis should address how potential structural issues were addressed in facility design and construction.
- Continue monitoring the subsidence and determine if new, more stringent flood standards are needed to be set to mitigate for added flood risk.

Chapter 21.
Hazardous Materials

HAZARDOUS MATERIALS RANKING	
Jackson County	
City of Edna	
City of Ganado	
City of La Ward	

DEFINITIONS	
Hazardous Materials	Matter (solid, liquid, or gas) or energy that when released is capable of creating harm to people, the environment, and property, including weapons of mass destruction

21.1 GENERAL BACKGROUND

According to the NFPA, a hazardous material (HAZMAT) is defined as "matter (solid, liquid, or gas) or energy that when released is capable of creating harm to people, the environment, and property, including weapons of mass destruction" (FEMA, 2019). HAZMAT incidents can cause significant impacts such as death, long-lasting health effects, or damage to buildings, infrastructure, and the environment.

HAZMATs vary greatly in the types of health risks they pose to humans, according to FEMA (2019). The risk to human health can vary from thermal, radiological, asphyxiation, chemical, etiological (biological), and mechanical harm:

- Thermal harm results from exposure to temperature extremes.
- Radiological harm results from exposure to radioactive materials.
- Asphyxiation results from exposure to materials that reduce oxygen levels that may cause suffocation.
- Chemical harm results from exposure to chemicals, including poison and corrosives.
- Etiological (Biological) harm results from exposure to biological materials, which include bacteria, viruses, and biological toxins.
- Mechanical harm results from exposure to, or contact with, fragmentation or debris scattered because of pressure release, explosion, or boiling liquid expanding vapor explosion.

HAZMAT incidents can happen during production, storage, transportation, use, or disposal (Atlantic Beach Official Website, 2021). During transportation, the method of transport could become involved in a traffic accident that would cause the material to be released. HAZMATs can also be released while being stored and handled due to poor packaging and nonsecure transportation.

21.2 HAZARD PROFILE

HAZMAT incidents can be a secondary hazard to natural hazard events such as floods, hurricanes, tornadoes, and earthquakes. Not only can these hazards cause an incident, but they can also hinder response efforts. In the case of Hurricane Floyd in September 1999, communities along the Eastern United States were faced with flooded junkyards, disturbed cemeteries, deceased livestock, floating propane tanks, uncontrolled fertilizer spills, and a variety of other environmental pollutants causing widespread concern.

Weather conditions will directly affect how a HAZMAT incident develops. The micro-meteorological effects of buildings and terrain can alter the travel and duration of agents. Non-compliance with fire and building codes, as well as failure to maintain existing fire and containment features can substantially increase the damage from a HAZMAT release. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind, and wildlife. These factors contribute to the importance of maintaining an effective response team at all times.

Commercial Facilities Hazard

The EPA regulates hazardous chemicals used in commercial facilities and sets the limits of exposure to hazardous materials within the workplace. Chemical manufacturing, metal production, metal fabrication, and petroleum processing are four industries "responsible for approximately 90% of all industrial materials and waste generated", including hazardous materials (Eastern Kentucky University, 2020). Exposure to hazardous materials at these facilities comes in four forms (gases or vapors, liquids, dust, and solids) and can result in a variety of health issues or even death. In the event of a spill, leak, or exposure, appropriate safety equipment should be utilized to mitigate the effects.

Some HAZMATs are not as heavily regulated but can be just as dangerous under the right conditions. Ammonium nitrate, a chemical commonly used as fertilizer, is non-reactive under most conditions; however, when stored improperly can become destructive. When exposed to extreme heat, ammonium nitrate can be destabilized and make a fire burn even hotter or cause an explosion. If the destabilized chemical were confined or contaminated, there is a greater risk of explosion (Wertz, 2020).

Two incidents of note are the Beirut, Lebanon storage facility explosion and the West, Texas fertilizer plant explosion were directly caused by the chemical ammonium nitrate:

In the port city of Beirut, on August 4, 2020, the improper storage of ammonium nitrate led to a major explosion. The explosion killed over 200 people and destroyed over 77,000 homes. The damage resulted in major, long-lasting critical infrastructure damage as well as the city and countries economy. (Fakih, 2021). The United National Development Program has estimated that the cost of cleaning up the environmental degradation from the explosion will be over $100 million.

In West, Texas on April 17, 2013, an explosion occurred at the West Fertilizer Company. A fire started at the plant leading to an explosion of the ammonium nitrate storage. The explosion resulted in 15 deaths, approximating 200 injuries, and 350 damaged homes. Local community structures, as well as private residents, were heavily damaged or destroyed during the explosion leading to long-lasting impacts on the community (ABS Consulting, 2015).

Nuclear Power

The EPA as well as the Nuclear Regulatory Commission regulate the functioning of nuclear power plants and the hazardous materials used at such facilities. These entities set high standards for the operation of facilities that use radioactive material in order to protect employees, surrounding communities, and the environment.

Located to the southeast of Jackson County is the South Texas Project (STP) Nuclear Operating Company. The facility sits on approximately 12,220 acres in Matagorda County. This site operates two units producing large amounts of clean electricity for the state of Texas. During normal operation, there is an extremely minimal amount of radiation released. For instance, if a person were to stand at the South Texas Project Boundary for one year, they would receive an additional 0.06 Millirem (mR) of radiation when compared to the average amount received during a year for a U.S. citizen. This is extremely low compared to the 5-13 mR of radiation exposure received from consumer products per year for the average U.S. citizen.

The possibility of a major nuclear accident is extremely low but not impossible. Few historical examples of nuclear power plant failure exist, but their occurrence and resulting impacts are devastating to local communities and the environment. Such as in the case of Chernobyl in April 1986, a nuclear accident could lead to injury or death of local citizens and wildlife. Such accidents have the potential to also create inhabitable areas which can take decades to recover.

The local nuclear plant, STP, has three separate barriers in place to protect against radiation release. The facility also goes above and beyond the requirements set by the EPA and Nuclear Regulatory Commission to ensure the safe operation and containment of hazardous materials. STP has established a 10-mile emergency planning zone in the event an incident may occur. No portion of Jackson County falls within this planning zone. For more information in regard to emergency operations for STP please refer to the Safety Takes Preparedness document and the STP website.

Solar Farms Hazard

Solar farms expose the environment to multiple hazardous materials. The panels used to convert sunlight to electricity utilize toxic materials that can be leached into the environment. Issues may arise from the disposal of old solar modules. The Electric Power Research Institute conducted a study on solar panels which concluded that the disposal of solar panels in landfills is not recommended due to the potential for modules to break causing a release of toxic materials into the environment, specifically the soil). Solar panels often contain lead, cadmium, and other toxic chemicals which can leach into the environment unless disposed of properly when broken or once the end of their lifecycle has been reached (Shellenberger, 2019). Several solar farms are in the development stage within the planning area but cannot be shown due to proprietary nature of these developments that are not yet complete.

Lithium Battery Storage

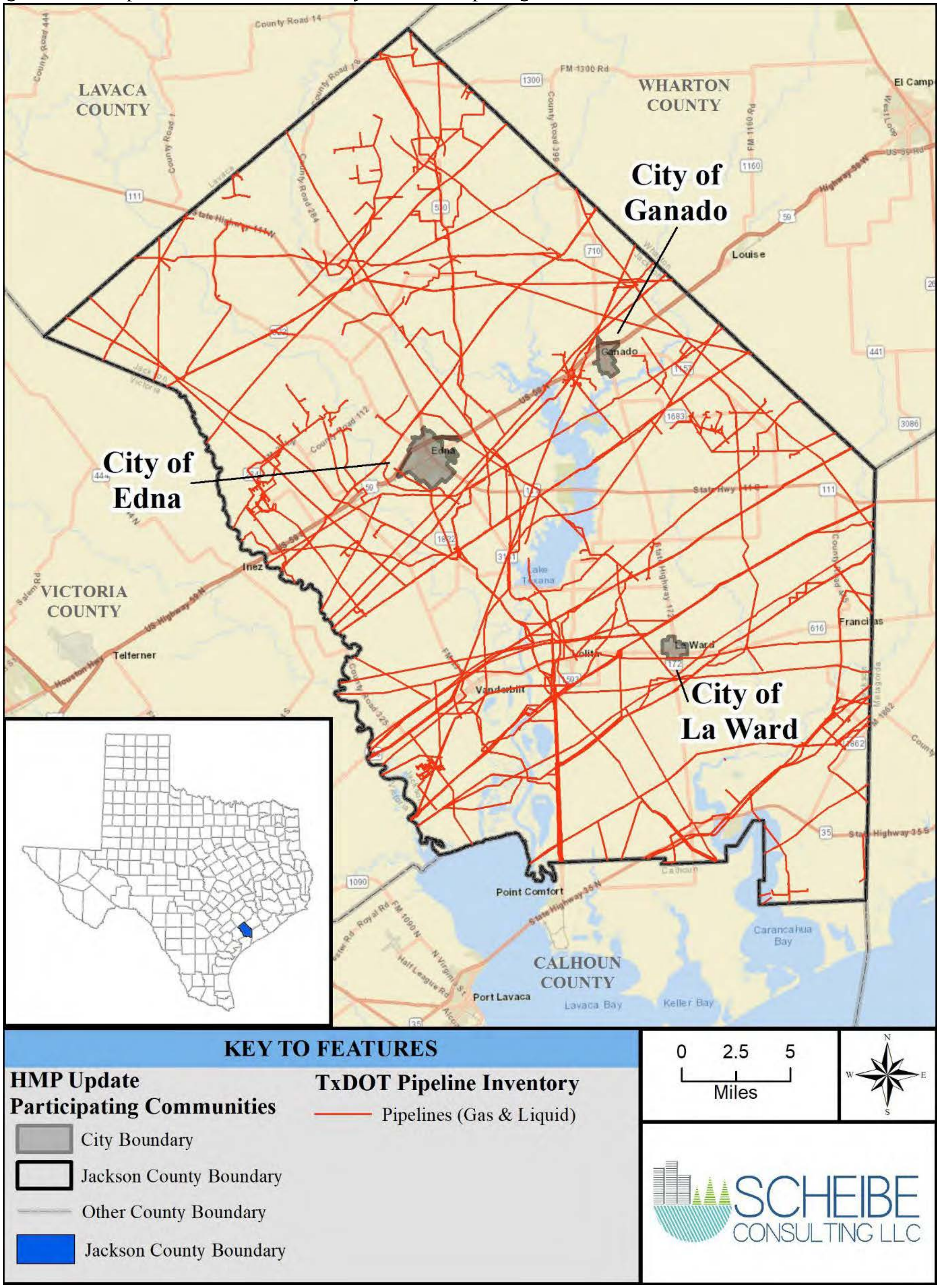
Lithium batteries are considered hazardous material and must be transported following regulations established by the U.S. Department of Transportation's Hazardous Materials Regulations. Lithium-ion batteries contain highly flammable solvents separated by a thin plastic film (Phelan, 2020). If there is an issue with the plastic film and the solvents combine, a fire or explosion can occur, potentially releasing toxic gases.

Pipeline Hazard

The Pipeline and Hazardous Materials Safety Administration (PHMSA) regulates and ensures the safe and secure movement of hazardous materials through pipelines (PHMSA, 2021). Many factors can contribute to pipeline safety issues such as "manufacturing issues, external weather and environmental issues, and age-related integrity issues" (PHMSA, 2019). Hazardous liquid lines transport crude oil, refined liquid product, liquid carbon dioxide, liquid anhydrous ammonia, and highly volatile liquids. Pipelines also sever as the major mode of transportation for natural gas as well as other hazardous gases in the United States.

These pipelines create a web throughout the United States spanning approximately 2.6 million miles with diameters ranging from 2 to 48 inches. According to the PHMSA, "43 percent of all hazardous liquid pipelines were installed prior to 1970". In recent decades, many improvements have been made to pipeline manufacturing and construction. Pipelines constructed prior to 1970 are "vulnerable to seam-quality issues" (PHSMA, 2019). The transportation of HAZMATs through pipelines is considered low risk for an exposure incident but can result in high consequences should an incident occur. Figure 21-2 identifies the locations of all pipelines in Jackson County according to Texas Department of Transportation (TxDOT) records. These records identified approximately 964 miles of liquid transmission pipeline and 1,084 miles of gas transmission pipelines are within Jackson County.

Figure 21-2. Pipelines in Jackson County and Participating Communities

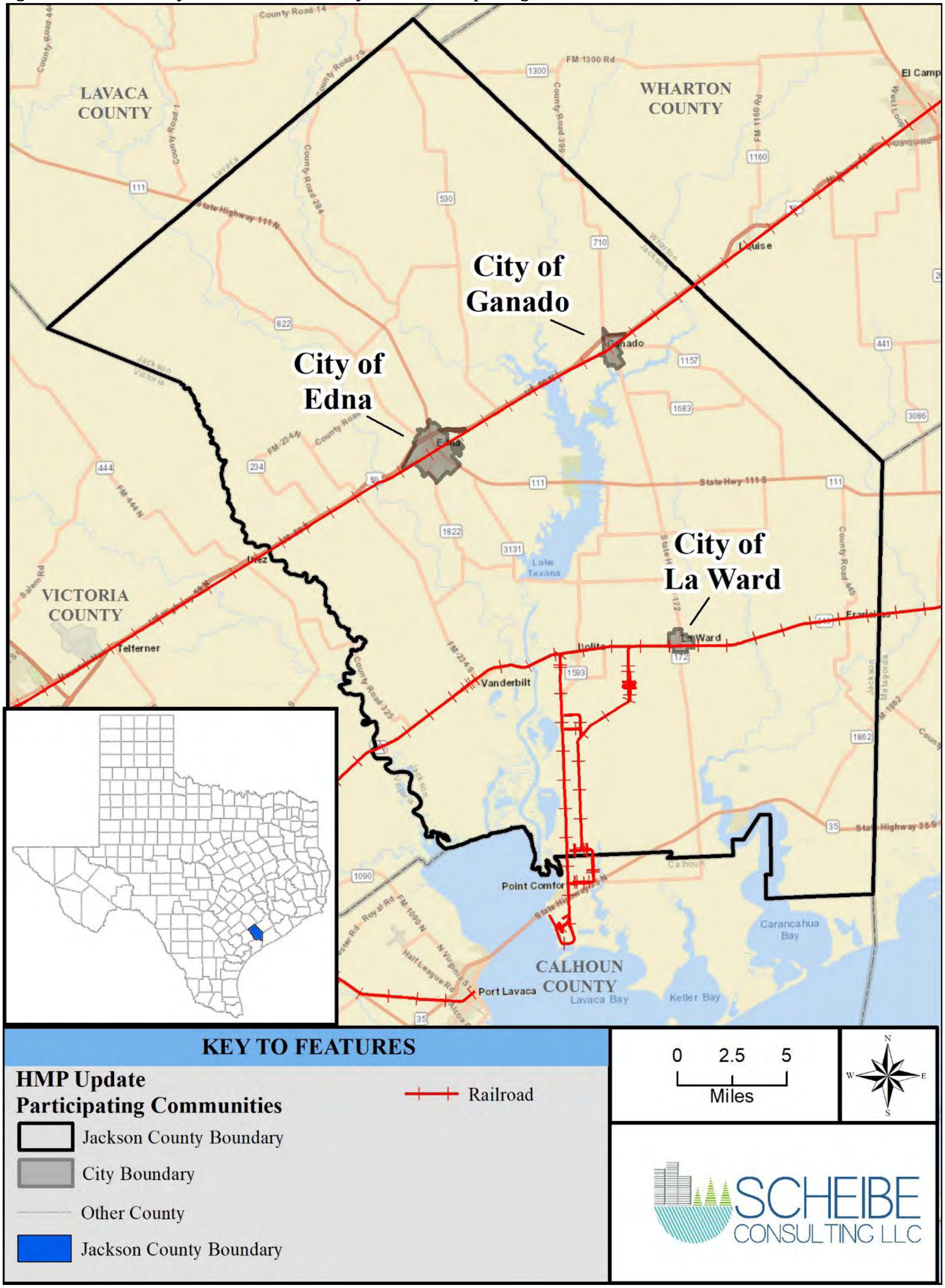


Note: From TxDOT

Railway Hazard

Railways are often used for the transport of HAZMATs due to their high level of safety as a mode of transportation. According to the Federal Railroad Administration (FRA), from 1994 to 2005, 116 fatalities occurred due to hazardous materials released in highway accidents whereas only 14 fatalities occurred due to hazardous material released in railroad accidents (2020). The FRA administers and oversees the movement of hazardous materials. When HAZMATs are transported over railways, a range of safety measures are taken, ranging from "special train formations, improved maintenance of vehicles and track, routing away from heavily populated areas and special handling and security" (IRSC, n.d.). Accidents involving trains carrying HAZMATs can result in toxic spills, most of which are caused by derailed trains. Trains don't carry passengers when they carry HAZMATs, so spills mostly affect those who live in the community where the spill occurs (Pottroff & Karlin, 2021). Figure 21-3 displays the locations of the railways that run through Jackson County.

Figure 21-3. Railways in Jackson County and Participating Communities



21.2.1 Past Events

Jackson County has experienced 13 incidents from 1990 to 2021, five of which are classified as serious HAZMAT incidents according to the PHMSA database. This database classifies a serious incident includes:

- a fatality or major injury caused by the release of hazardous material
- the evacuation of 25 or more employees or responders or any number of the general public as a result of the release of a hazardous material or exposure to fire
- a release or exposure to fire which results in the closure of a major transportation artery
- the alteration of an aircraft flight plan or operation
- the release of radioactive materials from Type B packaging
- the suspected release of Risk Group 3 or 4 infectious substance
- the release of over 11.9 gallons or 88.2 pounds of a severe marine pollutant
- the release of a bulk quantity (over 119 gallons or 882 pounds) of hazardous material.

The five serious HAZMAT events in the planning area are as follows:

- On January 8, 1990, a car was involved in a train derailment caused by a failed roller bearing near Vanderbilt, TX. Some material was transferred to hoppers and returned to the shipper for reconditions. The remaining materials were sold to a salvage buyer "as is, where is". The salvage buyer then transferred material to covered hoppers for transport. The material was spilled on the ground when taken to the landfill for disposal. The car rolled over and came to rest with the manway facing the ground. A small fire under the fitting burned away a gasket on a liquid line flange. When the car was rolled upright the leak stopped. A new gasket was installed in the flange. In another car, the handle on the liquid valve was turned slightly when the car rolled causing a small leak the valve was closed, and the handle was removed for safety. The plug was also tightened. This was classified as a serious bulk release.
- On May 16, 1991, a train derailed south of Vanderbilt, TX. Union Pacific personnel responded and found a tank car had left the track and was struck by an unknown object which tore away a small portion of the jacket (approximately 18" in diameter). The object also dented the tank shell and head on the A end where they were welded together. No gouging occurred and no metal was removed. However, the weld between the head and fire ring cracked and allowed the product to escape (crack measure about 4"). The tank car was lying with the protective housing toward the ground. Although the crack was at the 9 o'clock position, the point of damage was on the ground. Water was pumped into the car to stop the product from leaking. Other railcars were removed from the tank car. Once removed, the car was rolled upright and the product burned in a flare operation. The car was filled with water to force any remaining nitrogen. The tank car was then filled with nitrogen at atmospheric pressure and sent for repair. This was classified as a serious bulk release and serious evacuations.
- On December 12, 2006, a tractor-tanker unit was involved in an accident while traveling on FM3131 and Highway 172 in Ganado, TX. The tractor-tanker unit overturned and end up in a roadside ditch. The accident caused a small puncture in the center of the tanker resulting in a leak of approximately one quart of diesel fuel. The Texas Highway Patrol, Jackson County Hazmat Team, Ganado Fire Department, and Praxair, Inc.-NAIG Liquid Bulk Distribution Emergency Response Team responded

to assess the site. Ganado Fire Department personnel performed the cleanup of the diesel fuel using absorbent pads. The tanker was uprighted and the Praxair, Inc.-NAIG Liquid Bulk Distribution Emergency Response Team vented the remaining product inside of the tanker. No injuries or exposures were reported as a result of the hazardous material. This was classified as a serious bulk release resulting in a major artery closed.

- On June 16, 2008, a tractor-tanker traveling north of Highway 59 in Edna, TX. They were involved in a rollover when trying to reverse. The left tires fell into a ditch on 700 block of Elm Street, leaving the tractor and trailer laying on their side. The fire department and highway patrol responded to the scene. The fire department blocked off all roads near the accident and evacuated 1 block around the accident for approximately 5 hours. Fire Marshal 1 reported no injuries and no hazardous materials leaks. Dirt was left on oil and diesel to absorb materials. The tractor and trailer were pulled off by a wrecker service. This was classified as an event causing serious evacuations and closure of a major artery.
- On September 17, 2017, an Atlas Oil Transport truck and a third-party were traveling southeast on State Highway 111 near Edna, TX. The third-party was attempting to turn left on CR 283 and Atlas Oil Transport truck attempted to pass it (legally). The vehicles struck each other causing a puncture on the right side of the tank. This caused a crude oil release of approximately 2,300 gallons in a ditch. This was classified as a serious bulk release.

21.2.2 Location

Figure 21-4 shows the hazardous materials facilities in Jackson County. This list was compiled with the use of the HAZUS-HM inventory system as well as local knowledge. Undocumented hazardous materials storage may be located in the planning area at locations not identified in Figure 21-4. Hazardous materials may also travel throughout the planning area via railroads, pipelines, or roads.

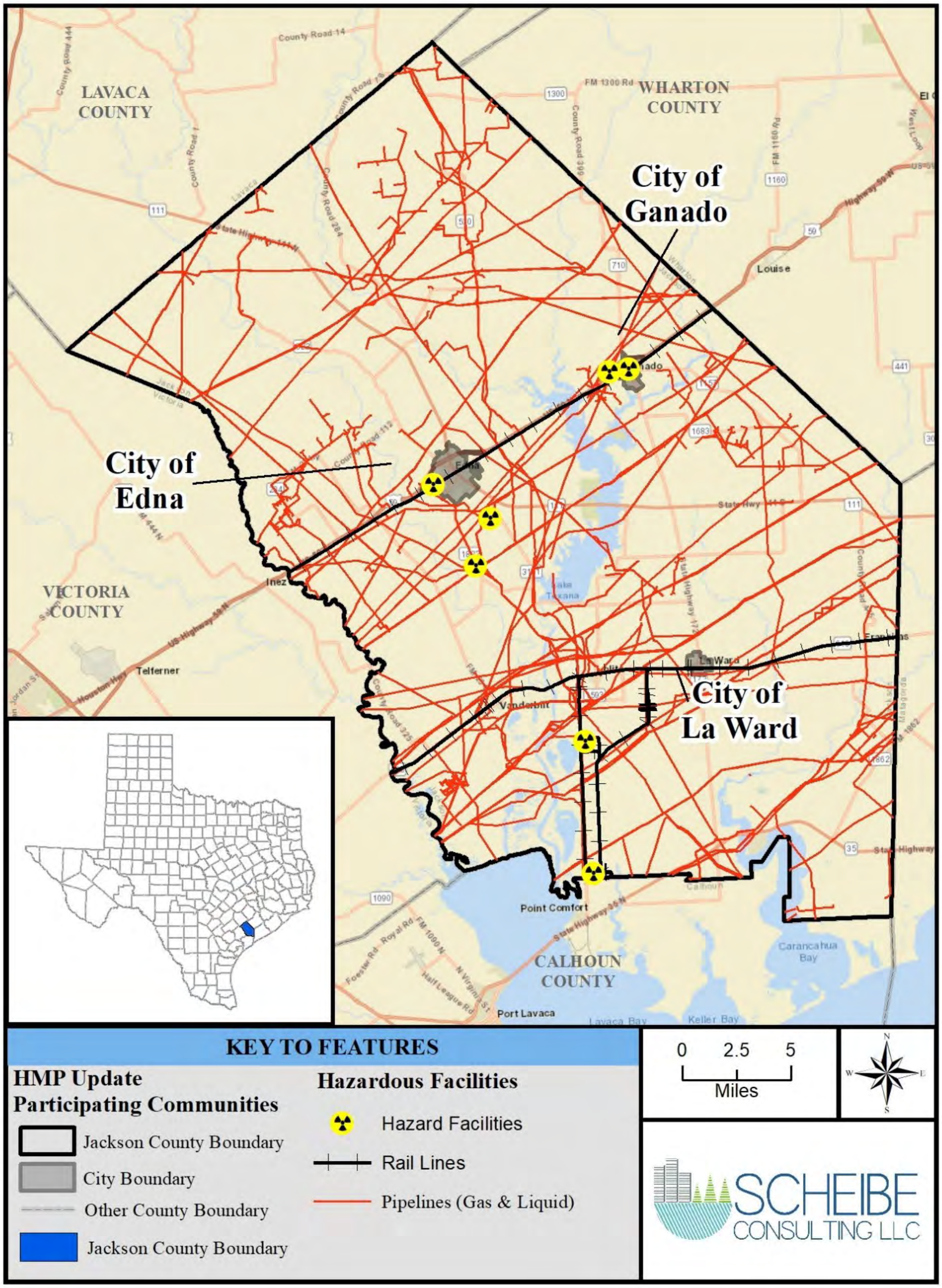


Figure 21-4. HAZMAT Facilities in Jackson County and Participating Communities

21.2.3 Frequency

Based on historical occurrence data provided by PHMSA, it can be expected that a HAZMAT incident will occur somewhere in the county every 2 to 3 years, most likely linked to a transportation incident. Specifically, the Jackson County Unincorporated area and the City of Edna can expect an event approximant once every 6 years. Both areas are classified with a “High” probability of occurrence. The City of Ganado is classified as having a “Medium” probability of occurrence and can expect an event once every 11 years. The City of La Ward is classified as “Low” probability of occurrence due to lack of historic events but still is considered probable due to its exposure level.

21.2.4 Severity

HAZMAT spills or toxic releases can have a substantial impact. Such events can cause multiple deaths, completely shut down facilities for 30 days or more, and cause more than 50 percent of affected properties to be destroyed or suffer major damage. Shielding in the form of sheltering-in-place can protect people and property from harmful events. Long-term effects can also result from releases in the form of contamination to land, soil, and groundwater. The impacts associated with incidents are highly dependent upon the product being transported. A release of hazardous materials could endanger lives and cause damage to property in the immediate area (within less than a half-mile radius).

21.2.5 Warning Time

Warning time for hazardous materials incidents is minimal to none. There are, however, more long-term and gradual releases which should be expected with different facility types and monitored.

21.3 SECONDARY HAZARDS

Hazardous materials spills and leaks can pollute waterways exposing fish to toxic chemicals causing immediate death or long-term disease. Spills can also negatively impact the growth of other aquatic life, destroying plant habitats and food sources. Common secondary hazards associated with toxic releases and hazardous materials include:

- Water quality
- Fire
- Air quality
- Public Health
- Agricultural Operations

21.4 EXPOSURE

All of Jackson County is exposed to HAZMATs, however, those closest to the storage facilities, the nuclear plant, and solar farms, as well as those along the railways, highways, and pipelines, face a greater risk of exposure. An analysis was conducted to identify population and property within a half-mile radius of all documents hazardous materials locations (See Tables 21-2 through 21-6).

21.4.1 Population

It can be assumed that the entire planning area population may be potentially exposed to hazardous materials. Certain areas are at a higher risk of exposure due to their location near HAZMAT facilities (See Tables 21-2 through 21-6).

21.4.2 Property

According to the HAZUS-MH system inventory data (updated with 2010 U.S. Census data and 2018 RS Means Square Foot Costs), there are 6,626 buildings within the census blocks that define the planning area with an asset replaceable value of $1.4 billion (excluding contents). About 93% of these buildings (and 79% of the building value) are associated with residential housing. Other types of buildings in this report include agricultural, education, religious, and governmental structures. See hazard loss tables for community-specific total assessed numbers (e.g., Table 21-8). Table 21-1 list the exposed structures and population for the participating communities.

TABLE 21-1
EXPOSED STRUCTURES AND POPULATION

Jurisdiction	Residential	Commercial	Other *	**Total Structures**	**Total Population**
City of Edna	2,143	133	100	**2,376**	**5,499**
City of Ganado	657	34	17	**708**	**2,003**
City of La Ward	88	6	6	**100**	**213**
Unincorporated Area	3,256	82	104	**3,442**	**6,360**
Jackson County Total	**6,144**	**255**	**227**	**6,626**	**14,075**

Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.

Although all structures within the planning area are considered at risk to HAZMAT incidents, those located near the HAZMAT facilities and along railways, major roads, and pipelines have a greater risk of exposure. Tables 21-2 through 21-5 list the exposed structures and population within a half-mile radius of storage/commercial facilities, pipelines, railways, and major roadways.

TABLE 21-2 EXPOSED STRUCTURES AND POPULATION WITHIN A HALF-MILE RADIUS OF STORAGE/COMMERCIAL FACILITIES					
Jurisdiction	Residential	Commercial	Other *	**Total Structures**	**Total Population**
City of Edna	316	15	20	**351**	**918**
City of Ganado	584	32	17	**633**	**1605**
City of La Ward	0	0	0	**0**	**0**
Unincorporated Area	209	12	5	**226**	**518**
Jackson County Total	**1109**	**59**	**42**	**1210**	**3,041**
Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.					

TABLE 21-3 EXPOSED STRUCTURES AND POPULATION WITHIN A HALF-MILE RADIUS OF PIPELINES					
Jurisdiction	Residential	Commercial	Other *	**Total Structures**	**Total Population**
City of Edna	194	6	9	**209**	**534**
City of Ganado	67	1	0	**68**	**236**
City of La Ward	67	6	6	**79**	**155**
Unincorporated Area	2,388	63	83	**2,534**	**4,916**
Jackson County Total	**2,716**	**76**	**98**	**2,890**	**5,841**
Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.					

TABLE 21-4 EXPOSED STRUCTURES AND POPULATION WITHIN A HALF-MILE RADIUS OF RAILWAYS					
Jurisdiction	Residential	Commercial	Other *	**Total Structures**	**Total Population**
City of Edna	1,205	98	66	**1,369**	**3,244**
City of Ganado	466	24	15	**505**	**1,283**
City of La Ward	82	6	6	**94**	**194**
Unincorporated Area	634	22	19	**675**	**1,577**
Jackson County Total	**2,387**	**150**	**106**	**2,643**	**6,298**
Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.					

TABLE 21-5 EXPOSED STRUCTURES AND POPULATION WITHIN A HALF-MILE RADIUS OF MAJOR ROADWAYS					
Jurisdiction	Residential	Commercial	Other *	**Total Structures**	**Total Population**
City of Edna	1,951	126	94	**2,171**	**4,959**
City of Ganado	657	34	17	**708**	**1,829**
City of La Ward	83	6	6	**95**	**199**
Unincorporated Area	742	23	12	**777**	**1,513**
Jackson County Total	**3,433**	**189**	**129**	**3,751**	**8,500**
Note: *Other includes industrial, agricultural, religious, governmental, and educational classifications.					

21.4.3 Critical Facilities and Infrastructure

All critical facilities are likely vulnerable to HAZMATs. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to HAZMAT spills or pipeline explosions.

21.4.4 Environment

The environment is highly exposed to HAZMAT incidents. Natural habitats can experience major damage and destruction during a HAZMAT incident. The effects of a HAZMAT event can have long-lasting impacts on an area. Incidents can lead to the contamination of the water, soil, sediment, and air in an area. High levels of contamination can create an uninhabitable area.

21.5 VULNERABILITY

All populations, buildings, critical facilities, and infrastructure in the planning area are vulnerable to HAZMAT incidents. Citizens and wildlife are subject to health risks from exposure to HAZMATs. Elderly and economically disadvantaged populations in the planning area are at greater risk during these events due to a lack of physical and financial ability to prepare for and mitigate a HAZMAT incident.

21.5.1 Population

Vulnerable populations are the elderly, low-income, linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are living near major roads, railways, and the HAZMAT facilities. These populations face higher chances of illness or death when a HAZMAT incident occurs. Commuters who are caught near a HAZMAT incident may be particularly vulnerable. Additionally, individuals engaged in outdoor recreation during a HAZMAT event may be exposed to harsh chemicals. Table 21-7 contains the vulnerable populations by jurisdiction in the planning area.

TABLE 21-7 MOST VULNERABLE POPULATION						
Jurisdiction	Youth Population (<16)	% of Total Population	Elderly Population (>65)	% of Total Population	Economically Disadvantage (Income < $20,000)	% of Total Population
City of Edna	1,481	26.93%	876	15.93%	371	6.75%
City of Ganado	502	25.06%	270	13.48%	100	4.99%
City of La Ward	71	33.33%	24	11.27%	22	10.33%
Unincorporated Area	1,525	23.98%	1,143	17.97%	448	7.04%
Jackson County Total	**3,579**	**25.43%**	**2,313**	**16.43%**	**941**	**6.69%**

21.5.2 Property

All property is vulnerable during HAZMAT events, but properties in poor condition or particularly vulnerable locations may risk the most damage. Those that are located over or near HAZMAT facilities, railways, major roads, or pipelines may be vulnerable to damage in the event of a spill, fire, or explosion.

Loss estimations for HAZMAT incidents are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing historical data from transportation incidents listed in the PHMSA database. Annualized losses of ‘negligible’ are less than $50 annually but are included due to the possibility of a high-value event. The annualized loss estimated for hazardous materials incidents is shown in Table 21-8. This table does not include estimates for other assessed hazardous materials exposure types and is not an accurate loss estimation for all hazardous material incidents. There is potential for a high-value hazardous materials incident to occur throughout the planning area.

TABLE 21-8 LOSS ESTIMATES FOR HAZARDOUS MATERIAL			
Jurisdiction	Exposed Value	Annualized Loss	Annualized Loss Percentage
City of Edna	$873,172,834	$6,698	<0.1
City of Ganado	$253,570,646	$16,325	<0.1
City of La Ward	$27,144,277	Negligible	Negligible
Unincorporated Area	$1,215,680,242	$23,808	<0.1
Jackson County Total	**$2,369,568,000**	**$46,830**	**<0.1**

Community Perception of Vulnerability

See the front page of the current chapter for a summary of hazard rankings for Jackso County and participating communities in this HMP update. Chapter 22 gives a detailed description of these rankings and Chapter 23 addresses mitigations actions for this hazard vulnerability.

21.5.3 Critical Facilities and Infrastructure

Damage to roadways and structures poses the greatest issue for emergency functions during an event. Of particular concern are roads providing access to vulnerable populations and critical facilities. Severe damage to major routes can disrupt the shipment of goods and other commerce as well as emergency functions. Damage to certain facilities could cause prolonged impacts on the planning area.

21.5.4 Environment

The vulnerability of the environment to HAZMATs is the same as the exposure, discussed in Section 21.4.4.

21.6 FUTURE TRENDS IN DEVELOPMENT

Jurisdictions in the planning area should ensure that known HAZMAT facilities are regulated under their planning and zoning programs. In areas where hazardous materials may be present, permitting processes should require investigations to access risk and vulnerability to hazard areas. HAZMAT issues generally do impact land use and structure development. Issues pertaining to land use in these areas are likely addressed through jurisdictional building codes, ordinances, and regulations.

21.7 SCENARIO

Although HAZMAT incidents are infrequent, impacts can be significant. A worst-case event would involve a large HAZMAT incident in a populated area. Such an event could lead to the instantaneous loss of life and property. If a major roadway were to be involved in such an event, emergency operations and supply chains could be hindered, causing further risks to public health and safety. Damage to subsurface infrastructure could hinder water, electric, sewer, and gas supply to portions of the planning area. Damage to this infrastructure could also lead to the contamination of the water supply resulting in long-lasting impacts.

21.8 ISSUES

The major issues for a HAZMAT incident are the following:

- Hazardous materials incidents are unpredictable and can spread fast leaving little time to react and mitigate the effects of the incident
- Spills and releases can cause facilities to be shut down for prolonged periods
- The capacity for backup power generation is limited
- The older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to HAZMAT incidents
- Knowledge of the long-term impacts of solar Farms to land, agriculture, soil, and groundwater is limited, and means to mitigate these potential impacts are not well defined

Chapter 22.
Planning Area Risk Ranking

A risk ranking was performed for the hazards of concern described in this plan. This risk ranking assesses the probability of each hazard's occurrence as well as its likely impact on the people, property, and economy of the planning area. The risk ranking was conducted by the Steering Committee based on the hazard risk assessment. Estimates of risk were generated with data from HAZUS-MH using methodologies promoted by FEMA. These rankings were presented to and discussed by the Stakeholder Committee and analyzed alongside survey results to ensure community involvement. The final rankings were used in establishing mitigation priorities.

22.1 PROBABILITY OF OCCURRENCE

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

- **High** – Hazard event is likely to occur within 10 years (Probability Factor = 3)
- **Medium** – Hazard event is likely to occur within 25 years (Probability Factor = 2)
- **Low** – Hazard event is not likely to occur within 100 years (Probability Factor = 1)
- **No exposure** – There is no probability of occurrence (Probability Factor = 0)

The assessment of hazard frequency is generally based on past hazard events in the planning area. The Steering Committee assigned the probabilities of occurrence for each hazard, as shown in Table 22-1.

TABLE 22-1.
HAZARD PROBABILITY OF OCCURRENCE

	Jackson County		City of Edna		City of Ganado		City of La Ward	
Hazard	High/Med/ Low/No Impact	Probability Factor	High/Med/ Low/No Impact	Probability Factor	High/Med/ Low/No Impact	Probability Factor	High/Med/ Low/No Impact	Probability Factor
Coastal Erosion	High	3	No Exposure	0	No Exposure	0	No Exposure	0
Dam/Levee Failure	Low	1	Low	1	No Exposure	0	No Exposure	0
Drought	High	3	High	3	High	3	High	3
Earthquake	No Exposure	0	No Exposure	0	No Exposure	0	No Exposure	0
Expansive Soils	High	3	High	3	High	3	High	3
Extreme Heat	High	3	High	3	High	3	High	3
Flood	High	3	High	3	High	3	High	3
Hail	High	3	High	3	High	3	High	3
Hazardous Materials	High	3	High	3	Medium	2	Low	1
Hurricane/ Tropical Storm	High	3	High	3	High	3	High	3
Land Subsidence	High	3	High	3	High	3	High	3
Lightning	Low	1	Low	1	Low	1	Low	1
Pandemic	High	3	High	3	High	3	High	3
Tornado	High	3	High	3	High	3	High	3
Wildfire	High	3	Medium	2	Low	1	Low	1
Wind	High	3	High	3	High	3	High	3
Winter/Ice Storm	High	3	High	3	High	3	High	3

22.2 IMPACT

Hazard impacts were assessed in three categories, impacts on: people, property, and the local economy. The planners generally followed the following ranking system for each category. Planners also applied an element of subjectivity when assigning values for impacts based on their local knowledge. Numerical impact factors were assigned as follows:

People – Values were assigned based on the percentage of the total population exposed to the hazard event, but a level of subjectivity was applied to these rankings based on the local knowledge. The degree of impact on individuals will vary and is not measurable, so the calculation assumes for simplicity and consistency that all people who live in a hazard zone will be equally impacted when a hazard event occurs. Impact factors were assigned as follows:

- High – 50% or more of the population is exposed to a hazard (Impact Factor = 3)
- Medium – 25% to 49% of the population is exposed to a hazard (Impact Factor = 2)
- Low – 24% or less of the population is exposed to the hazard (Impact Factor = 1)
- No impact – None of the population is exposed to a hazard (Impact Factor = 0)

Property – Values were assigned based on the percentage of the total assessed property value exposed to the hazard event, but a level of subjectivity was applied to these rankings based on local knowledge:

- High – 30% or more of the total assessed property value is exposed to a hazard (Impact Factor = 3)
- Medium – 15% to 29% of the total assessed property value is exposed to a hazard (Impact Factor = 2)
- Low – 14% or less of the total assessed property value is exposed to the hazard (Impact Factor = 1)
- No impact – None of the total assessed property value is exposed to a hazard (Impact Factor = 0)

Economy – Values were assigned based on total impact to the economy from the hazard event and activities conducted after the event to restore the community to previous functions. Values were assigned based on the number of days the hazard impacts the community, including impacts on tourism, businesses, road closures, or government response agencies, but a level of subjectivity is applied to these rankings based on local knowledge.

- High – Community impacted for more than 7 days (Impact Factor = 3)
- Medium – Community impacted for 1 to 7 days (Impact Factor = 2)
- Low – Community impacted for less than 1 day (Impact Factor = 1)
- No impact – No community impacts estimated from the hazard event (Impact Factor = 0)

The impacts of each hazard category were assigned a weighting factor to reflect the significance of the impact. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions: impact on people was given a weighting factor of 3; impact on property was given a weighting factor of 2; and impact on the economy was given a weighting factor of 1. The impacts for each hazard are summarized in Table 22-2 through Table 22-4. The total impact factor shown on the tables equals the impact factor multiplied by the weighting factor.

TABLE 22-2. IMPACT ON POPULATION FROM HAZARD								
	Jackson County		City of Edna		City of Ganado		City of La Ward	
Hazard	High/Med/ Low/No Impact	Impact Factor	High/Med/ Low/No Impact	Impact Factor	High/Med/ Low/No Impact	Impact Factor	High/Med/ Low/No Impact	Impact Factor
Coastal Erosion	No Impact	0	No Impact	0	No Impact	0	No Impact	0
Dam/Levee Failure	M	2	No Impact	0	No Impact	0	No Impact	0
Drought	H	3	H	3	H	3	H	3
Earthquake	No Impact	0	L	1	No Impact	0	L	1
Expansive Soils	L	1	H	3	H	3	M	2
Extreme Heat	M	2	M	2	H	3	H	3
Flood	H	3	H	3	M	2	H	3
Hail	L	1	M	2	M	2	M	2
Hazardous Materials	H	3	H	3	H	3	M	2
Hurricane/ Tropical Storm	H	3	H	3	H	3	H	3
Land Subsidence	L	1	M	2	L	1	M	2
Lightning	L	1	L	1	M	2	H	3
Pandemic	H	3	H	3	H	3	H	3
Tornado	L	1	M	2	M	2	L	1
Wildfire	L	1	M	2	L	1	L	1
Wind	M	2	H	3	M	2	M	2
Winter/Ice Storm	L	1	M	2	M	2	M	2

TABLE 22-3. IMPACT ON PROPERTY FROM HAZARD								
	Jackson County		City of Edna		City of Ganado		City of La Ward	
Hazard	High/Med/ Low/No Impact	Impact Factor	High/Med/ Low/No Impact	Impact Factor	High/Med/ Low/No Impact	Impact Factor	High/Med/ Low/No Impact	Impact Factor
Coastal Erosion	L	1	No Impact	0	No Impact	0	No Impact	0
Dam/Levee Failure	M	2	No Impact	0	No Impact	0	No Impact	0
Drought	M	2	M	2	M	2	M	2
Earthquake	No Impact	0	L	1	No Impact	0	L	1
Expansive Soils	L	1	M	2	M	2	H	3
Extreme Heat	L	1	L	1	M	2	H	3
Flood	H	3	H	3	H	3	M	2
Hail	M	2	L	1	M	2	M	2
Hazardous Materials	H	3	H	3	H	3	M	2
Hurricane/ Tropical Storm	H	3	H	3	H	3	H	3
Land Subsidence	L	1	M	2	L	1	M	2
Lightning	L	1	L	1	L	1	L	1
Pandemic	No Impact	0	L	1	L	1	No Impact	0
Tornado	M	2	L	1	M	2	L	1
Wildfire	M	2	L	1	L	1	L	1
Wind	M	2	M	2	M	2	L	1
Winter/Ice Storm	M	2	L	1	M	2	M	2

TABLE 22-4. IMPACT ON ECONOMY FROM HAZARD								
	Jackson County		City of Edna		City of Ganado		City of La Ward	
Hazard	High/Med/ Low/No Impact	Impact Factor	High/Med/ Low/No Impact	Impact Factor	High/Med/ Low/No Impact	Impact Factor	High/Med/ Low/No Impact	Impact Factor
Coastal Erosion	L	1	No Impact	0	No Impact	0	No Impact	0
Dam/Levee Failure	L	1	No Impact	0	No Impact	0	No Impact	0
Drought	H	3	H	3	No Impact	0	No Impact	0
Earthquake	No Impact	0	L	1	No Impact	0	No Impact	0
Expansive Soils	L	1	L	1	No Impact	0	No Impact	0
Extreme Heat	L	1	L	1	No Impact	0	No Impact	0
Flood	H	3	H	3	M	2	L	1
Hail	L	1	L	1	M	2	L	1
Hazardous Materials	M	2	M	2	M	2	M	2
Hurricane/ Tropical Storm	H	3	H	3	H	3	H	3
Land Subsidence	No Impact	0	L	1	No Impact	0	No Impact	0
Lightning	L	1	L	1	No Impact	0	No Impact	0
Pandemic	H	3	M	2	H	3	M	2
Tornado	L	1	L	1	M	2	H	3
Wildfire	L	1	M	2	No Impact	0	No Impact	0
Wind	L	1	M	2	L	1	No Impact	0
Winter/Ice Storm	L	1	L	1	M	2	M	2

22.3 RISK RATING AND RANKING

The risk rating for each hazard was calculated by multiplying the probability factor by the sum of the weighted impact factors for people, property, and operations, as summarized in Table 22-5. Based on these ratings, a priority of high, medium, or low was assigned to each hazard. The hazards ranked as being of highest concern vary by jurisdiction but generally include, drought, extreme heat, flood, hurricane/tropical storm, and pandemic. Table 22-6 summarizes the hazard risk ranking.

TABLE 22-5.
HAZARD RISK RANKING CALCULATIONS

	Jackson County			City of Edna			City of Ganado			City of La Ward		
Hazard	Probability Factor	Impact Weighted Sum	Total	Probability Factor	Impact Weighted Sum	Total	Probability Factor	Impact Weighted Sum	Total	Probability Factor	Impact Weighted Sum	Total
Coastal Erosion	3	1	6	0	0	0	0	0	0	0	0	0
Dam/Levee Failure	1	11	11	1	0	0	0	0	0	0	0	0
Drought	3	16	48	3	16	48	3	13	39	3	13	39
Earthquake	0	0	0	0	6	0	0	0	0	0	5	0
Expansive Soils	3	6	18	3	14	42	3	13	39	3	12	36
Extreme Heat	3	9	27	3	9	27	3	13	39	3	15	45
Flood	3	18	54	3	18	54	3	14	42	3	14	42
Hail	3	8	24	3	9	27	3	12	36	3	11	33
Hazardous Materials	3	17	24	3	17	24	2	17	16	1	12	6
Hurricane/ Tropical Storm	3	18	54	3	18	54	3	18	54	3	18	54
Land Subsidence	3	5	15	3	11	33	3	5	15	3	10	30
Lightning	1	6	6	1	6	6	1	8	8	1	11	11
Pandemic	3	12	36	3	13	39	3	14	42	3	11	33
Tornado	3	8	24	3	9	27	3	12	36	3	8	24
Wildfire	3	8	24	2	10	20	1	5	5	1	5	5
Wind	3	11	33	3	15	45	3	11	33	3	8	24
Winter/Ice Storm	3	8	24	3	9	27	3	12	36	3	12	36

Notes:
Impact Weighted Sum=Total Impact Factor People+ Total Impact Factor Property + Total Impact Factor Economy
Total = Probability x Impact Weighted Sum

TABLE 22-6.
HAZARD RISK SUMMARY

Hazard	Jackson County	City of Edna	City of Ganado	City of La Ward
Coastal Erosion	Low	N/A	N/A	N/A
Dam/Levee Failure	Low	Low	N/A	N/A
Drought	High	High	High	High
Earthquake	N/A	N/A	N/A	N/A
Expansive Soils	Low	High	High	High
Extreme Heat	Medium	Medium	High	High
Flood	High	High	High	High
Hail	Medium	Medium	High	Medium
Hazardous Materials				
Hurricane/ Tropical Storm	High	High	High	High
Land Subsidence	Low	Medium	Low	Medium
Lightning	Low	Low	Low	Low
Pandemic	High	High	High	Medium
Tornado	Medium	Medium	High	Medium
Wildfire	Medium	Medium	Low	Low
Wind	Medium	High	Medium	Medium
Winter/Ice Storm	Medium	Medium	High	High

PART 3
MITIGATION AND PLAN MAINTENANCE STRATEGY

Chapter 23.
Area-Wide Mitigation Actions and Implementation

The Steering Committee reviewed a variety of hazard mitigation alternatives that present a broad range of alternatives to be considered for use in the planning area, in compliance with Title 44 Code of Federal Regulations (44 CFR) (Section 201.6(c)(3)(ii)). These provided a baseline of mitigation alternatives that are backed by a planning process, are consistent with the planning partners' goals and objectives, and are within the capabilities of the partners to implement. The Steering Committee reviewed the full range of actions as well as the county and participating cities' ability to implement the variety of mitigation actions. Hazard mitigation actions recommended in this plan were selected from among the alternatives presented in the menu as well as other projects known to be necessary.

23.1 RECOMMENDED MITIGATION ACTIONS

The Steering Committee identified actions that could be implemented to provide hazard mitigation benefits. Table 23-1 lists the recommended mitigation actions and the hazards addressed by the action. All of the hazards profiled in this plan are addressed by more than one mitigation action.

Table 23-2 provides more details on the mitigation actions, including the mitigation action description, action type, estimated cost, potential funding sources, timeline, and benefit to the community (high, medium, or low). Mitigation types used for this categorization are as follows:

- Local Plans and Regulations (LPR) – These actions include government authorities, policies, or codes that influence the way land and buildings are being developed and built.
- Structure and Infrastructure Projects (SIP) – These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.
- Natural Systems Protection (NSP) – These are actions that minimize damage and losses, and also preserve or restore the functions of natural systems.
- Education and Awareness Programs (EAP) – These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These initiatives may also include participation in national programs, such as StormReady and Firewise Communities.

23.2 BENEFIT/COST REVIEW AND PRIORITIZATION

The action plan must be prioritized according to a benefit/cost analysis of the proposed projects and their associated costs (44 CFR, Section 201.6(c)(3)(iii)). The benefits of proposed projects were weighed against estimated costs as part of the project prioritization process. The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) Grant Program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each project was performed. Each of the mitigation actions was assigned a subjective ranking (high, medium, and low) based on these discussions related to the costs and benefits of these projects. Table 23-2 shows the benefit of each mitigation action.

The committee analyzed all chosen mitigation actions and used a prioritization method based on the method used in the previous hazard mitigation plan. This prioritization evaluation process reviewed specific characteristics for each mitigation action. The evaluated components are as follows: cost-benefit ranking, benefits to life safety, property protection, cost-effectiveness, multi-hazard reduction, timeline, and feasibility.

The planning partners used the results of the benefit/cost review and prioritization exercise to rank the mitigation actions in order of priority, with 1 being the highest priority. The highest priority mitigation actions are shown in red on Table 23-2, medium priority actions are shown in yellow, and low priority actions are shown in green.

TABLE 23-1.
MITIGATION ACTIONS DEVELOPED TO ADDRESS HAZARDS

Action No.	Title	Coastal Erosion	Dam/Levee Failure	Drought	Earthquake	Expansive Soil	Extreme heat	Flood	Hail	Hazardous Material	Land Subsidence	Hurricane/ Tropical Storm	Lightning	Pandemic	Tornado	Wildfire	Wind	Winter/Ice Storm
JACKSON COUNTY																		
1*	Purchase and install shutters for Jackson County Hospital District Facility								X	x		x			x	x	x	x
2*	Flood Plan to include water pumps to vacate standing water from hospital		X					x				x						
3*	Parmetto Bend Spillway - Emergency Stop Log Deployment System		x					x				x						
4*	Bank Stabilization Project	x	x	x	x	x	x	x			x	x			x	x		X
5*	Planting Vegetation on Slopes	x	x	x		x	x	x				x					x	X
6*	Purchase Flow Water Tanks			x			x											
7*	Provide for traffic control on non- regulated intersections.		x		x			x		x		x		x		x		
8*	Create and Implement a Drought and Expansive Soils Contingency Plan			x		x	x				x							X
9*	Reduce fire fuels and potential fire risk in County															x	x	
10*	Implement a tree trimming program								x			x	x		x	x	x	X
11*	Retrofit county courthouse for a hurricane shelter				X							X						

TABLE 23-1.
MITIGATION ACTIONS DEVELOPED TO ADDRESS HAZARDS

Action No.	Title	Coastal Erosion	Dam/Levee Failure	Drought	Earthquake	Expansive Soil	Extreme heat	Flood	Hail	Hazardous Material	Land Subsidence	Hurricane/ Tropical Storm	Lightning	Pandemic	Tornado	Wildfire	Wind	Winter/Ice Storm
12*	Develop water conservation and preventative measures program			x		x	x											
13*	Install automatic switch for the County Services Building generator		x		x			x		x		x		x	x	x		X
14*	Harden critical facilities		x		x	x		x		x	x	x	x	x	x	x	x	X
15*	Strengthen County Road 480 with the development of a headwall.	x						x				x						
16*	Purchase message board trailers (solar boards) in event of emergency		x		x		x	x	x	x		x	x	x	x	x		X
17*	Purchase Emergency Generator for Jackson County – Pct. 1 Barn		x		x		x	x	x	x		x		X	x	x		X
18*	Debris Removal and Drainage Enhancements – Pct. 1 County Roads							x				x						
19*	Navidad River Property Acquisition		x					x				X						
20*	Property Acquisition at Site 5- LaSalle RC&D		x					x				X						
21*	Lavaca River Acquisition							x				X						
22*	Arenosa Creek Acquisition at Site 8 – Gasch/Kutach.		x					x				X						

TABLE 23-1. MITIGATION ACTIONS DEVELOPED TO ADDRESS HAZARDS																		
Action No.	Title	Coastal Erosion	Dam/Levee Failure	Drought	Earthquake	Expansive Soil	Extreme heat	Flood	Hail	Hazardous Material	Land Subsidence	Hurricane/ Tropical Storm	Lightning	Pandemic	Tornado	Wildfire	Wind	Winter/Ice Storm
23*	Provide training for elected officials and professional technical staff	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	X
24*	Implement major clearing of trees and brush from all main creeks and ditches.							x				X						
25	Weather Resistant windows courthouse			x			x		x			x			x	x	x	X
26	Update Flood Damage Prevention Order							x				X						
CITY OF EDNA																		
1*	Purchase 100kw generator for Community Safe Room				x		x	x	x	x		x	x		x	x	x	X
2*	Purchase emergency generator for City of Edna Sewer Lift Station				x			x				x	x	x	x	x	x	x
3*	Construction of combined/harden First Responder station for EMS/Fire/Police departments.				x			x		x		x	x	x	x	x	x	X
4*	Portable electronic road signs/ message boards				x			x	x	x		x	x	x	x	x	x	X
5*	Implement a tree trimming program						x		x			x	x		x	x	x	X
6*	Retrofit and harden existing public facilities			x	x	x	x	x	x	x	x	x	x	x	x	x	x	X
7*	Floodproof sewage treatment plant							x				X						
8*	Develop project to divert rainwater and runoff that flows through town							x				X						

TABLE 23-1.
MITIGATION ACTIONS DEVELOPED TO ADDRESS HAZARDS

Action No.	Title	Coastal Erosion	Dam/Levee Failure	Drought	Earthquake	Expansive Soil	Extreme heat	Flood	Hail	Hazardous Material	Land Subsidence	Hurricane/ Tropical Storm	Lightning	Pandemic	Tornado	Wildfire	Wind	Winter/Ice Storm
9*	Drainage Improvements – Mexico Street/ MLK Boulevard							x				X						
10*	Purchase emergency generator for City of Edna Fire/EMS Building, Police Department, City Hall			x	x		x	x	x	x		x	x	x	x	x	x	X
11*	Drill additional water wells to increase water supply			x			x				x					x		x
12*	Install Emergency Notification System			x	x		x	x	x	x		x	x	x	x	x	x	X
13*	Educate homeowners on hazards			x	x	x	x	x	x	x	x	x	x	x	x	x	x	X
14	Drainage Improvements throughout City							x				X						
15	Update Drainage Master Plan							x				X						
16	Update Development Codes, Subdivision Ordinances, and Drainage Criteria					x		x			x	x				x	x	X
17	Improve Water/Sewer Infrastructure Throughout City			x		x		x			x	x						X
18	Improve Wastewater Treatment Plant					x		x			x	x						
CITY OF GANADO																		
1	Install Outdoor Warning Sirens				x		x	x	x	x		x	x	x	x	x	x	X
2	Clean and remove debris from ditches and creeks in community.							x				x				x	x	X

TABLE 23-1. MITIGATION ACTIONS DEVELOPED TO ADDRESS HAZARDS																		
Action No.	Title	Coastal Erosion	Dam/Levee Failure	Drought	Earthquake	Expansive Soil	Extreme heat	Flood	Hail	Hazardous Material	Land Subsidence	Hurricane/ Tropical Storm	Lightning	Pandemic	Tornado	Wildfire	Wind	Winter/Ice Storm
3	Replace sewer lines.			x	x	x		x			x	x						X
4	Create a public educational campaign			x	x	x	x	x	x	x	x	x	x	x	x	x	x	X
5	Retrofit and harden City Hall and install a safe room.				x		x	x	x	x		x	x	x	x	x	x	X
6	Construct a new harden Emergency Services Building.				x			x	x	x		x	x	x	x	x	x	X
7	Emergency generators for Sewer Lift Stations							x				x	x		x	x	x	X
8	Emergency generators for water system			x	x	x	x	x			x	x				x	x	X
9	Devers Creek Drainage Improvements							x				X						
10	Drainage Improvements							x				X						
11	Rehab Water Storage Tanks			x	x	x	x	x			x	x				x	x	X
12	Long-term Water Supply Planning			x	x	x	x	x			x	x				x	x	X
13	Drainage Master Planning							x				X						
14	Update of Subdivision Ord.					x		x	x			x					x	x
CITY OF LA WARD																		
1	Drainage Master Plan							x				X						
2	Purchase Back-up generators			x	x	x	x	x			x	x				x	x	X

TABLE 23-1.
MITIGATION ACTIONS DEVELOPED TO ADDRESS HAZARDS

Action No.	Title	Coastal Erosion	Dam/Levee Failure	Drought	Earthquake	Expansive Soil	Extreme heat	Flood	Hail	Hazardous Material	Land Subsidence	Hurricane/ Tropical Storm	Lightning	Pandemic	Tornado	Wildfire	Wind	Winter/Ice Storm
3	Road Reconstruction				x	x		x		x		x		x		x		X
4	Water and Sewer Infrastructure Reconstruction			x		x	x	x			x	x				x		X
5	Educate homeowners on hazards			x	x	x	x	x	x	x	x	x	x	x	x	x	x	X
6	Update Development Codes, Subdivision Ordinances, and Drainage Criteria					x		x	x			x	x		x	x	x	X
7	Portable electronic road signs/ message boards			x	x		x	x	x	x		x	x	x	x	x	x	x

Notes:

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS

Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
JACKSON COUNTY										

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
1	Purchase and install shutters for Jackson County Hospital District Facility	Installation of Aluminum All Weather Wind Grade Shutters to protect against hail, hurricane/tropical storms, tornado, and wind.	8	SIP	G1, G2, G6	Court	$10,000 TO $100,000	County Funds	36	Low
2	Flood Plan to include water pumps to vacate standing water from hospital	Property Protection Plan for the Jackson County Hospital District including a drainage study for facility and water pumps to alleviate floodwaters.	18	LPR	G1, G2, G4, G6	Court	$10,000 TO $100,000	County Funds	24	High
3	Parmetto Bend Spillway - Emergency Stop Log Deployment System	Complete preliminary engineering and submit to State Dam Safety Team and other participating agencies for review and comment. Develop and prepare contract documents for procurement. Solicit and accept proposals. Enter into construction agreement. Construct project.	25	SIP	G1, G2, G5, G6	Court	> $100,000	BRIC, HMGP, FMA	48	Medium
4	Bank Stabilization Project	Provide rock riprap to fit the slope of the bank and stabilize the shoreline.	26	SIP	G4,G6	Court	> $100,000	BRIC, HMGP, FMA	36	Low

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
5	Planting Vegetation on Slopes	Planting grasses, vines, shrubs, and minor trees are slope planning techniques to manage coastal erosion at strategic locations	17	NSP	G1, G2, G5, G6	Court	$10,000 TO $100,000	County Funds	36	Low
6	Purchase Flow Water Tanks	Obtain elevated, high volume/high flow water tanks (high volume at least 6000 gal, and high flow at least 3, preferably 8) spaced throughout the area for additional potable water source. Area is 114 square miles.	16	SIP	G1, G2, G4, G5, G6	Court	$10,000 TO $100,000	BRIC, HMGP, FMA	36	Medium
7	Provide for traffic control on non-regulated intersections.	Provide for traffic control on non- regulated intersections (signs, traffic officer, and one-way routes) during flood events when intersection is flooded.	7	SIP	G1, G2, G4, G5, G6	Court	$10,000 TO $100,000	County Funds	36	Medium
8	Create and Implement a Drought and Expansive Soils Contingency Plan	Develop a Drought Contingency Plan with water conservation stages to use during extreme heat, an additional potable water source, and develop ordinance to mitigate foundation expansive soil problems. It will address measures to minimize expansive soils around foundations and infrastructure as groundwater is depleted from drought and extreme heat conditions.	9	LPR	G1, G2, G3, G4, G5, G6	Court	$10,000 TO $100,000	County Funds	36	Low

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
9	Reduce fire fuels and potential fire risk in County	Remove downed trees, cedar trees, and brush to reduce fire fuels and potential fire risk.	12	EAP	G1, G2, G3, G4, G5, G6	Court	$10,000 TO $100,000	County Funds	48	Low
10	Implement a tree trimming program	Implement a program to trim trees hanging in right-of-way of streets that when downed during severe winter storm, pose a threat to structures, cars and citizens.	14	NSP	G1, G2, G4, G6	Court	$10,000 TO $100,000	County Funds	36	Medium
11	Retrofit county courthouse for a hurricane shelter	Obtain funding to retrofit county courthouse for a hurricane shelter that can also withstand hail and wind events.	6	SIP	G1, G4	Court	> $100,000	BRIC, HMGP, FMA	36	High
12	Develop water conservation and preventative measures program	Develop program to educate homeowners and provide them incentives to: install low-flow plumbing for toilets, energy-efficient washer/dryer, rain harvesting devices, property perimeter drainage systems, applying soil stabilizers, and use R-value building materials.	24	LPR	G1, G3, G4, G5, G6	Court	$10,000 TO $100,000	County Funds	36	Medium

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
13	Install automatic switch for the County Services Building generator	Transfer from manual to automatic switch for the County Services Building generator to be used from the hazard events of earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	5	SIP	G1, G2, G6	Court	$10,000 TO $100,000	BRIC, HMGP, FMA	36	High
14	Harden critical facilities	Critical facilities will be hardened by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low-flow plumbing; replacing landscaping with drought and fire resistant plants; implementing higher standards for foundations from expansive soil issues, and using R-value building materials to resist heat.	4	SIP	G1, G2, G6	Court	> $100,000	BRIC, HMGP, FMA	36	Medium
15	Strengthen County Road 480 with the development of a headwall.	Strengthen County Road 480 with the development of a headwall.	15	SIP	G1, G2, G6	Court	> $100,000	BRIC, HMGP, FMA	24	Medium

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
16	Purchase message board trailers (solar boards) in event of emergency	Purchase message board trailers (solar boards) in event of emergency.	19	EAP	G1, G3, G4, G6	Court	$10,000 TO $100,000	County Funds	36	Medium
17	Purchase Emergency Generator for Jackson County – Pct. 1 Barn	Acquire a generator (portable or stationary) large enough to power the County Pct. 1 Barn and gas pumps for refueling that will need to be operational during and after a from the hazard events of earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	3	SIP	G1, G2, G6	Court	> $100,000	BRIC, HMGP, FMA	24	High
18	Debris Removal and Drainage Enhancements – Pct. 1 County Roads	Reduce obstacles including debris and incorporate drainage enhancements that will reduce flooding on county roads. Aggressive debris control and culvert replacement is essential to mitigate against further road erosion costing extensive repairs and further culvert replacements.	13	SIP, NSP	G1, G2, G6	Court	$10,000 TO $100,000	County Funds	36	High
19	Navidad River Property Acquisition	There is a flood prone property at 1EWP- Chase Cemetery and acquisition can mitigate the problem.	20	SIP	G1, G2, G5, G6	LNRA	> $100,000	LNRA	48	Low

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS

Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
20	Property Acquisition at Site 5- LaSalle RC&D	There is a flood prone property at Site 5- LaSalle RC&D that acquisition can mitigate the problem of repetitive flooding.	21	SIP	G1, G2, G5, G6	JCCWDD	> $100,000	JCCWDD	48	Low
21	Lavaca River Acquisition	There is a flood prone property at Site 6 – Goat Trail and acquisition can mitigate the problem of repetitive flooding.	22	SIP	G1, G2, G5, G6	JCCWDD	> $100,000	JCCWDD	48	Low
22	Arenosa Creek Acquisition at Site 8 – Gasch/Kutach.	A flood prone property acquisition can mitigate the problem of repetitive flooding.	23	SIP	G1, G2, G5, G6	JCCWDD	> $100,000	JCCWDD	48	Low
23	Provide training for elected officials and professional technical staff	Provide training for elected officials and professional technical staff (including emergency management coordinators) on emergency management issues.	11	EAP	G2, G4, G5	Court	$10,000 TO $100,000	County Funds	24	Low
24	Implement major clearing of trees and brush from all main creeks and ditches.	Implement major clearing of trees and brush from all main creeks and ditches. Increase dimensions of drainage culverts in troublesome areas. Get easements to private property.	10	NSP	G1, G2, G6	JCCWDD	$10,000 TO $100,000	JCCWDD	36	High

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
25	Weather Resistant windows courthouse	Implement weather resistant windows for the Courthouse to improve energy efficiency.	2	SIP	G1, G2, G6	Court	$10,000 TO $100,000	County Funds	36	Medium
26	Update Flood Damage Prevention Order	Update ordinance to improve clarity on what is expected of developers in the County.	1	LPR	G1, G2, G5, G6	Court / Floodplain Adm.	$10,000 TO $100,000	County Funds	12	High
CITY OF EDNA										
1	Purchase 100kw generator for Community Safe Room	Purchase and install 100kw generator to power Community Safe Room that is designated as a triage center, satellite emergency management office, radio communication and first responder shelter, and public shelter due to loss of power from earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	6	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	BRIC, HMGP, FMA	36	High
2	Purchase emergency generator for City of Edna Sewer Lift Station	Purchase and install 30kw generator to maintain continuity of waste water treatment services and prevent potential health impacts due to loss of power from earthquakes, extreme heat,	7	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	BRIC, HMGP, FMA	36	High

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS

Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.								
3	Construction of combined/harden First Responder station for EMS/Fire/Police departments.	Purchase land, design and construct a harden, energy efficient, and xeriscape landscaped combined EMS/Fire/Police facility to maintain continuity of government services and enhance rapid restoration of all emergency response and public services and cooling center. This facility will be hardened by being elevated two feet above base floos elevation, use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, constuction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low-flow plumbing; replacing landsxaping with drought and fire resistant plants; implementing higher standards for foundations for expansive soil issues, and using R-value building materials to	8	SIP	G1, G4	Public Works	> $100,000	BRIC, HMGP, FMA	48	Medium

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS

Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		resist heat.								
4	Portable electronic road signs/ message boards	Portable electronic signs can provide traveler instructions and can also be used to provide alerting and instructions for other hazardous conditions during flooding, fire and winter storm events. Portable signs will reduce need for man- power at stationed routes of evacuations locations.	10	EAP	G1, G3, G4, G6	Public Works	< $10,000	City	24	Low
5	Implement a tree trimming program	Develop and implement tree trimming program to clear limbs hanging in right-of- way and in drainage systems that when downed, pose threat to structures, cars, and citizens during severe weather events.	9	NSP	G1, G2, G4, G6	Public Works	$10,000 to $100,000	City	24	Low
6	Retrofit and harden existing public facilities	Retrofit and harden existing facility by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low-	18	SIP	G1, G4	Public Works	> $100,000	BRIC, HMGP, FMA	48	Medium

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		flow plumbing; replacing landscaping with drought and fire resistant plants; implementing higher standards for foundations, and using R-value building materials to resist heat								
7	Floodproof sewage treatment plant	Floodproof sewage treatment plant located in flood hazard by installing dikes and pumping system.	11	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High
8	Develop project to divert rainwater and runoff that flows through town	Develop project to divert rainwater and runoff that flows through town by installing a system of dikes and drainage ditches to Lavaca River.	16	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High
9	Drainage Improvements – Mexico Street/ MLK Boulevard	Replace current drainage culverts with larger box culverts with parallel wings across MLK Boulevard to Mexico Street.	17	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
10	Purchase emergency generator for City of Edna Fire/EMS Building, Police Department, City Hall	Purchase and install 30kw generator to maintain continuity of government in case of loss of power due to earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	15	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	BRIC, HMGP, FMA	36	High
11	Drill additional water wells to increase water supply	Drill additional water wells to increase water supply during times of drought.	12	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	BRIC, HMGP, FMA	48	High
12	Install Emergency Notification System	Install a new ENS for residents to register their land-lines and cell phone numbers with system for emergency notification of hazard events.	13	EAP	G1, G3, G4, G6	Public Works	< $10,000	City	36	Low
13	Educate homeowners on hazards	Provide education to homeowners on how to mitigate hazard damage from their homes. Use city website and public forums.	14	EAP	G1, G3, G4, G6	Planning	< $10,000	City	24	Medium
14	Drainage Improvements throughout City	Implement drainage improvements, including culvert upgrades, channel widening, regional detention, bridge upgrades, and stormsewer improvements	1	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS

Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
15	Update Drainage Master Plan	Develop a City-wide Drainage Master Plan focused on local drainage issues. This plan will merge with the regional FIF study of Dry Creek	2	LPR	G1, G2, G4, G5, G6	Public Works	> $100,000	TWDB, BRIC	36	High
16	Update Development Codes, Subdivision Ordinances, and Drainage Criteria	Update development codes and min. finish floor elevation standards.	3	LPR	G1, G2, G4, G5, G6	Public Works	$10,000 to $100,000	City	36	Medium
17	Improve Water/Sewer Infrastructure Throughout City	Improve water mains, wastewater mains, forcemains, and improve water main pressure balances	5	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High
18	Improve Wastewater Treatment Plant	Improve wastewater treatement plant to make it more flood resilient and improve treatment capacity and I&I.	4	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High
CITY OF GANADO										
1	Install Outdoor Warning Sirens	Install Outdoor Warning Sirens. The city needs ways to warn residents about impending weather conditions when they are outside.	8	SIP, EAP	G1, G2, G3, G4, G6	Public Works	< $10,000	City	24	Medium

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
2	Clean and remove debris from ditches and creeks in community.	The city will clean and remove debris from ditches and creeks.	9	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	City	36	High
3	Replace sewer lines.	The city will replace sewer lines as needed.	10	SIP, NSP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High
4	Create a public educational campaign	The city will create a public educational campaign for schools and homeowners on how to mitigate their schools and homes from natural hazards.	3	EAP	G1, G3, G4, G6	Planning	< $10,000	City	24	Medium
5	Retrofit and harden City Hall and install a safe room.	The city will retrofit and harden City Hall by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry- proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low-flow plumbing; replacing landscaping with drought and fire resistant plants; implementing higher standards for foundations for	14	SIP	G1, G4	Public Works	> $100,000	BRIC, HMGP, FMA	48	Medium

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
		expansive soils, and installing a safe room.								
6	Construct a new harden Emergency Services Building.	Purchase land, design and construct a harden, energy efficient, and xeriscape landscaped combined EMS/FIRE/POLICE facility to maintain Continuity of Government services and enhance rapid restoration of all Emergency Response and Public Services. The facility by the use of tornado, wind, fire, hail, ground movement, and impact resistant materials (windows, doors, roofing, construction, siding, roof bracings); dry-proofing buildings; upgrading to higher standard insulation; installing lighting rods and grounding systems; retrofitting for low- flow plumbing; replacing landscaping with drought and fire resistant plants; implementing higher standards for foundations for expansive soils	13	SIP	G1, G4	Public Works	> $100,000	BRIC, HMGP, FMA	48	Medium

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS

Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
7	Emergency generators for Sewer Lift Stations	Install permanent 30kw generator to maintain continuity of waste water treatment services and prevent potential health impacts due to loss of power from earthquakes, extreme heat, flood, hail, hurricane/tropical storms, lightning, tornado, wildfire, wind, and winter weather.	4	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	BRIC, HMGP, FMA	48	High
8	Emergerncy generators for water system	New generators for water system to ensure adequate pumping is available for water tower during hazards.	5	SIP	G1, G2, G6	Public Works	$10,000 to $100,000	BRIC, HMGP, FMA	48	High
9	Devers Creek Drainage Improvements	Coordinate with JCCWDD to develop region detention and channel widening improvements along Devers Creek.	6	SIP	G1, G2, G6	JCCWDD	> $100,000	BRIC, HMGP, FMA	48	High
10	Drainage Improvements	Drainage improvements throughout the City, including culvert improvements, detention, channel improvements, bridge improvements, and stormsewer improvements	7	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, HMGP, FMA	48	High

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS

Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
11	Rehab Water Storage Tanks	Improve existing water storage tanks and possibly increasing storage capacity.	11	SIP	G1, G2, G6	Public Works	> $100,000	BRIC, TWDB	48	High
12	Long-term Water Supply Planning	Develop a long-term water supply plan that includes a new water model and overall plan to manage development.	12	LPR	G1, G2, G3, G4, G5, G6	Public Works	$10,000 to $100,000	City	48	Medium
13	Drainage Master Planning	Develop a drainage master plan with a focus on identifying flood reduction projects for local drainage issues.	1	LPR	G1, G2, G4, G5, G6	Public Works	$10,000 to $100,000	BRIC, TWDB	36	High
14	Update of Subdivision Ord.	Develop improved drainage standards for development throughout the City. Including improved finish floor and detention standards.	2	LPR	G1, G2, G4, G5, G6	Planning	< $10,000	City	36	Medium
CITY OF LA WARD										

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS										
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
1	Drainage Master Plan	Develop a drainage master plan with a focus on local drainage issues using Atlas 14 rainfall	1	LPR	G1, G2, G4, G5, G6	City Council	$10,000 to $100,000	City	24	High
2	Purchase Back-up generators	Purchase generators to help provide power during power outages similar to the Winter Storm of 2021.	3	SIP	G1, G2, G6	City Council	$10,000 to $100,000	BRIC, HMGP, FMA	48	High
3	Road Reconstruction	Reconstruct roads that have deteriorated due to flooding and other issues.	2	SIP	G1, G2, G6	City Council	> $100,000	City	48	High
4	Water and Sewer Infrastructure Reconstruction	Improve water and wastewater supply, improve water mains, lift stations, wastewater mains, and water supply resiliency.	4	SIP	G1, G2, G6	City Council	> $100,000	BRIC, HMGP, FMA	48	High

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS											
Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
5	Educate homeowners on hazards	Provide education to homeowners on how to mitigate hazard damage from their homes. Use city website and public forums.	5	EAP	G1, G3, G4, G6	City Council	< $10,000	City	24	Medium
6	Update Development Codes, Subdivision Ordinances, and Drainage Criteria	Update development codes and min. finish floor elevation standards.	6	LPR	G1, G2, G4, G5, G6	City Council	$10,000 to $100,000	City	36	Medium
7	Portable electronic road signs/ message boards	Portable electronic signs can provide traveler instructions and can also be used to provide alerting and instructions for other hazardous conditions during flooding, fire and winter storm events. Portable signs will reduce need for man- power at stationed routes of evacuations locations.	7	EAP	G1, G3, G4, G6	City Council	< $10,000	City	24	Low

Notes:

CEM	Community Emergency Manager	IRC	International Residential Code
CFM	Community Floodplain Manager	LPR	Local Plans and Regulations
CRS	Community Rating System	N/A	Not Applicable
EAP	Education and Awareness Programs	NFIP	National Flood Insurance Program
FEMA	Federal Emergency Management Agency	NSP	Natural Systems Protection

TABLE 23-2. RECOMMENDED MITIGATION ACTIONS

Action No.	Title	Description	Mitigation Action Ranking	Action Type	Applicable Goals	Responsible Department	Estimated Cost	Potential Funding Sources	Timeline in Months	Benefit
FIRM	Flood Insurance Rate Map		NWS	National Weather Service						
FMA	Flood Mitigation Assistance		PDM	Pre-Disaster Mitigation						
GIS	Geographic Information System		SIP	Structure and Infrastructure Project						
HMGP	Hazard Mitigation Grant Program		TCRFC	Texas Colorado River Floodplain Coalition						
IBC	International Building Code									

Chapter 24.
Plan Adoption and Maintenance

24.1 PLAN ADOPTION

A hazard mitigation plan must document that it has been formally adopted by the governing body of the jurisdiction requesting federal approval of the plan (44 CFR Section 201.6(c)(5)). For multi-jurisdictional plans, each jurisdiction requesting approval must document that it has been formally adopted. All planning partners fully met the participation requirements specified by the Steering Committee and will seek Disaster Mitigation Act of 2000 (DMA) compliance under this plan. The plan will be submitted for review to the Texas Division of Emergency Management (TDEM) and then to the Federal Emergency Management Agency (FEMA) Region VI for review and pre-adoption approval. Once pre-adoption approval has been provided, all planning partners will formally adopt the plan. All partners understand that DMA compliance and its benefits cannot be achieved until the plan is adopted. Copies of the resolutions adopting this plan for all planning partners can be found in Appendix D.

24.2 PLAN MAINTENANCE STRATEGY

A hazard mitigation plan must present a plan maintenance process that includes the following (44 CFR Section 201.6(c)(4)):

- A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan over a 5-year cycle
- A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate
- A discussion on how the community will continue public participation in the plan maintenance process.

This chapter details the formal process that will ensure that the Jackson County Hazard Mitigation Plan remains an active and relevant document and that the planning partners maintain their eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every 5 years. This chapter also describes how public participation will be integrated throughout the plan maintenance and implementation process. It also explains how the mitigation strategies outlined in this plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The plan’s format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

24.2.1 Plan Implementation

The effectiveness of the hazard mitigation plan depends on its implementation and incorporation of its action items into partner jurisdictions’ existing plans, policies, and programs. Together, the action items in the plan provide a framework for activities that the partnership can implement over the next 5 years. The planning partners have established goals and objectives and have prioritized mitigation actions that will be implemented through existing plans, policies, and programs.

The Jackson County Emergency Management will have the lead responsibility for overseeing the plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared responsibility among Jackson County and the cities of Edna, Ganado, and La Ward. The public will be invited to attend meetings regarding the implementation of the plan and feedback will be solicited at the end of the meeting.

24.2.2 Steering Committee

The Steering Committee is a total volunteer body that oversaw the development of the plan and made recommendations on key elements of the plan, including the maintenance strategy. It was the Steering Committee's position that an implementation committee with representation similar to the initial Steering Committee should have an active role in the plan maintenance strategy. The Steering Committee and the Implementation Committee are the same. Therefore, it is recommended that a Steering Committee remain a viable body involved in key elements of the plan maintenance strategy. The new Steering Committee should strive to include representation from the planning partners, as well as other stakeholders in the planning area. The public will be invited to attend Steering Committee meetings regarding maintenance of the plan and will be asked for feedback or comments on the maintenance strategy.

The principal role of the new implementation committee in this plan maintenance strategy will be to review the annual progress report and provide input to the Jackson County Emergency Management Coordinator on possible enhancements to be considered at the next update. Future plan updates will be overseen by a Steering Committee similar to the one that participated in this plan development process, so keeping an interim Steering Committee intact will provide a head start on future updates. Completion of the progress report is the responsibility of each planning partner, not the responsibility of the Steering Committee. It will simply be the Steering Committee's role to review the progress report in an effort to identify issues needing to be addressed by future plan updates.

With the adoption of this plan, the implementation committee will be tasked with plan monitoring, evaluation, and maintenance. The participating jurisdictions and agencies, led by the Jackson County Emergency Management Coordinator, agree to:

- Meet annually, and after a disaster event, to monitor and evaluate the implementation of the plan;
- Act as a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high priority, low- or no-cost recommended actions;
- Maintain vigilant monitoring of multi-objective, cost-share, and other funding opportunities to help the community implement the plan's recommended actions for which no current funding exists;
- Monitor and assist in implementation and update of this plan;
- Keep the concept of mitigation in the forefront of community decision making by identifying plan recommendations when other community goals, plans, and activities overlap, influence, or directly affect increased community vulnerability to disasters;
- Report on plan progress and recommended changes to the Jackson County Commissioners Court and governing bodies of participating jurisdictions; and
- Inform and solicit input from the public.

The implementation committee is an advisory body and can only make recommendations to county, city, or district elected officials. Its primary duty is to see the plan successfully carried out and to report to the community governing boards and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, hearing stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information in areas accessible to the public.

24.2.3 Plan Maintenance Schedule

The implementation committee will meet annually and after a state or federally declared hazard event as appropriate to monitor progress and update the mitigation strategy. The Jackson County Emergency Management Coordinator will be responsible for initiating the plan reviews with the implementation committee.

24.2.4 Annual Progress Report

The minimum task of each planning partner will be the evaluation of the progress of its individual action plan during a 12-month performance period. This review will include the following:

- Summary of any hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement and feedback received from the community
- Brief discussion about why targeted strategies were not completed
- Re-evaluation of the action plan to evaluate whether the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs or initiatives that involve hazard mitigation
- Monitor the incorporation of the Mitigation Plan into planning mechanisms

The planning team has created a template to guide the planning partners in preparing a progress report (see Appendix E). The plan maintenance Steering Committee and the public will provide feedback to the planning team on items included in the template. The planning team will then prepare a formal annual report on the progress of the plan. This report should be used to:

- Post on the Jackson County Emergency Management website
- Provide information for a press release that will be issued to the local media
- Inform planning partner governing bodies of the progress of actions implemented during the reporting period

Uses of the progress report will be at the discretion of each planning partner. Annual progress reporting is not a requirement specified under 44 CFR. However, it may enhance the planning partnership's opportunities for funding. While failure to implement this component of the plan maintenance strategy will not jeopardize a planning partner's compliance under the DMA, it may jeopardize its opportunity to partner and leverage funding opportunities with the other partners.

Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan. Changes in vulnerability can be identified by noting:

- Decreased vulnerability as a result of implementing recommended actions,
- Increased vulnerability as a result of failed or ineffective mitigation actions, and/or
- Increased vulnerability as a result of new development (and/or annexation).

24.2.5 Plan Update

Local hazard mitigation plans must be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits under the DMA (44 CFR, Section 201.6(d)(3)). The Jackson County partnership intends to update the hazard mitigation plan on a 5-year cycle from the date of initial plan adoption. This cycle may be accelerated to less than 5 years based on the following triggers:

- A Presidential Disaster Declaration that impacts the planning area
- A hazard event that causes loss of life
- A comprehensive update of the county or participating city's comprehensive plan

It will not be the intent of future updates to develop a completely new hazard mitigation plan for the planning area. The update will, at a minimum, include the following elements:

- The update process will be convened through a Steering Committee.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The action plans will be reviewed and revised to account for any actions completed, dropped, or changed and to account for changes in the risk assessment or new partnership policies identified under other planning mechanisms (such as the comprehensive plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to participate in the update process and comment on the update prior to adoption.
- The partnership governing bodies will adopt their respective portions of the updated plan.

24.2.6 Continuing Public Involvement

The public will continue to be apprised of the plan's progress through the Jackson County Emergency Management's websites and other methods as appropriate. This site will not only house the final plan, it will become the one-stop-shop for information regarding the plan, the partnership, and plan implementation. Copies of the plan will be distributed to the public library system in Jackson County Library. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from a new Steering Committee. This strategy will be based on the needs and capabilities of the planning partnership at the time of the update. This strategy will include the use of local media outlets within the planning area to notify the public of the implementation, monitoring, and evaluation of the plan. The public will be invited to participate in each stage by attending meetings and provide feedback to the planning team and new Steering Committee. The Steering Committee may include community stakeholders, such as prominent businesses, local action groups, etc.

24.2.7 Incorporation into Other Planning Mechanisms

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The existing Jackson County regulations, ordinances, and plans (including the Jackson County Emergency Operations Plan), and the comprehensive plans of the partner cities are considered to be integral parts of this plan. The county and partner cities, through the adoption of comprehensive plans and zoning ordinances, have planned for the impact of natural hazards.

It will be the responsibility of the county and the cities to determine additional implementation procedures when appropriate. This includes integrating the requirements of the hazard mitigation plan into other local planning documents, processes, or mechanisms.

All municipal planning partners are committed to creating a linkage between the hazard mitigation plan and their individual comprehensive plans. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- Comprehensive plans
- Strategic plans
- Partners' emergency response plans
- Capital improvement programs
- Municipal codes
- Community design guidelines
- Water-efficient landscape design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Community wildfire protection plans
- Growth management plans
- Ordinances, resolutions, and regulations
- Continuity of operations plans

The previous *Jackson County Hazard Mitigation Plan Update 2016* identified mitigation actions for each participating community. These mitigation actions and their current status are listed in Table 2-2. Ongoing or delayed mitigation actions identified in the previous plan were carried forward into new mitigation actions for Jackson County or the City of Edna, the City of Ganado, or the City of La Ward. The annual progress report discussed in Chapter 24.2.4 and Appendix E will provide a framework for tracking future mitigation actions and the incorporation of this plan into other planning mechanisms. Past efforts to integrate the 2016 HMP for Jackson Co. were successful in that each community formally passed a resolution to adopt the HMP. No other action was taken with regard to past efforts related to integration.

Opportunities to integrate the requirements of this plan into other local planning mechanisms will continue to be identified through future meetings of the Steering Committee, by the individual communities and the county, and through the annual and five-year review processes as required by FEMA. The primary means for integrating mitigation strategies into other local planning mechanisms will be through the revision, update, and implementation of each jurisdiction's individual plans that require specific planning and administrative tasks (for example, plan amendments, ordinance revisions, capital improvement projects, etc.).

The previous Steering Committee representatives will remain charged with ensuring that the goals and strategies of new and updated local planning documents for their jurisdictions or agencies are consistent with the goals and actions of the Jackson County Hazard Mitigation Plan Update and will not contribute to increased hazard vulnerability in Jackson County, the City of Edna, the City of Ganado, or the City of La Ward. During the planning process for new and updated local planning documents, such as a comprehensive plan, capital improvements plan, or emergency management plan, the applicable jurisdiction will provide a copy of the Jackson County Hazard Mitigation Plan Update to the appropriate parties and recommend that all goals and strategies of new and updated local planning documents are consistent with and support the goals of the Jackson County plan and will not contribute to increased hazards in the affected jurisdiction(s).

Although it is recognized that there are many possible benefits to integrating components of this plan into other local planning mechanisms, the development and maintenance of this stand-alone hazard mitigation plan is deemed by the Steering Committee to be the most effective and appropriate method to ensure the implementation of local hazard mitigation actions at this time. All organizations will incorporate the Jackson County Hazard Mitigation Plan Update into existing plans in an effort to mitigate the impact of future disasters. A list of the existing plans and procedures in which mitigation activities will be integrated is listed in Table 24-1.

TABLE 24-1. INCORPORATION OF MITIGATION ACTIVITIES				
Type of Plan	Department	Review Timeline	New or Existing	Actions to be Integrated
JACKSON COUNTY				
Subdivision Regulations	Permit and Inspection Department	5 years	Existing	Maintain current data on high-risk areas via the mitigation plan and regularly incorporate information on high-risk hazard areas into the subdivision requirements, thereby eliminating or reducing potential impacts on current and future development.
Jackson County Flood Prevention Order, 2014	County Department of Land Development, Permit, and Inspection, Floodplain Management Office, Certified Floodplain Manager	2 years	Existing	Overlay high-risk/flood-prone areas with current and future floodplain regulations, thereby minimizing or reducing the impacts of flooding on current and future development.
Water Supply Plan/Drought Contingency Plan	Public Works Department	5 years	New	Create a water supply plan in advance of drought; implement and update the plan taking into consideration hazard mitigation plan data on extreme heat, expansive soils, and land subsidence.
Jackson County Emergency Operations Plan	Department of Emergency Management	2 years	Existing	Integrate and implement hazard mitigation plan data on high hazards and applicable mitigation actions that are affected by or will affect the emergency operations plan on an annual basis.
Site Plan Review Process	Permitting and Inspections	Regularly	Existing	The Permitting and Inspections Department will consider the high hazard areas within the community and make development decisions in the best interest of the community integrating the mitigation plan data and proposed actions as applicable into their decision-making processes.
CITY OF EDNA				
City of Edna Comprehensive Plan, 1972	City Council, Planning and Zoning Commission	30 years	Existing	During the regular review process, bring the mitigation actions to the City Council for approval. The Council will approve or deny the actions.
City of Edna Code of Ordinance - Zoning (1996, as amended)	Code Enforcement, Planning and Zoning Commission	10 years	Existing	During the City's regular review and update of the City's zoning ordinance, they will incorporate current data on high hazard areas, thereby reducing or eliminating the potential negative impacts of high hazards on existing and future development.

TABLE 24-1. INCORPORATION OF MITIGATION ACTIVITIES				
Type of Plan	Department	Review Timeline	New or Existing	Actions to be Integrated
Subdivision Ordinance	Code Enforcement, Planning and Zoning Commission	10 years	Existing	During the City's regular review and update of the subdivision regulations, they will incorporate current data on high hazard areas thereby reducing or eliminating the potential negative impacts of high hazards on existing and future development.
Flood Damage Reduction Ordinance	City Manager	5 years	Existing	During the regular review process, the City Floodplain Administrator will bring any flood mitigation actions identified in the hazard mitigation plan to the City Council to recommend incorporation into the ordinance. The Council will approve or deny the actions.
Site Plan Review Process	Code Enforcement	Regularly	Existing	The Code Enforcement Department will consider the high hazard areas within the community and make development decisions in the best interest of the community integrating the mitigation plan data and proposed actions as applicable into their decision-making processes.
Emergency Operations Plan	City Manager, County Emergency Management	Annual	Existing	Under the leadership of the County Department of Emergency Management, all appropriate planning documents will be updated to include and implement the appropriate mitigation actions as prioritized in the current hazard mitigation plan.
1972 Capital Improvements Plan	City Council	30 years	Existing	Bring the identified mitigation actions to the City Council for approval as part of the capital improvements funding stream plans for the City. The Council will approve or deny the actions.
CITY OF GANADO				
Zoning Code, Chapters 3 and 5 - City of Ganado Code of Ordinances	Board of Code Enforcement	10 years	Existing	During the City's regular review and update of the City's zoning ordinance, they will incorporate current data on high hazard areas, thereby reducing or eliminating the potential negative impacts of high hazards on existing and future development.
City of Ganado Subdivision Code (1993, as amended)	Board of Code Enforcement	10 years	Existing	During the City's regular review and update of the subdivision regulations, they will incorporate current data on high hazard areas thereby reducing or eliminating the potential negative impacts of high hazards on existing and future development.
Standard for Floodplain Management (Adopted 1987)	Board of Code Enforcement	5 years	Existing	During the regular review process,bring the identified actions to the Board of Code Enforcement and the City Council for approval. The Council will approve or deny the actions.
Site Plan Review Process	Board of Code Enforcement	Regularly	Existing	The Board of Code Enforcement will consider the high hazard areas within the community and make development decisions in the best interest of the community integrating the mitigation plan data and proposed actions as applicable into their decision-making processes.

TABLE 24-1. INCORPORATION OF MITIGATION ACTIVITIES				
Type of Plan	Department	Review Timeline	New or Existing	Actions to be Integrated
Emergency Operations Plan	Mayor, County Emergency Management	Annual	Existing	Under the leadership of the County Department of Emergency Management, all appropriate planning documents will be updated to include and implement the appropriate mitigation actions as prioritized in the current hazard mitigation plan.
5-year CapitalImprovement Plan	City Council	Regularly	Existing	During the Capital Improvement Plan update, bring the identified actions to theCity Council for approval and eligibility for funding.
CITY OF LA WARD				
City of La Ward Subdivision Code	City Council	10 years	New	During the City's regular review and update of the subdivision regulations, they will incorporate current data on high hazard areas thereby reducing or eliminating the potential negative impacts of high hazards on existing and future development.
City Master Plan	City Council	10 years	New	During the regular review process, bring the mitigation actions to the City Council for approval. The Council will approve or deny the actions.

REFERENCES

30 Tex. Admin. Environmental Quality (2005)

7 C.F.R. Appendix A-Subpart E-Part 1724. Hazard Potential Classification for Civil Works Projects

ABS Consulting. 28 August 2015. West Fertilizer Incident Support Services Final Report. Accessed August 2021 at https://www.csb.gov/assets/1/6/west_fertilizer_incident_support_services_fpr_finalrev1_compressed_02111___.pdf?15619

Ahrens, M. 2013.National Fire Protection Association. Lighting Fires and Lightning Strikes. Accessed at https://www.nfpa.org/News-and-Research/Data-research-and-tools/US-Fire-Problem/Lightning-Fires-and-Lightning-Strikes

American Journal of Managed Care. 2021. A Timeline of COVID-19 Developments in 2020. Accessed May 2021 at https://www.ajmc.com/view/a-timeline-of-covid19-developments-in-2020

Atlantic Beach Official Website. (n.d.). Hazardous material incidents. https://coab.us/591/Hazardous-Material-Incidents#:~:text=Hazardous%20materials%20come%20in%20the,of%20chemical%20accidents%20in%20plants.

Center for Climate and Energy Solutions. No Date. Hurricanes and Climate Change. Accessed at https://www.c2es.org/content/hurricanes-and-climate-change/

Center for Climate and Energy Solutions. No Date. Tornadoes and Climate Change. Accessed at https://www.c2es.org/content/tornadoes-and-climate-change/

Center for Disease Control. 2016. SARS (10 Years After). Accessed May 2021 at https://www.cdc.gov/dotw/sars/

Center for Disease Control. 2018. Past Pandemics Accessed May 2021 at https://www.cdc.gov/flu/pandemic-resources/basics/past-pandemics.html

City-Data.Com. 2021. Edna. Accessed at http://www.city-data.com/city/Edna-Texas.html

City-Data.Com. 2021. Ganado. Accessed at http://www.city-data.com/city/Ganado-Texas.html

Cleveland Clinic. April 2021. How Climate Change May Affect Future Pandemics. Accessed on May 2021 at https://newsroom.clevelandclinic.org/2021/04/21/how-climate-change-may-affect-future-pandemics/

Colorado State Tropical Weather & Climate Research. 2021. Colorado State University Tropical Cyclone Impact Probabilities. Accessed at https://tropical.colostate.edu/resources.html

Congressional Office of Technology Assessment (OTA). 1993. Preparing for an Uncertain Climate, Vol. I. OTA–O–567. U.S. Government Printing Office, Washington, D.C.

Dillon, Gregory K; Gilbertson-Day, Julie W. 2020. Wildfire Hazard Potential for the United States (270-m), version 2020. 3rd Edition. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2015-0047-3

Domenico, P.A., and F.W. Schwartz. 1990. Physical and chemical hydrogeology: New York, NY, John

Eastern Kentucky University. (2020, July 22). Top toxic chemicals in American industries. EKU Online. https://safetymanagement.eku.edu/blog/top-hazardous-materials-in-american-industries/.

Environmental Protection Agency. 2016. “Heat-Related Deaths.” Accessed April 2021 at https://www.epa.gov/sites/production/files/2016-08/documents/print_heat-deaths-2016.pdf.

Environmental Protection Agency; 430-R-16-061. October 2016. Climate Change and Extreme Heat. Accessed at https://www.epa.gov/sites/production/files/2016-10/documents/extreme-heat-guidebook.pdf

Fakih, L., & Majzoub, A. (2021, August 3). "They killed us from the inside". Human Rights Watch. https://www.hrw.org/report/2021/08/03/they-killed-us-inside/investigation-august-4-beirut-blast#.

Federal Emergency Management Agency. (2019). (rep.). Hazardous Materials Incidents: Guidance for State, Local. Tribal, Territorial, and Private Sectors.

Federal Emergency Management Agency. 2001. Understanding Your Risks (FEMA 386-2). Accessed September 2021 at https://mitigation.eeri.org/wp-content/uploads/FEMA_386_2.pdf

Federal Emergency Management Agency. 2004. FEMA 333 - Federal Guidelines for Dam Safety. Accessed at https://www.ferc.gov/sites/default/files/2020-04/fema-333.pdf

Federal Emergency Management Agency. 2013. FEMA 64 - Federal Guidelines for Dam Safety. Accessed at https://www.fema.gov/sites/default/files/2020-08/eap_federal_guidelines_fema_p-64.pdf

Federal Emergency Management Agency. 2018. Hazards, United States – Multi-Hazard (HAZUS-MH). Software Database.

Federal Emergency Management Agency. n.d. OpenFEMA Dataset: Disaster Declaration Summaries. Accessed at https://www.fema.gov/about/openfema/data-sets

Federal Emergency Management Agency. N.d. OpenFEMA Dataset: FIMA NFIP Redacted Claims. Accessed at https://www.fema.gov/flood-insurance

Federal Emergency Management Agency. No Date. Unit 13: Pandemic Scenario. Accessed May 2021 at https://training.fema.gov

Federal railroad Administration. (2020, February 25). Hazardous Materials Transportation. Hazardous Materials Transportation | FRA. https://railroads.dot.gov/program-areas/hazmat-transportation/hazardous-materials-transportation.

Freeze, R.A. and J.A. Cherry, J.A. 1979. Groundwater: Englewood Cliffs, N.J. Prentice-Hall, 604 pp

Haleem, A., Javaid, M., & Vaishya, R. (2020). Effects of COVID-19 pandemic in daily life. Current medicine research and practice, 10(2), 78–79. https://doi.org/10.1016/j.cmrp.2020.03.011

Hazardous materials incidents. Ready.gov. (2021, February 18). https://www.ready.gov/hazardous-materials-incidents.

International Railway Safety Council. (n.d.). Common Risks Managed by the Railway Industry. International Railway Safety Council. https://international-railway-safety-council.com/common-risks-managed-railway-industry/.

Javaria U. COVID-19 Severity Index comparison between Asia and Europe: A guide to Prevention from Pandemic. J Prev Med Vol. 5 Iss No.6: 69

Kleiner, Diana J. 1952. “Matagorda County,” Handbook of Texas Online, accessed May 05, 2015. Uploaded on may 28, 2021. Published by the Texas State Historical Association at https://www.tshaonline.org/handbook/entries/matagorda-county

Leake, S.A., 2016. Land Subsidence From Ground-Water Pumping. Accessed July 2021 at https://geochange.er.usgs.gov/sw/changes/anthropogenic/subside/

Madhav N, Oppenheim B, Gallivan M, et al. November 2017. Disease Control Priorities: Improving Health and Reducing Poverty. 3rd edition. Chapter 17. Accessed on May 2021 at https://www.ncbi.nlm.nih.gov/books/NBK525302/ DOI: 10.1596/978-1-4648-0527-1_ch17

National Academies of Sciences, Engineering, and Medicine. 2011. A Guide for Assessing Community Emergency Response Needs and Capabilities for Hazardous Materials Releases. Washington, DC: The National Academies Press. https://doi.org/10.17226/14502.

National Aeronautics and Space Administration. August 2, 2004. NASA News. Accessed at https://www.nasa.gov/home/hqnews/2004/jul/HQ_04252_glaciers.html

National Climatic Data Center Storm Event Database. 2021. Accessed September 2021 at https://www.ncdc.noaa.gov/stormevents/

National Drought Mitigation Center (University of Nebraska-Lincoln), United States Department of Agriculture, National Oceanic and Atmospheric Administration. April 2021. Drought Impact Reporter. Accessed April 2021 at Map of Drought Impacts (unl.edu).

National Drought Mitigation Center (University of Nebraska-Lincoln), United States Department of Agriculture, National Oceanic and Atmospheric Administration. April 6, 2021. United States Drought Monitor. Accessed at https://droughtmonitor.unl.edu/CurrentMap.aspx. Accessed April 2021.

National Integrated Drought Information System. September 2018. PDF. Accessed at https://www.drought.gov/sites/default/files/2020-07/NIDIS_NDAWN_StrategicPlan_2018.pdf

National Oceanic and Atmospheric Administration - National Weather Service. 2019. Storm Prediction Center WCM. Accessed March 2021 at https://www.spc.noaa.gov/wcm/

National Oceanic and Atmospheric Administration - National Weather Service. No date. Heat Index. Accessed at https://www.weather.gov/ama/heatindex

National Oceanic and Atmospheric Administration. 2020. Climate.gov – IBTrACS Historical Hurricane Tracks. Accessed at https://www.climate.gov/maps-data/dataset/historical-hurricane-tracks-gis-map-viewer

National Oceanic and Atmospheric Administration. 2021. Climate Data Online Search. Accessed September 15, 2021 at https://www.ncdc.noaa.gov/cdo-web/search

National Oceanic and Atmospheric Administration. No Date. National Hurricane Center and Central Pacific Hurricane Center – Saffir-Simpson Hurricane Wind Scale. Accessed at https://www.nhc.noaa.gov/aboutsshws.php

National Oceanic and Atmospheric Administration. No Date. National Hurricane Center and Central Pacific Hurricane Center – Tropical Cyclone Climatology. Accessed at https://www.nhc.noaa.gov/climo/

National Oceanic and Atmospheric Administration-National Centers for Environmental Information. April 2021. Drought Severity Index and Palmer Drought Hydrological Index. Accessed April 2021 at Historical Palmer Drought Indices | Temperature, Precipitation, and Drought | National Centers for Environmental Information (NCEI) (noaa.gov).

National Oceanic and Atmospheric Administration--National Centers for Environmental Information. April 2021. Standard Precipitation Index and Palmer Z Index. Accessed April 2021 at Drought - March 2021 | State of the Climate | National Centers for Environmental Information (NCEI) (noaa.gov).

National Oceanic and Atmospheric Administration-National Severe Strom Laboratory. N.d. Sever Weather 101- Damaging Winds. Accessed at https://www.nssl.noaa.gov/education/svrwx101/wind/

National Oceanic and Atmospheric Administration-National Weather Service. 2019. Storm Prediction Center WCM. Accessed March 2021 at https://www.spc.noaa.gov/wcm/

National Oceanic and Atmospheric Administration-National Weather Service. No Date. The Enhanced Fujita Scale (EF Scale). Accessed at https://www.weather.gov/oun/efscale

National Oceanic and Atmospheric Administration-National Weather Service. No date. Wind Chill Chart. Accessed at https://www.weather.gov/safety/cold-wind-chill-chart

National Research Council. 1991. Mitigating losses from land subsidence in the United State: Washington, D.C. National Academy Press, 58 p.

Natural Resources Defense Council. May 2012. "Killer Summer Heat: Projected Death Toll Rising Temperatures in America Due to Climate Change." Accessed at NRDC: Killer Summer Heat - Projected Death Toll from Rising Temperatures in America Due to Climate Change (PDF)

Olive, W.W., Chleborad, A.F., Frahme, C.W., Shlocker, Julius, Schneider, R.R., and Schuster, R.L. 1989. welling clays map of the conterminous United States. U.S Geological Survey. map, U.S Geological Survey.

Paine, J. G., Caudle, T., and Andrews, J. R., 2021, Shoreline movement and beach and dune volumetrics along the Texas Gulf Coast, 1930s to 2019: The University of Texas at Austin, Bureau of Economic Geology, final report prepared for the General Land Office under contract no. 16-201-000, 101 p.

Phelan, M. (2020, July 10). Why do lithium-ion batteries explode? Phelan Petty. https://phelanpetty.com/blog/why-do-lithium-ion-batteries-explode/.

Pipeline and Hazardous Materials Safety Administration. (2000, October 1). Serious Incident Definition.

Pipeline and Hazardous Materials Safety Administration. (2019, October 1). Pipeline Safety: Safety of Hazardous Liquid Pipelines. Federal Register. https://www.federalregister.gov/documents/2019/10/01/2019-20458/pipeline-safety-safety-of-hazardous-liquid-pipelines.

Pipeline and Hazardous Materials Safety Administration. (2021, May 5). PHMSA Regulations. PHMSA. https://www.phmsa.dot.gov/regulations.

Pipelines: Where are they? Texas Pipeline Awareness Alliance. (2018). https://pipeline-safety.org/pipelines-where-they-are/.

Pottroff & Karlin. (2021, February 2). Toxic spills. Train Accidents. https://www.pottroff.com/areas-of-practice/train-accidents/toxic-spills/.

Ratzlaff, K.W. 1982. Land-Surface Subsidence in the Texas Coastal Region: Texas Department of Water Resources Report 272, 26 p

Schattenber, P. (2021, March 2). Agricultural Losses From Winter Storm Exceed $600 Million. Accessed at https://today.tamu.edu/2021/03/02/agricultural-losses-from-winter-storm-exceed-600-million/

Shellenberger, M. (2019, May 28). If solar panels are so clean, why do they produce so much toxic waste? Forbes. https://www.forbes.com/sites/michaelshellenberger/2018/05/23/if-solar-panels-are-so-clean-why-do-they-produce-so-much-toxic-waste/?sh=6e19dfa0121c.

Sumrall, A. (2021, March 1). Winter Storm Uri Staggers Matagorda County Agriculture. Matagorda County. https://matagorda.agrilife.org/2021/03/01/winter-storm-uri-staggers-matagorda-county-agriculture/

Texas A&M Forest Service. 2021. Texas Wildfire Risk Assessment Portal (TxWRAP). Texas Wildfire Risk. Accessed at https://www.texaswildfirerisk.com/

Texas Commission on Environmental Quality (TCEQ). August 2009. Design and Construction Guidelines for Dams in Texas. Accessed at https://www.tceq.texas.gov/assets/public/comm_exec/pubs/rg/rg-473.pdf

Texas Department of Emergency Management. 2013. State of Texas Hazard Mitigation Plan. Accessed at https://www.yumpu.com/en/document/view/27406146/state-of-texas-hazard-mitigation-plan-texas-department-of-public-

Texas Department of Emergency Management. 2018. State of Texas Hazard Mitigation Plan. Accessed at http://tdem.wpengine.com/wp-content/uploads/2019/08/txHazMitPlan.pdf

Texas Department of Emergency Management. 2018. State of Texas Hazard Mitigation Plan. Accessed at http://tdem.wpengine.com/wp-content/uploads/2019/08/txHazMitPlan.pdf

Texas Health and Human Services. May 17, 2021. Texas COVID-19 Data. Accessed May 2021 at https://dshs.texas.gov/coronavirus/AdditionalData.aspx

Texas Parks & Wildlife. No date. Natural Regions of Texas. Accessed at https://tpwd.texas.gov/gis/#data

Texas Real Estate Research Center at Texas A&M University. No Date. Building Permits. Accessed at https://www.recenter.tamu.edu/data/building-permits

Texas Water Development Board. April 2014. Updated December 2016. "State of Texas Emergency Management Plan (Drought Annex)." Accessed at

Texas Water Development Board. No Date. Gulf Coast Aquifer. Accessed July 2021 at https://www.twdb.texas.gov/groundwater/aquifer/majors/gulf-coast.asp

Tomascik, J. (2021, May 18). Redfish farmers, industry suffer losses after freeze, COVID-19. Texas Farm Bureau. https://texasfarmbureau.org/redfish-farmers-industry-suffer-losses-after-freeze/.

United States Army Corps of Engineers. 1997. EM 1110-2-1420. Hydrologic Engineering Requirements for Reservoirs. Accessed at https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1420.pdf

United States Army Corps of Engineers. 2018. National Inventory of Dams (NID). Accessed at https://nid.sec.usace.army.mil

United States Bureau of Labor Statistics. 2021. FRED Economic Data. Accessed September 2021 at https://fred.stlouisfed.org/series/TXMATA1URN

United States Census Bureau. 2020. 2019 American Community Survey 5-Year Estimates. Accessed on September 14, 2021 at https://data.census.gov/cedsci/profile?g=0500000US48239

United States Department of Agriculture. 2017. Census of Agriculture - County Profile - Matagorda County, Texas. Accessed at https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Texas/cp48239.pdf

United States Department of Agriculture/PRISM Climate Group. 2015. 30-Year Normals. Accessed at https://prism.oregonstate.edu/normals/

United States Geological Survey. 1989. The Severity of an Earthquake. Accessed April 2021 at https://pubs.usgs.gov/gip/earthq4/severitygip.html

United States Geological Survey. 2000. Land Subsidence in the United States: USGS Fact Sheet-165-00. Accessed July 2021 at https://water.usgs.gov/ogw/pubs/fs00165/

United States Geological Survey. 2008. An Atlas of ShakeMaps for Selected Global Earthquakes. U.S. Geological Survey Open-File Report 2008-1236. Prepared by Allen, T.I., Wald, D.J., Hotovec, A.J., Lin, K., Earle, P.S. and Marano, K.D.

United States Geological Survey. 2010. PAGER—Rapid Assessment of an Earthquake's Impact. U.S. Geological Survey Fact Sheet 2010-3036.

United States Geological Survey. 2016. National Land Cover Database. MRLC. Accessed at https://www.mrlc.gov/national-land-cover-database-nlcd-2016

United States Geological Survey. 2021. Earthquake Hazards Accessed April 2021 at https://www.usgs.gov/natural-hazards/earthquake-hazards/earthquakes

United States Geological Survey. No Date. Land Subsidence. Accessed July 2021 at https://www.usgs.gov/mission-areas/water-resources/science/land-subsidence

Vaisala - National Lightning Detecting Network. 2020. Annual Lightning Report 2020. Accessed at https://www.vaisala.com/sites/default/files/documents/WEA-MET-Annual-Lightning-Report-2020-B212260EN-A.pdf

Vaisala - National Lightning Detecting Network. 2020. Annual Lightning Report 2020. Accessed at https://www.vaisala.com/sites/default/files/documents/WEA-MET-Annual-Lightning-Report-2020-B212260EN-A.pdf

Wertz, J. (2020, January 29). A Common Fertilizer Can Cause Explosions. Uneven Regulation Puts People at Risk. Center for Public Integrity. https://publicintegrity.org/environment/growing-food-sowing-trouble/fertilizers-explosive-potential-west-texas/.

Wilhite, D.A, and M.H. Glantz. 1985. Understanding the Drought Phenomenon: The Role of Definitions. Water International. 10 (3): 111-120. https://www.vaisala.com/sites/default/files/documents/WEA-MET-Annual-Lightning-Report-2020-B212260EN-A.pdf

Young, S., Pham, H., Lu, Z., & Qu, F. 2020. Mapping of Ground Surface Deformation Rates in Wharton County Based on the Analysis of Remote Sensing Data.

Young, S.C. 2016. Estimates of Land Subsidence in GMA 15 Based on Ground Surface Elevation Data and Model Results, prepared for Calhoun County GCD, Coastal Bend GCD, Coastal Plains GCD, Pecan

Jackson County

Hazard Mitigation Plan Update

APPENDIX A.

ACRONYMS AND DEFINITIONS

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ACRONYMS AND DEFINITIONS

ACRONYMS

Note: Acronyms are defined the first time they are used in each part of this plan

%g	Percent Gravity Acceleration
°C	Degrees Celsius
°F	Degrees Fahrenheit
44 CFR	Title 44 Code of Federal Regulations
AIDS	Acquired Immunodeficiency Syndrome
ASTM	American Society for Testing and Materials
BFE	Base Flood Elevation
BEG	Bureau of Economic Geology
CDC	Center for disease Control
CEM	Certified Emergency Manager
CEPRA	Coastal erosion Planning and Response Act
CFR	Code of Federal Regulations
COVID-19	Coronavirus Disease 2019
CPZ	Community Protection Zone
CRS	Community Rating System
CWA	Clean Water Act
CWPP	Community Wildfire Protection Plan
CWSRF	Clean Water State Revolving Fund
DCM	Drainage Criteria Manual
DMA	Disaster Mitigation Act of 2000
DMP	Drainage Master Plan
DPS	Department of Public Safety
EAP	Education and Awareness Program
EDA	Endangered Species Act
EDC	Economic Development Corporation
EF	Enhanced Fujita
EMS	Emergency Medical Services
ENS	Emergency Notification System
EOC	Emergency Operations Center

EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESD	Emergency Service District
ETJ	Extraterritorial Jurisdiction
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHBM	Flood Hazard Boundary Map
FIRM	Flood Insurance Rate Map
FRA	Federal Railroad Administration
gal	Gallon
GIS	Geographic Information System
GLF	Geophysical Log Facility
HAZMAT	Hazardous Materials
HAZUS-MH	Hazards United States Multi-Hazard
H-GAC	Houston-Galveston Area Council
HIV	Human Immunodeficiency Virus
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
IBC	international building code
IPAWS	Integrated Public Alert & Warning System
IRC	international residential code
ISD	Independent School District
JCCWDD	Jackson County County Wide Drainage District
JCHD	Jackson County Hospital District
kts	knots
kw	Kilowatt
LCRA	Lower Colorado River Authority
LNRA	Lavaca-Navidad River Authority
LPR	Local Plans and Regulations
ML	Local Magnitude Scale
MLI	Midterm Levee Inventory
mph	Miles per Hour
mR	Millirem

MUD	municipal utility district
MW	Moment Magnitude
NASA	National Aeronautic Space Administration
NCDC	National Climatic Data Center
NEHRP	National Earthquake Hazard Reduction Program
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NID	National Inventory of Dams
NIDIS	National Integrated Drought Information System
NLD	National Levee Database
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
NSP	Natural Systems Protection
NSSL	National Sever Storm Laboratory
NWS	National Weather Service
OTA	Congressional Office of Technology Assessment
Pct.	Precinct
PDI	Palmer Drought Index
PDM	Pre-Disaster Mitigation Grant Program
PGA	Peak Ground Acceleration
PHDI	Palmer Hydrological Drought Index
PHMSA	Pipeline and Hazardous Materials Safety Administration
PID	Photoionization Detector
PMF	Probable Maximum Flood
PSI	Pandemic Severity Index
SARS	Severe Acute Respiratory Syndrome
SFHA	Special Flood Hazard Area
SIP	Structure and Infrastructure Project
SPI	Standardized Precipitation Index
SSI	Storm Susceptibility Index
STP	South Texas Project
SWCD	Soil and Water Conservation District
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality

TCRFC	Texas Colorado River Floodplain Coalition
TDEM	Texas Division of Emergency Management
TFS	Texas Forest Service
TNRIS	Texas Natural Resources Information System
TSSWCB	Texas State Soil and Water Conservation Board
TSSWCD	Texas State Soil and Water Conservation District
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
TxWRAP	Texas A&M Forest Service Wildfire Risk Assessment Portal
UBC	Unified Building Code
UDC	Unified Development Code
U.S.	United States
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey
VFD	Volunteer Fire Department
VRI	Value Response Index
WCID	Water Control and Improvement District
WHO	World Health Organization
WHP	Wildfire Hazard Potential
WUI	Wildland Urban Interface

DEFINITIONS

100-Year Flood: The term "100-year flood" can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1% chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1% annual chance flood, which is now the standard definition used by most federal and state agencies and by the National Flood Insurance Program (NFIP).

Accredited Levee: A levee that is shown on a FIRM as providing protection from the 1% annual chance or greater flood. A **non-accredited** or **de-accredited levee** is a levee that is not shown on a FIRM as providing protection from the 1% annual chance or greater flood. A **provisionally accredited levee** is a previously accredited levee that has been de-accredited for which data and/or documentation is pending that will show the levee is compliant with NFIP regulations.

Acre-Foot: An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre-foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Asset: An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the "100-year" or "1% chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the NFIP are protected to the same degree against flooding.

Basin: A basin is an area within which all surface water, whether from rainfall, snowmelt, springs, or other sources, flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as "watersheds" and "drainage basins."

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable risk reduction factors, including a reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost-effectiveness.

Breach: An opening through which floodwaters may pass after part of a levee has given way.

Building: A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment: A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability
- Fiscal capability

Collapsible soils: Collapsible soils consist of loose, dry, low-density materials that collapse and compact under the addition of water or excessive loading. Soil collapse occurs when the land surface is saturated at depths greater than those reached by typical rain events. This saturation eliminates the clay bonds holding the soil grains together. Similar to expansive soils, collapsible soils result in structural damage such as cracking of the foundation, floors, and walls in response to settlement.

Common Vehicle: Disease transmitted by a common inanimate vehicle resulting in multiple infections; most commonly food or water

Community Protection Zones (CPZ): CPZs are based on an analysis of the "Where People Live" housing density data and surrounding fire behavior potential and represent those areas considered the highest priority for wildfire mitigation planning activities. “Rate of Spread” data is used to determine the areas of concern around populated areas that are within a 2-hour fire spread distance.

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

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as a habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. For the purposes of this plan, critical facilities include:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, or water-reactive materials.
- Hospitals, nursing homes, and housing are likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event.
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers are needed for disaster response before, during, and after hazard events.
- Public and private utilities, facilities, and infrastructure are vital to maintaining or restoring normal services to areas damaged by hazard events.
- Government facilities.

Dam: A barrier, including one for flood detention, designed to impound liquid volumes and which has a height of dam greater than six feet (Texas Administrative Code, Ch. 299, 1986).

Dam Failure: Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris Flow: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Deposition: Deposition is the placing of eroded material in a new location.

Disaster Mitigation Act of 2000 (DMA): The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster hazard mitigation grant program (HMGP) were established.

Drainage Basin: A basin is an area within which all surface water, whether from rainfall, snowmelt, springs, or other sources, flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Drainage basins are also referred to as **watersheds** or **basins.**

Drought: Drought is a period of time without substantial rainfall or snowfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages for some activity, group, or environmental function. Hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well-being, and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.

Earthquake: An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

Emergency Action Plan: A document that identifies potential emergency conditions at a dam and specifies actions to be followed to minimize property damage and loss of life. The plan specifies actions the dam owner should take to alleviate problems at a dam. It contains procedures and information to assist the dam owner in issuing early warning and notification messages to responsible downstream emergency management authorities of the emergency situation. It also contains inundation maps to show emergency management authorities the critical areas for action in case of an emergency. (FEMA 64)

Enhanced Fujita Scale (EF-scale): The EF-scale is a set of wind estimates (not measurements) based on damage. It uses 3-second gusts estimated at the point of damage based on a judgment of 8 levels of damage to the 28 indicators. These estimates vary with height and exposure. Standard measurements are taken by weather stations in openly exposed area.

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

Expansive Soil: Expansive soils are soils that expand when water is added and shrink when they dry out. They usually undergo significant volume change with the addition of depletion of pore water. Generally, the result of the chemical structure of certain types of clay soils.

Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

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

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

Fire Behavior: Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).

Fire Frequency: Fire frequency is the broad measure of the rate of fire occurrence in a particular area. An estimate of the areas most likely to burn is based on past fire history or fire rotation in the area, fuel conditions, weather, ignition sources (such as human or lightning), fire suppression response, and other factors.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate.

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

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's FIRM. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by floodwaters from any source. A FIRM identifies most, but not necessarily all, of a community's floodplain as the SFHA.

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation by more than one foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

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

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

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

Frequency: For the purposes of this plan, frequency refers to how often a hazard of a specific magnitude, duration, or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1% chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Fujita Scale of Tornado Intensity: Tornado wind speeds are sometimes estimated on the basis of wind speed and damage sustained using the Fujita Scale. The scale rates the intensity or severity of tornado events using numeric values from F0 to F5 based on tornado wind speed and damage. An F0 tornado (wind speed less than 73 miles per hour [mph]) indicates minimal damage (such as broken tree limbs), and an F5 tornado (wind speeds of 261 to 318 mph) indicates severe damage.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Ground Subsidence: Ground subsidence is the sinking of land over human-caused or natural underground voids and the settlement of native low-density soils.

Groundwater Depletion: Groundwater depletion occurs when groundwater is pumped from pore spaces between grains of sand and gravel. If an aquifer has beds of clay or silt within or next to it, the lowered water pressure in the sand and gravel causes slow drainage of water from the clay and silt beds. The reduced water pressure is a loss of support for the clay and silt beds. Because these beds are compressible, they compact (become thinner), and the effects are seen as a lowering of the land surface.

Hazard: A hazard is a source of potential danger or adverse condition that could harm people or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster.

Hazardous Materials (HAZMAT): Matter (solid, liquid, or gas) or energy that when released is capable of creating harm to people, the environment, and property, including weapons of mass destruction

Hazards U.S. Multi-Hazard (HAZUS-MH) Loss Estimation Program: HAZUS-MH is a GIS-based program used to support the development of risk assessments as required under the DMA. The HAZUS-MH software program assesses risk in a quantitative manner to estimate damages and losses associated with natural hazards. HAZUS-MH is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. HAZUS-MH has also been used to assess vulnerability (exposure) for other hazards.

High Hazard Dam: Dams where failure or operational error will probably cause loss of human life. (FEMA 333)

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

Hydraulics: Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology: Hydrology is the analysis of the waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

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

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

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

Inventory: The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Land Subsidence: Land subsidence is the loss of surface elevation due to the removal of subsurface support. In Texas, there are three types of subsidence that warrant the most concern: groundwater depletion, sinkholes in karst areas, and erosion.

Landslide: Landslides can be described as the sliding movement of masses of loosened rock and soil down a hillside or slope. Fundamentally, slope failures occur when the strength of the soils forming the slope exceeds the pressure, such as weight or saturation, acting upon them.

Levee: A man-made structure, usually an earthen embankment or concrete floodwall, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide reasonable assurance of excluding temporary flooding from the leveed area.

Lightning: Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a “bolt,” usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder. Lightning is a major threat during thunderstorms. In the United States, 75 to 100 people are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in fine-grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy and generally results in extreme property damage and threats to life and safety.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under state law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Actions: Mitigation actions are specific actions to achieve goals and objectives that minimize the effects of a disaster and reduce the loss of life and property.

National Flood Insurance Program (NFIP): The NFIP provides federally backed flood insurance in exchange for communities enacting floodplain regulations.

Objective: For the purposes of this plan, an objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal.

Outbreak: The sudden rise in the incidence of a disease.

Pandemic: An outbreak of a disease that occurs over a wide geographic area, such as multiple countries or continents, and typically affects a significant proportion of the population; a pandemic outbreak of a disease.

Peak Ground Acceleration: Peak Ground Acceleration is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate the probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

- Four or more paid flood losses in excess of $1,000; or
- Two paid flood losses in excess of $1,000 within any 10-year period since 1978; or
- Three or more paid losses that equal or exceed the current value of the insured property.

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

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk: Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to the occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking: This ranking serves two purposes, first to describe the probability that a hazard will occur, and second to describe the impact a hazard will have on people, property, and the economy. Risk estimates for the jurisdiction are based on the methodology that the jurisdiction used to prepare the risk assessment for this plan. The following equation shows the risk ranking calculation:

Risk Ranking = Probability + Impact (people + property + economy)

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

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

Significant Hazard Dam: Dams where failure or operational error will result in no probable loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities, or can impact other concerns. Significant hazard dams are often located in rural or agricultural areas but could be located in areas with population and significant infrastructure. (FEMA 333)

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

Soil Erosion: Soil erosion is the removal and simultaneous transportation of earth materials from one location to another by water, wind, waves, or moving ice.

Special Flood Hazard Area: The base floodplain is delineated on a FIRM. The SFHA is mapped as a Zone A in riverine situations. The SFHA may or may not encompass all of a community's flood problems.

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Stream Bank Erosion: Streambank erosion is common along rivers, streams, and drains where banks have been eroded, sloughed, or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair. Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%. For this study, steep slope is defined as slopes greater than 33%.

Sustainable Hazard Mitigation: This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

Thunderstorm: A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Tornado: A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

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

Tropical Depression: A tropical cyclone with maximum sustained surface wind speed (using the U.S. 1-minute average) ranges from 4 kt (39 mph) to 63 kt (73 mph).

Values Response Index (VRI): The wildfire VRI reflects a rating of the potential impact of a wildfire on values or assets. The VRI is an overall rating that combines the impact ratings for WUI (housing density) and Pine Plantations (pine age) into a single measure. VRI combines the likelihood of a fire occurring

Vector: Living organisms that can transmit infectious pathogens between humans, or from animals to humans (threat) with those areas of most concern that are adversely impacted by fire to derive a single overall measure of wildfire risk.

Vulnerability: Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Watershed: A watershed is an area that drains downgradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Wildfire: Wildfire refers to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. The topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.

Wildfire Hazard Potential (WHP): The wildfire threat or WHP is the likelihood of a wildfire occurring or burning into an area. The threat is calculated by combining multiple landscape characteristics including surface and canopy fuels, fire behavior, historical fire occurrences, weather observations, terrain conditions, and other factors.

Windstorm: Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

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

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

APPENDIX B.

LOCAL MITIGATION PLAN REVIEW TOOL

APPENDIX B.
LOCAL MITIGATION PLAN REVIEW TOOL

This appendix presents the local mitigation action review tool for the Jackson County Hazard Mitigation Plan. The review tool demonstrates how the plan meets federal regulations and offers state and FEMA planners an opportunity to provide feedback on the plan to the community.

LOCAL MITIGATION PLAN REVIEW TOOL

The Local Mitigation Plan Review Tool demonstrates how the local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

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

Jurisdiction:	**Title of Plan:**	**Date of Plan:**
Jackson County, Texas	Jackson County Hazard Mitigation Plan Update 2021	01/14/2022

Local Point of Contact: Kelly Janica	**Address:** 115 W. Main, Room 104 Edna, TX 77957
Title: Emergency Management Coordinator	
Agency: Jackson County Emergency Management	
Phone Number:	**E-mail:** jceoc@co.jackson.tx.us

State Reviewer:	**Title:**	**Date:**

FEMA Reviewer:	**Title:**	**Date:**
Date Received in REMA region VI:		
Plan Not Approved		
Plan Approvable Pending Adoption		
Plan Approved		

SECTION 1:
REGULATION CHECKLIST

REGULATION CHECKLIST Regulation (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan** (section and/or page number)	**Met**	**Not Met**
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Pages ES-1 to ES-4 (Executive Summary); Pages 3-1 to 3-2 (Section 3.2), 3-4 (Section 3.4); Pages 3-4 to 3-5 (Section 3.5)		
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Pages 3-4 to 3-6 (Sections 3.4 through 3.6); Page 3-8 (Section 3.8.1)		
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Pages 3-7 through 3-10 (Section 3.8)		
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Page 3-6 to 3-7 (Section 3.7); Pages 6-33 to 6-46 (Section 6.9); Pages 7-1 to 7-11 (Chapter 7)		
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Pages 24-1 through 24-5 (Sections 24.2.1 through 24.2.6); Page 24-5 to 24-9 (Section 24.2.7)		
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Pages 24-1 through 24-9 (Section 24.2); Pages E-1 through E-9 (Appendix E)		
ELEMENT A REQUIRED REVISIONS:			
ELEMENT B. HAZARD IDENTIFICATION AND RIASK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Chapters 8 through 21, including: • Section 1 of each chapter (General Background) describes the type of hazard • Section 2.2 of each chapter (Location) Section 2.3 (Frequency); and 2.4 (Severity) of each chapter, which describe the extent of the hazard		

REGULATION CHECKLIST Regulation (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan** (section and/or page number)	**Met**	**Not Met**
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	• Previous occurrences: Pages 6-3 and 6-4 (Section 6.2); Chapters 8 through 21, Section 2.1 (Past Events) of each chapter Probability of future events: Chapters 8 through 21, Section 2.3 (Frequency) of each chapter		
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Chapters 8 through 21; specifically, Section 2.4 (Severity), Section 4, 5, and/or 6 (Exposure, Vulnerability, and/or Exposure and Vulnerability) of each chapter		
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Page 12-32 through 12-35 (Section 12.6.2, Property)		
<u>ELEMENT B REQUIRED REVISIONS:</u>			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Pages 6-33 to 6-46 (Section 6.9); Pages 7-1 through 7-11 (Chapter 7); Pages 24-5 through 24-9 (Section 24.2.7)		
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Pages 6-38 through 6-48 (description of laws, ordinances, and programs for each jurisdiction); Pages 7-1 through 7-11 (floodplain ordinances and availability of DFIRMs); Pages 12-32 through 12-35		
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Pages 4-1 through 4-2 (Chapter 4)		
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Pages 23-1 through 23-27(Chapter 23); specifically, Tables 23-1 and 23-2		
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Pages 23-1 and 23-2 (Section 23.2)		
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Pages 24-5 through 24-9 (Section 24.2.7); Specifically, Table 24-1		

REGULATION CHECKLIST Regulation (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan** (section and/or page number)	**Met**	**Not Met**
ELEMENT C REQUIRED REVISIONS:			
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (appliable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Chapter 6.8 (pages 6-29 through 6-33) and Chapters 8 through 20, Section 6 or Section 7 of each chapter (Future Trends in Development)		
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Pages 2-1 through 2-14 (Chapter 2)		
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Pages 1-1 through 1-3 (Chapter 1); Pages 2-1 through 2-14 (Chapter 2)		
ELEMENT D REQUIRED REVISIONS:			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	Pre-adoption review: Documentation to be provided upon issuance of pre-adoption approval by TDEM and FEMA Region VI		
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	Pre-adoption review: Documentation to be provided upon issuance of pre-adoption approval by TDEM and FEMA Region VI		
ELEMENT E REQUIRED REVISIONS:			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
F1.			
F2.			
ELEMENT F REQUIRED REVISIONS:			

SECTION 2:
PLAN ASSESSMENT

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas that could be improved beyond minimum requirements.

Element A: Planning Process

Element B: Hazard Identification and Risk Assessment

Element C: Mitigation Strategy

Element D: Plan Review, Evaluation, and Implementation (Plan Updates Only)

B. Resources for Implementing Your Approved Plan

SECTION 3:

MULTI-JURISDICTION SUMMARY SHEET (OPTIONAL)

INSTRUCTIONS: For multi-jurisdictional plans, a Multi-jurisdiction Summary Spreadsheet may be completed by listing each participating jurisdiction, which required Elements for each jurisdiction were 'Met' or 'Not Met,' and when the adoption resolutions were received. This Summary Sheet does not imply that a mini-plan be developed for each jurisdiction; it should be used as an optional worksheet to ensure that each jurisdiction participating in the Plan has been documented and has met the requirements for those Elements (A through E).

MULTI-JURISDICTION SUMMARY SHEET													
							Requirements Met (Y/N)					
#	Jurisdiction Name	Jurisdiction Type (city/borough/ township/ village, etc.)	Plan POC	Mailing Address	Email	Phone	A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	**F. State Require-ments**
1	Jackson County	County	Kelly Janica		jceoc@co.jackson.tx.us	361-782-1743						
2	City of Edna	Incorporated City	Gary Broz		gbroz@cityofedna.com	361-782-3122						
3	City of Ganado	Incorporated City	Blake Petrash		mayorprotem@cityofganado.com	281-627-4671						
4	City of La Ward	Incorporated City	Richard Koch		koch_wr@yahoo.com	361-781-2929						

Jackson County

Hazard Mitigation Plan Update

APPENDIX C.

PUBLIC OUTREACH

APPENDIX C.
PUBLIC OUTREACH

This appendix includes the agenda, sign-in sheets, and meeting notes from each of the Steering Committee Meetings. This appendix also includes the community brochure and results of the Jackson County Hazard Mitigation Plan questionnaire, as described in Section 3.7.2.

Hazard Mitigation Plan Update – Jackson County

Stakeholder Meeting #1

Wednesday, September 29, 2021 @ 3:00 P.M.

Location: Edna, TX

DISCUSSION TOPICS:

1. Introductions
2. Project Overview
3. Plan Components
4. Risk Assessment
    a. Hazard Identification
    b. Hazard Analysis
5. Community Survey Response
6. Introduction to Mitigation Strategies
7. Next Steps
8. Questions and Comments Session

ATTENDEES:

Eric Scheibe – Scheibe Consulting, LLC
Abigail Ayers – Scheibe Consulting, LLC
Judge Jill S Sklar – Jackson County – Jackson County Judge
Kelly Janica – Jackson County – Emergency Management Coordinator
Gary Broz – City of Edna – City Manager
Blake Petrash – City of Ganado – mayor Pro-Tem
Kurt Janica – Jackson County Emergency Service District #3 – Edna – Fire Chief
Patrick Brzozowski – Lavaca Navidad River Authority (LNRA) – General Manager
Rick McBrayer – Victoria County – Emergency Management Coordinator
Brandon Crow – Inteplast Group – Project Manager
Shanna Lopez – Waste management – Municipal Solutions Manager
Lance Smiga – Jackson County Hospital District – CEO / City of Edna – Mayor
Matt Brogger – Formosa Plastics – Environment Department Manager –
Charles Givens – Jackson County County Wide Drainage District – Manager
Tina Matejek – Jackson County – Floodplain/Permitting

ATTENDANCE SIGN-IN SHEET:

:

Jackson County Hazard Mitigation Plan Update 2021
Stakeholder Meeting #1 – September 29, 2021

Entity	Title	Name	Email	Sign-In
Jackon County	Jackson County Judge	Jill S Sklar	j.sklar@co.jackson.tx.us	
Jackon County	Emergency Management Coordinator	Kelly Janica	jceoc@co.jackson.tx.us	
City of Edna	City manager	Gary Broz	gbroz@cityofedna.com	
City of Ganado	Mayor Pro-Tem	Blake Petrash	mayorprotem@cityofganado.com	
City of LaWard	Mayor	Richard Koch	koch_wr@yahoo.com	
Wharton County	Deputy Emergency Management Coordinator	Debbie Cenko	debbie.cenko@co.wharton.tx.us	
ESD #3 - Edna	Fire Chief	Kurt Janica	kjanica@jcesd3.org	
LNRA	General Manager	Patrick Brzozowski	pbrzozowski@lnra.org	
LNRA	Water Resource Manager	Doug Andres	danders@lnra.org	
Victoria County	Emergency Management Coordinator	Rick McBrayer	rmcbrayer@victoriatxoem.org	
Inteplast Group	Senior Director Texas Administration	Dan Martino Brandon Crow	dmartino@inteplast.com bcrow@inteplast.com	
Waste Management	Municipal Solutions Manager	Shanna Lopez	smarti10@wm.com	

Jackson County Hazard Mitigation Plan Update 2021
Stakeholder Meeting #1 – September 29, 2021

Entity	Title	Name	Email	Sign-In
Jackson County Hospital District	CEO	Lance Smiga	lsmiga@jchd.org	
City of Edna	Mayor	Lance Smiga		
Formosa Plastics	Environment Department Manager	Matt Brogger	MattB@ftpc.fpcusa.com	
JCCWDD	Manager	Charles Givens	charles@jccwdd.com	
Jackson County	Floodplain/Permitting	Tina Matejek	t.matejek@co.jackson.tx.us	

NOTES:

Introductions

Project Overview

- Overview of hazard mitigation and objectives of the hazard mitigation plan

Plan Components

- Organization of the Hazard Mitigation Plan document
- Description of each section

Risk Assessment

- Explanation of ranking system for each hazard and results
- Committee members were encouraged to provide input during the presentation regarding assessment information

  Hazard Identification

  - All hazards from the previous plan included in the update as well as the addition of three hazards: hazardous materials, land subsidence, and pandemic

  Hazard Analysis

  - Analysis of each hazard was presented as well as the overall ranking for each community
  - Committee member noted more information regarding dam locations and inundation areas can be acquired via contact at TCEQ
    - Edits will be made as necessary once information is provided by TCEQ
  - Population and Structure risk numbers to be discussed between Scheibe Consulting and LNRA for Lake Texana
  - Current drought loss estimates only include agricultural loss estimates annualized over period of record
    - LNRA representative suggested drought loss information include impacts on the community and local industry due to water restriction measures from lake Texana during drought
    - LNRA agreed to provide additional data if possible
  - Committee member noted although there are no earthquakes recorded in the planning area, tremors have occurred
    - Unsure of monitoring locations and who monitors the area
    - Monitoring locations might need to be expanded in the area to ensure data is collected accurately
  - LNRA noted an earthquake or tremor event within 50 miles of Lake Texana dam could cause catastrophic failure
  - Committee member stated a majority of local fire departments report through the NFIRS software system
    - This information is likely to be more accurate than that collected from Texas Forest Service

Community Survey Response

- Community survey response numbers are high but continued push for public involvement was advised

- Survey will close prior to the second meeting

Introduction to Mitigation Strategies

- Explanation of mitigation action was provided
- Mitigation Actions will be the topic of the next Stakeholder Meeting
- All mitigation action items from the previous plan identified as ongoing or delayed will be carried forward
- Pending action items for Jackson County were discussed
    - No information for item #2 was provided – item to be deleted
    - Item #6 complete
    - Items #25-#28 all to be carried forward for future acquisition opportunities
- The committee was encouraged to review the material provided prior to the meeting to prepare for mitigation action focused meeting

Next Steps

- Create mitigation action items – next meeting topic
- Committee was encouraged to continue to distribute the community survey to increase participation
    - Community participation will aid in creating mitigation action items
- Community survey will close prior to the second meeting
- Draft Review and final meeting will occur after finalization of mitigation actions

Questions and Comments Session

- New potential action items may be to expand the rain radar network. This may require coordination/discussion with NWS

Note

- A representative from the City of La Ward was unable to attend the meeting. A separate meeting was set up to review all material and comments which were discussed during the stakeholder meeting to ensure the City of La Ward's continued involvement in the update process. Meeting minutes for the review meeting are included below.

Hazard Mitigation Plan Update – Jackson County

City of La Ward Stakeholder Meeting #1 Review

Thursday, September 30, 2021 @ 3:00 P.M.

Location: Virtual

DISCUSSION TOPICS:

1. Review of Stakeholder Meeting #1 Material
2. Possible Mitigation Actions

ATTENDEES:

Eric Scheibe – Scheibe Consulting, LLC
Abigail Ayers – Scheibe Consulting, LLC
Richard Koch – City of La Ward – Mayor

NOTES:

Review of Stakeholder Meeting #1 Material

- Material presented during the Stakeholder Meeting #1 was reviewed
- All comments made during the presentation were discussed
- No comments/suggestions were made by the City of La Ward representative

Possible Mitigation Actions

- The City of La Ward is in the process of creating a drainage master plan
    - Contact will be made with the engineering company creating the plan to help identify future projects which might reduce flooding issues in the community
- The community is continually looking to update and improve the storm sewer system
- The city is in the process of updating the water system
- A possible mitigation item is to reduce the infiltration into the wastewater system

Jackson County Hazard Mitigation Plan
Public Involvement and Participation

Jackson County and the participating communities created a brochure as a means to engage the public in the hazard mitigation planning process. The brochure contained information informing the public of what a hazard mitigation plan is as well as the benefits of participating as a community member. Also included was a list of hazards reviewed in the update. The brochure provided the community with links and contact information for any questions or concerns regarding the update of the plan. Lastly, a link and QR code for the survey was provided for the community members to complete as a means of active participation in the update process. Flyers were also used to engage the public. The flyers contained links to the previously mentioned documents and surveys. The brochure and flyers were distributed through the planning partners' websites, social media pages, offices, and local newspapers.

A copy of the brochures and flyers provided to community members can be found below as well as the results of the community survey.

Jackson County Brochure (English):

JACKSON COUNTY HAZARD MITIGATION PLAN

What is a Hazard Mitigation Plan?

A HMP is "the representation of the jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision-makers as they commit resources to reducing the effects of natural hazards" (44 CFR 201.6).

Hazards Evaluated

- Coastal Erosion
- Dam/Levee Failure
- Drought
- Expansive Soils
- Extreme Heat
- Earthquake
- Flood
- Hail
- Hurricane and Tropical Storms
- Land Subsidence
- Lightning
- Pandemic
- Tornado
- Wildfire
- Wind
- Winter Weather
- Hazardous Materials

What are the benefits of participating in the Hazard Mitigation Plan?

- Protect public safety and prevent loss of life and injury.
- Reduce harm to existing and future development.
- Maintain community continuity and strengthen the social connections that are essential for recovery.
- Prevent damage to your community's unique economic, cultural, and environmental assets.
- Minimize operational downtime and accelerate recovery of government and businesses after disasters.
- Reduce the costs of disaster response and recovery and the exposure to risk for first responders.
- Help accomplish other community objectives, such as capital improvements, infrastructure protection, open space preservation, and economic resiliency.

Schedule

Phase 1: Organize and Review → Phase 2: Update Risk Assessment → Phase 3: Engage the Public → Phase 4: Assemble the Plan → Phase 5: Adopt/Implement the Plan

HOW YOU CAN HELP

Public input on the mitigation planning process is very important and residents are encouraged to educate themselves about the existing plan and offer comments on the update.

A link to the public survey for the 2021 update to the Jackson County Hazard Mitigation Plan is included. This survey will gather input and evaluate citizens' preparedness for natural disasters.

For more information about hazard mitigation visit the Jackson County Emergency Management Department website:
http://www.co.jackson.tx.us/page/jackson.Emergency

Jackson County Resident?

Take our survey!

https://www.surveymonkey.com/r/JacksonCountyHMP

– Or –

Scan the QR code to complete the survey

For any questions about hazard mitigation or the process, please contact:

Eric Scheibe, PE, CFM
Phone: (512) 263-0418
Email: escheibe@scheibeconsulting.com

SCHEIBE CONSULTING LLC

Jackson County Brochure (Spanish):

PLAN DE MITIGACIÓN DE RIESGOS DEL CONDADO DE JACKSON

¿Qué es un Plan de Mitigación de Riesgos?

El Plan de Mitigación de Riesgos forma parte del esfuerzo del Condado de Jackson de minimizar o eliminar el riesgo a largo plazo para la vida humana y la propiedad debido a peligros conocidos como sequias, inundaciones, tornados, incendios forestales y otros desastres importantes.

Riesgos Evaluados

- Falla en la represa/dique
- Sequia
- Suelos Expansivos
- Calor Extremo
- Terremoto
- Inundación
- Granizo
- Hundimiento de Tierra
- La Erosión Costera
- Huracanes y Tormentas Tropicales
- Materiales Peligrosos
- Relámpagos
- Pandemia
- Tornado
- Incendio forestal
- Vientos Fuertes
- Clima de Invierno Severo

¿Cuáles son los beneficios de participar en un Plan de Mitigación de Riesgos?

- Proteger la seguridad pública y prevenir la pérdida de vidas y lesión.
- Reducir el daño a comunidades existentes y desarrollo futuro.
- Mantener la continuidad de la comunidad y fortalecer las conexiones sociales que son esenciales para recuperación.
- Evite daños a los activos económicos, culturales y ambientales únicos de su comunidad.
- Minimice el tiempo de inactividad operativo y acelere la recuperación del gobierno y las empresas después de los desastres.
- Reducir los costos de respuesta y recuperación ante desastres y la exposición al riesgo para los socorristas.
- Ayude a lograr otros objetivos de la comunidad, como mejoras de capital, protección de la infraestructura, preservación de espacios abiertos y capacidad de recuperación económica.

CALENDARIO

1º Etapa: Preparación y Revisión → 2º Etapa: Actualización de la evaluación de Riesgos → 3º Etapa: Encuesta Pública → 4º Etapa: Finalización del Plan Actualizado → 5º Etapa: Implementación del Plan Actualizado

¿COMO PUEDO AYUDAR?

Es muy importante que la comunidad nos ayude a identificar y analizar los riesgos que los pueden afectar. Alentamos a todos los miembros de la comunidad que nos ofrezcan comentarios sobre el plan actual y su actualización. Un enlace con la encuesta publica sobre la actualización del Plan de Mitigación de Riesgos del Condado de Jackson se encuentro abajo.

Para más información sobre la mitigación de riesgos visite el sitio de web del Departamento de Emergencias del Condado de Jackson:

http://www.co.jackson.tx.us/page/jackson.Emergency

Para preguntas adicionales sobre la mitigación de riesgos o este proceso por favor contacte al:

Sr. Eric Scheibe, PE, CFM
Tel: (512) 263-0418
Email: escheibe@scheibeconsulting.com

SCHEIBE CONSULTING LLC

¿Residente del Condado de Jackson?

¡Contesta nuestra encuesta!

https://www.surveymonkey.com/r/EncuestaJackson

– O –

Escanea el Código QR para completar la encuesta

Jackson County Flyer:

JACKSON COUNTY HAZARD MITIGATION PLAN 2021 UPDATE

Jackson County and it's planning partners, the cities of Edna, Ganado, and La Ward, have been working to update the Jackson County Hazard Mitigation Plan. The general public is invited to participate in a community survey to gauge the public's exposure to and understanding of hazards.

Please take a few moments to review the community brochure and complete the survey using the following links/QR codes.

VIEW THE BROCHURE AND TAKE THE SURVEY HERE!

English Brochure –
https://scheibeconsulting.sharefile.com/d-s80cb14616ace4c0ea7ffe204a2a7f338
English Survey –
https://www.surveymonkey.com/r/JacksonCountyHMP
Spanish Brochure –
https://scheibeconsulting.sharefile.com/d-sa88b17121e7e417393848633199023b3
Spanish Survey –
https://www.surveymonkey.com/r/EncuestaJackson

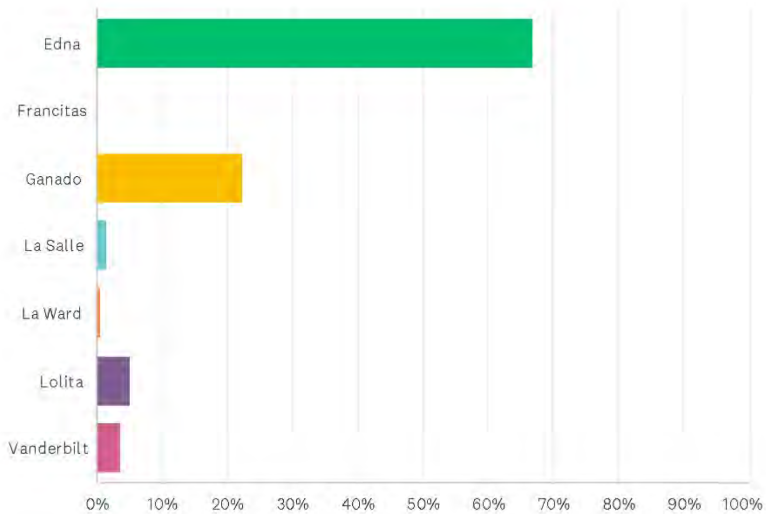
English		Spanish	
Brochure:	Survey:	Brochure:	Survey:

For more information about this process, please contact:
Eric Scheibe, PE, CFM
Scheibe Consulting, LLC
escheibe@scheibeconsulting.com

Jackson County Survey Results (English)

Q1 Where in Jackson County do you live?

Answered: 139 Skipped: 22



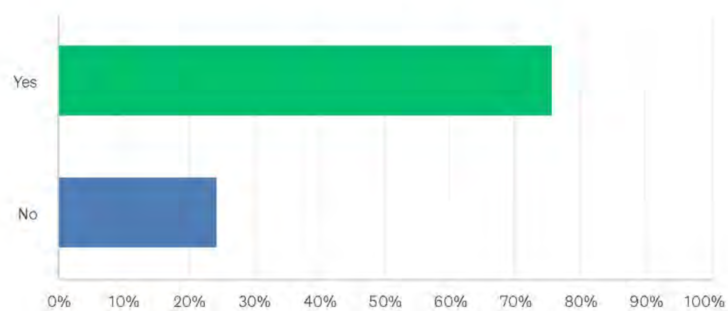
ANSWER CHOICES	RESPONSES	
Edna	66.91%	93
Francitas	0.00%	0
Ganado	22.30%	31
La Salle	1.44%	2
La Ward	0.72%	1
Lolita	5.04%	7
Vanderbilt	3.60%	5
TOTAL		139

#	OTHER (PLEASE SPECIFY)	DATE
1	Cape Carancahua	10/14/2021 8:12 AM
2	Cape carancahua	9/27/2021 6:26 PM
3	Cape Carancahua	9/25/2021 8:01 AM
4	Cape Carancahua	9/24/2021 9:41 AM
5	Cape Carancahua	9/23/2021 6:05 PM
6	Cape	9/23/2021 9:13 AM
7	Cape Carancuhua	9/22/2021 8:51 PM
8	Cape Carancahua	9/22/2021 5:57 PM

9	Palacios/Cape Carancahua	9/22/2021 12:04 PM
10	Cape Carancahua	9/22/2021 11:22 AM
11	Cape Carancuhua	9/21/2021 7:31 PM
12	Inez, Tx	9/17/2021 1:15 PM
13	El Toro	9/17/2021 1:04 PM
14	Victoria	9/17/2021 11:28 AM
15	Navidad Community	9/16/2021 9:47 AM
16	Cordele	9/14/2021 2:45 PM
17	PALACIOS	9/14/2021 11:20 AM
18	Cape Carancahua	9/13/2021 8:21 AM
19	Cape Carancahua	9/11/2021 6:43 PM
20	Cape Carancahua	9/11/2021 6:27 PM
21	Cape Carancahua	9/11/2021 3:48 PM
22	South of Edna	9/10/2021 3:38 PM
23	Cape Carancahua	9/10/2021 12:10 PM

Q2 Do you work in Jackson County?

Answered: 161 Skipped: 0

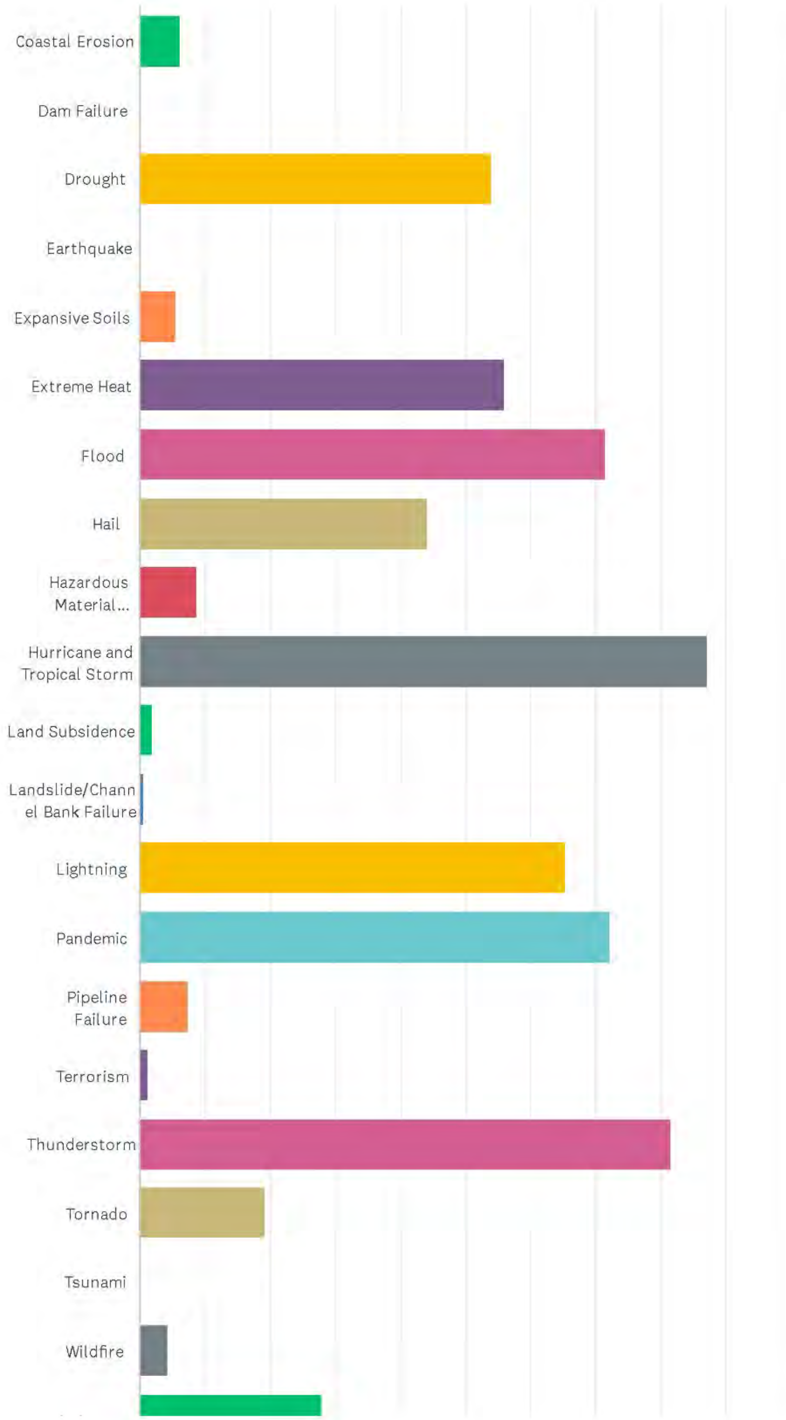


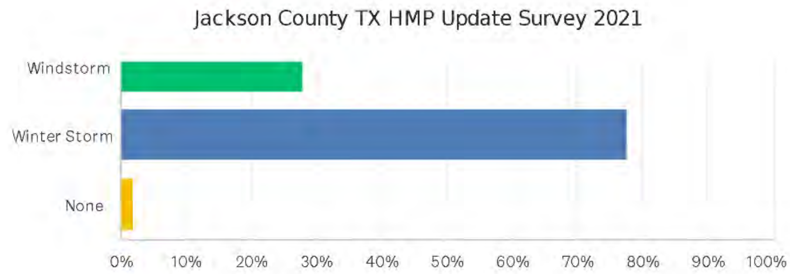
ANSWER CHOICES	RESPONSES	
Yes	75.78%	122
No	24.22%	39
TOTAL		161

Q3 Which of the following hazard events have you or anyone in your household experienced in the past 20 years within Jackson County? (Check all that apply)

Answered: 161 Skipped: 0

Jackson County TX HMP Update Survey 2021





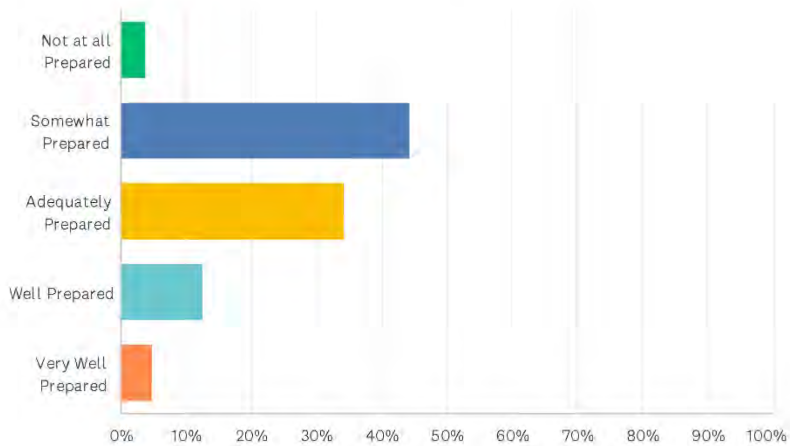
ANSWER CHOICES	RESPONSES	
Coastal Erosion	6.21%	10
Dam Failure	0.00%	0
Drought	54.04%	87
Earthquake	0.00%	0
Expansive Soils	5.59%	9
Extreme Heat	55.90%	90
Flood	71.43%	115
Hail	44.10%	71
Hazardous Material Release	8.70%	14
Hurricane and Tropical Storm	86.96%	140
Land Subsidence	1.86%	3
Landslide/Channel Bank Failure	0.62%	1
Lightning	65.22%	105
Pandemic	72.05%	116
Pipeline Failure	7.45%	12
Terrorism	1.24%	2
Thunderstorm	81.37%	131
Tornado	19.25%	31
Tsunami	0.00%	0
Wildfire	4.35%	7
Windstorm	27.95%	45
Winter Storm	77.64%	125
None	1.86%	3
Total Respondents: 161		

#	OTHER (PLEASE SPECIFY)	DATE
1	Freeze	9/25/2021 8:01 AM

2	Power outage	9/17/2021 1:15 PM
3	only lived here 2 years	9/17/2021 12:52 PM
4	Extreme winter freeze	9/13/2021 6:30 PM

Q4 How prepared is your household to deal with a natural hazard event?

Answered: 160 Skipped: 1

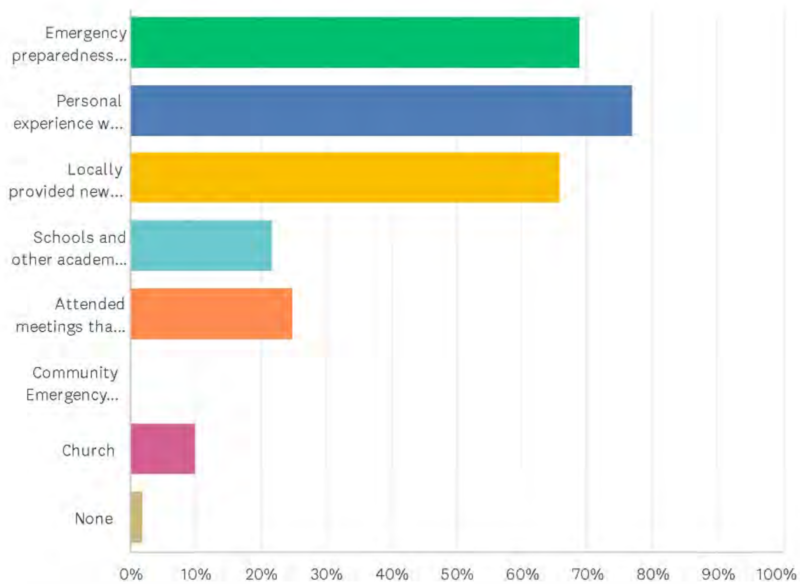


ANSWER CHOICES	RESPONSES	
Not at all Prepared	3.75%	6
Somewhat Prepared	44.38%	71
Adequately Prepared	34.38%	55
Well Prepared	12.50%	20
Very Well Prepared	5.00%	8
TOTAL		160

Q5 Which of the following have provided you with useful information to help you be prepared for a natural hazard event? (Check all that apply)

Answered: 161 Skipped: 0

Jackson County TX HMP Update Survey 2021

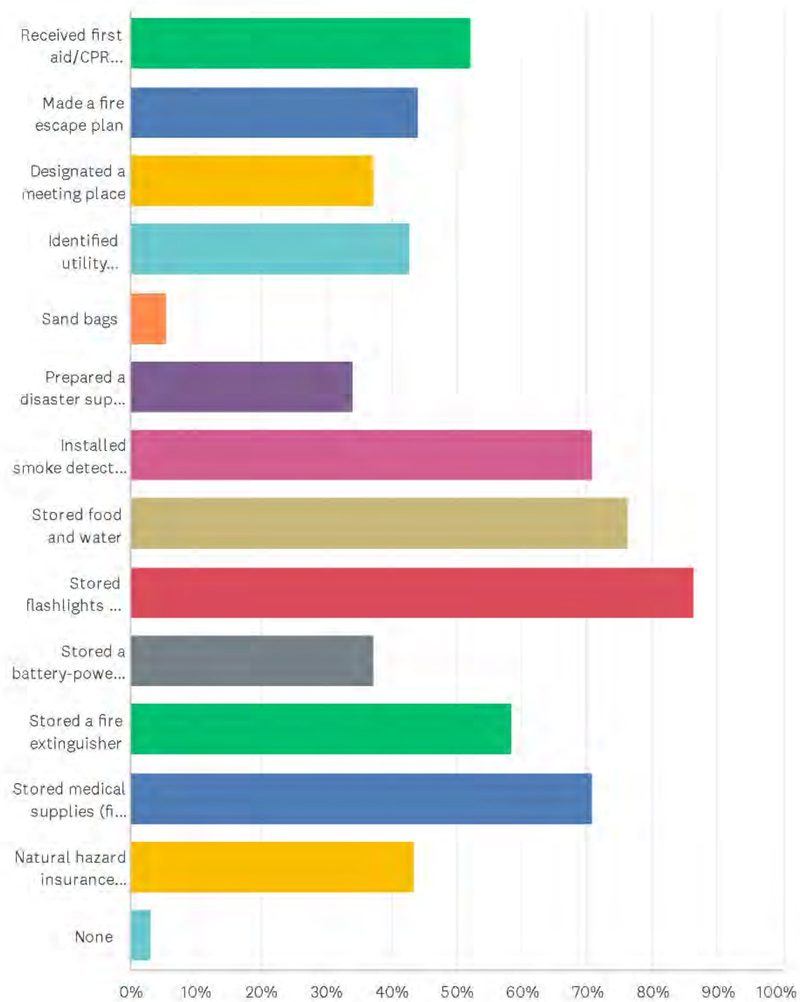


ANSWER CHOICES	RESPONSES	
Emergency preparedness information from a government source (e.g., federal, state, or local emergency management)	68.94%	111
Personal experience with one or more natural hazards/disasters	77.02%	124
Locally provided news or other media information	65.84%	106
Schools and other academic institutions	21.74%	35
Attended meetings that have dealt with disaster preparedness	24.84%	40
Community Emergency Response Training (CERT)	0.00%	0
Church	9.94%	16
None	1.86%	3
Total Respondents: 161		

#	OTHER (PLEASE SPECIFY)	DATE
1	32 years military service/military brat before my service	9/22/2021 9:45 PM
2	Social Media pages	9/22/2021 3:13 PM
3	Electric Cooperative	9/19/2021 4:49 PM
4	Neighbors	9/17/2021 1:15 PM
5	Internet	9/16/2021 1:45 PM
6	personal research	9/11/2021 3:48 PM

Q6 Which of the following steps has your household taken to prepare for a natural hazard event? (Check all that apply)

Answered: 161 Skipped: 0

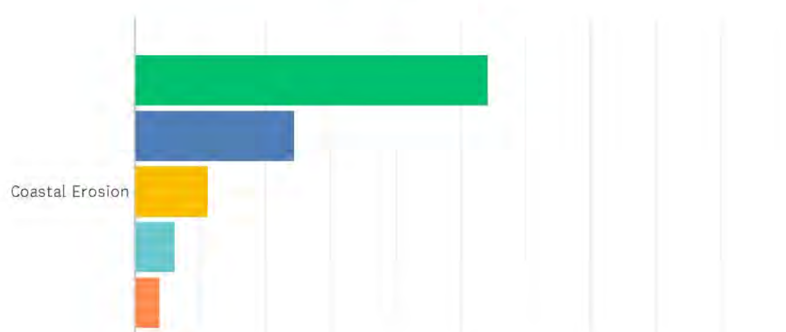


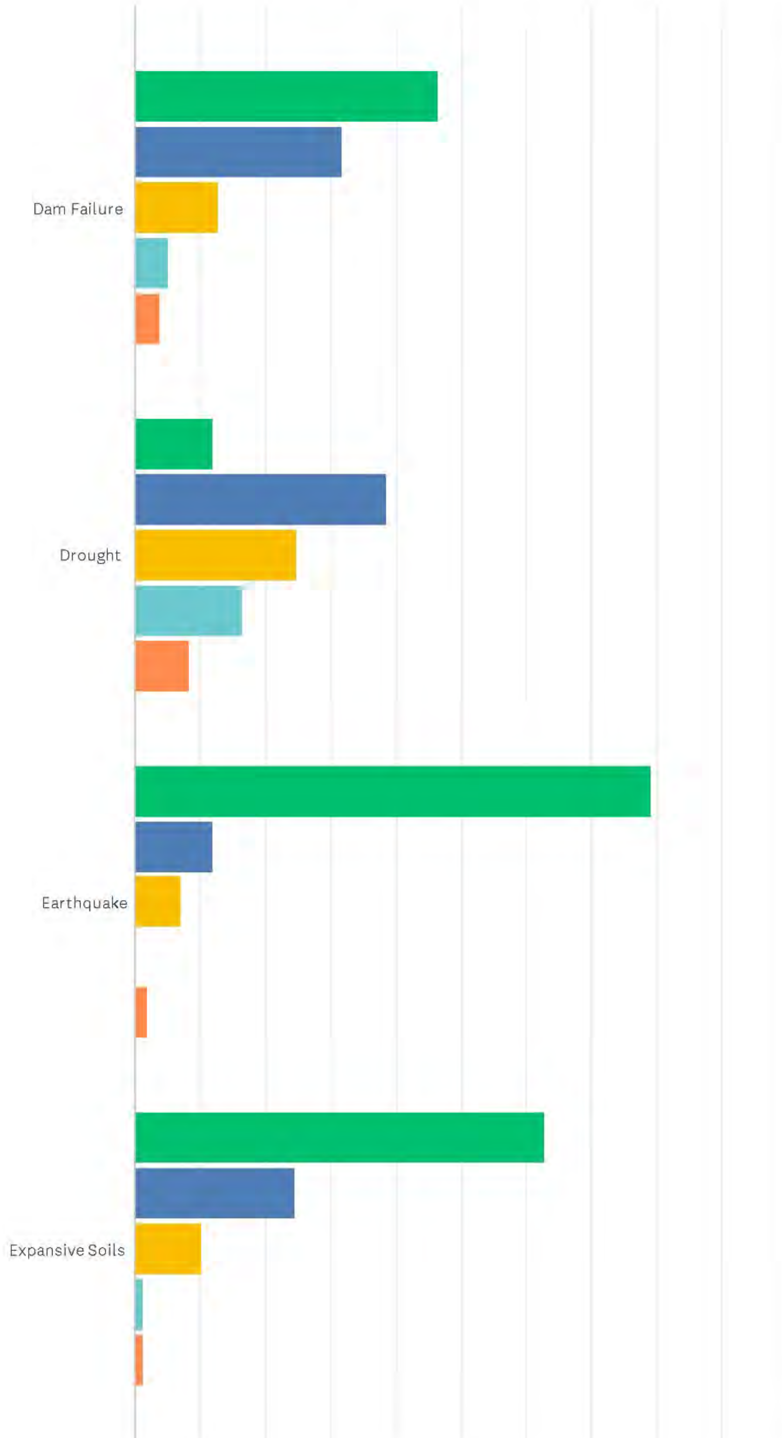
ANSWER CHOICES	RESPONSES	
Received first aid/CPR training	52.17%	84
Made a fire escape plan	44.10%	71
Designated a meeting place	37.27%	60
Identified utility shutoffs	42.86%	69
Sand bags	5.59%	9
Prepared a disaster supply kit	34.16%	55
Installed smoke detectors on each level of the house	70.81%	114
Stored food and water	76.40%	123
Stored flashlights and batteries	86.34%	139
Stored a battery-powered radio	37.27%	60
Stored a fire extinguisher	58.39%	94
Stored medical supplies (first aid kit, medications, personal protective equipment (PPE))	70.81%	114
Natural hazard insurance (Flood, Earthquake, Wildfire)	43.48%	70
None	3.11%	5
Total Respondents: 161		

#	OTHER (PLEASE SPECIFY)	DATE
1	Purchased emergency electrical generator	9/22/2021 3:13 PM
2	Bought a generator	9/21/2021 7:31 PM
3	Electric shut-offs / water shut-offs	9/17/2021 1:15 PM
4	generator	9/14/2021 11:06 AM
5	I'm a Fire Chief and my wife is an EMT	9/11/2021 3:48 PM

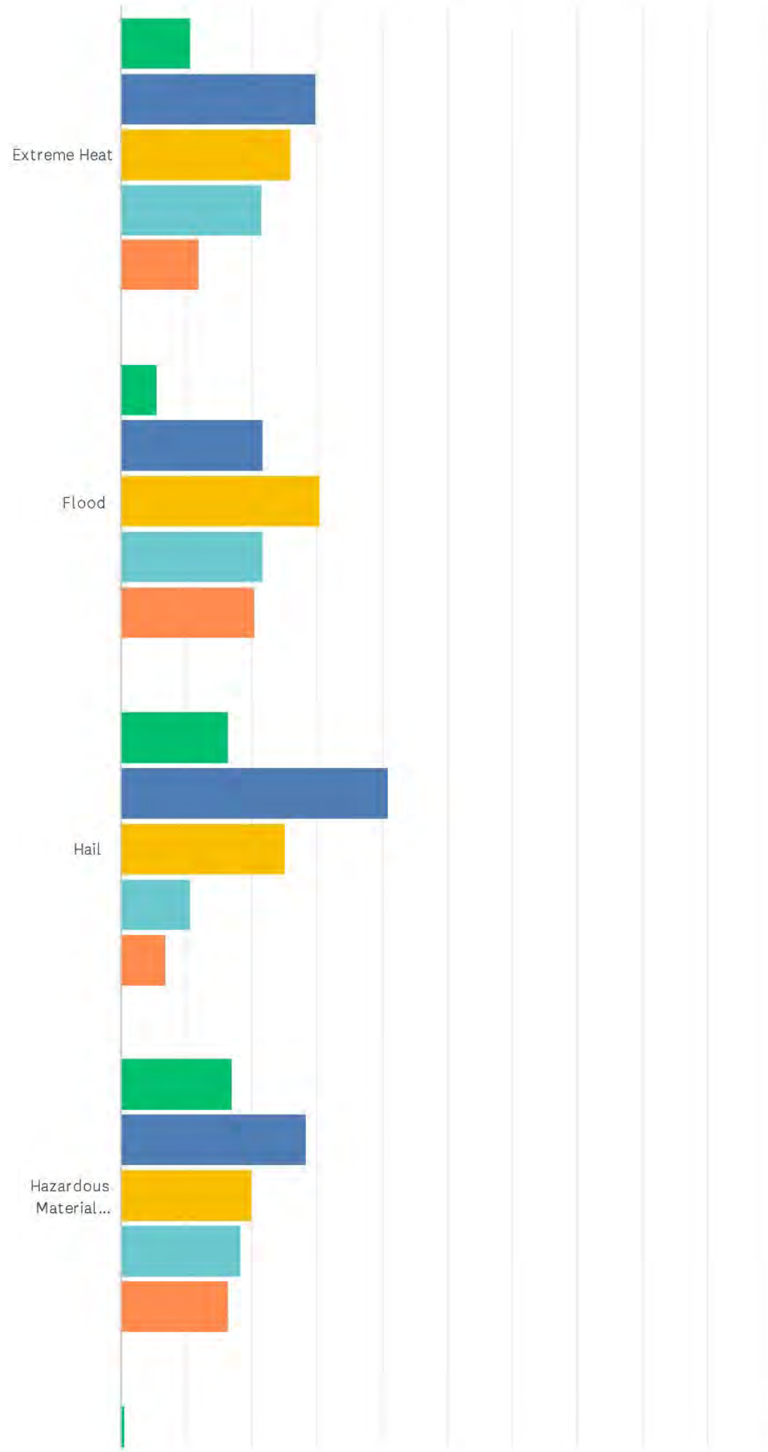
Q7 How concerned are you about the following natural hazards in Jackson County? (Check one response for each hazard)

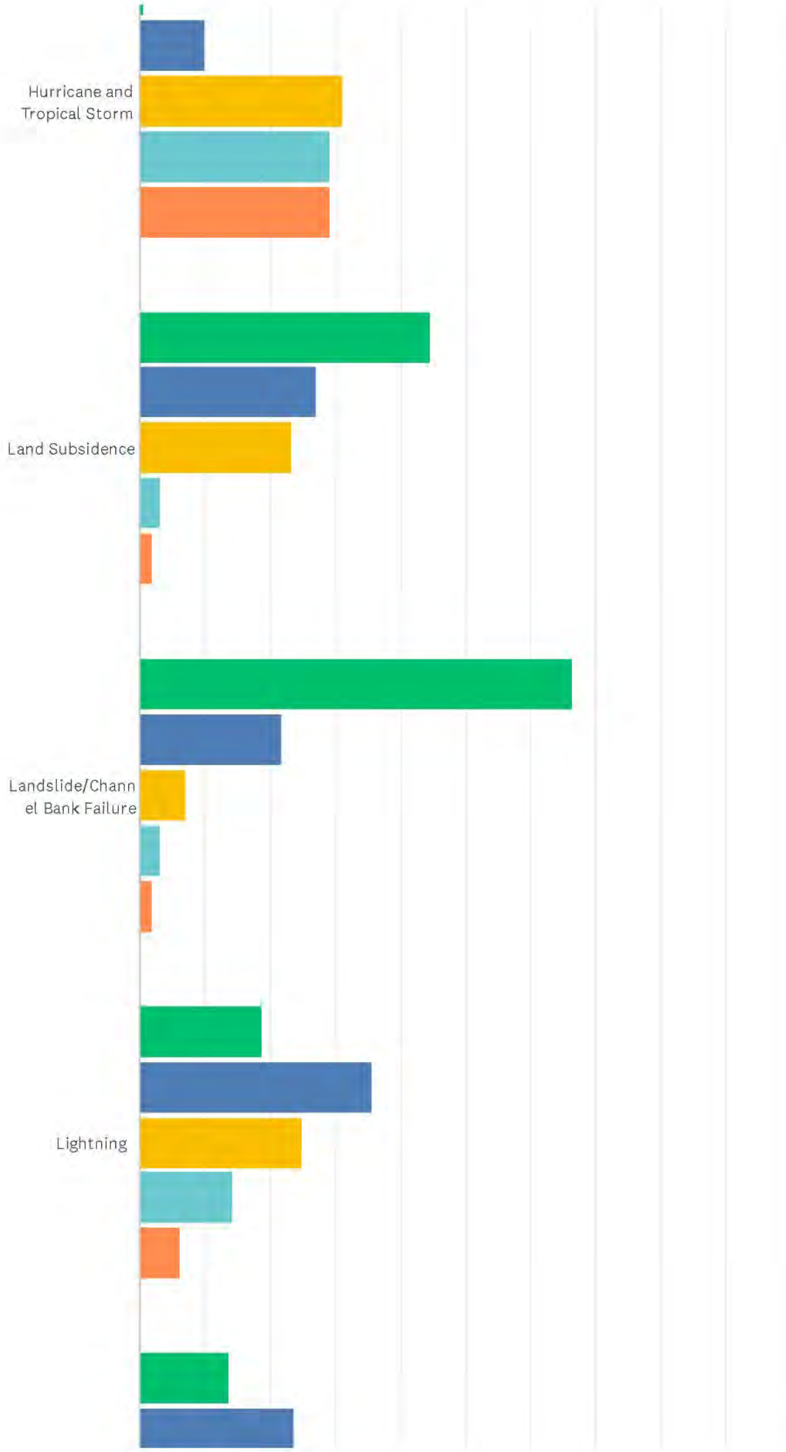
Answered: 161 Skipped: 0



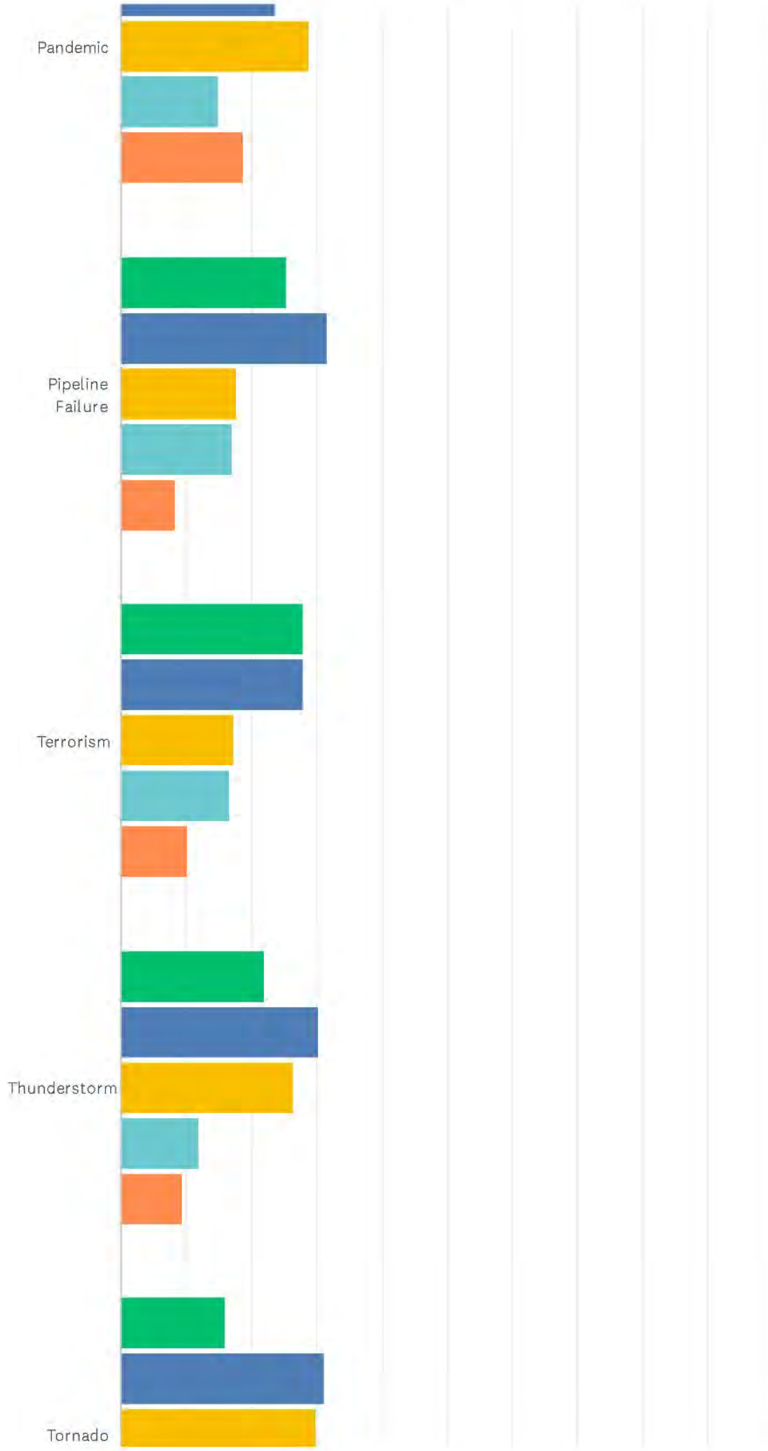

Dam Failure
Drought
Earthquake
Expansive Soils

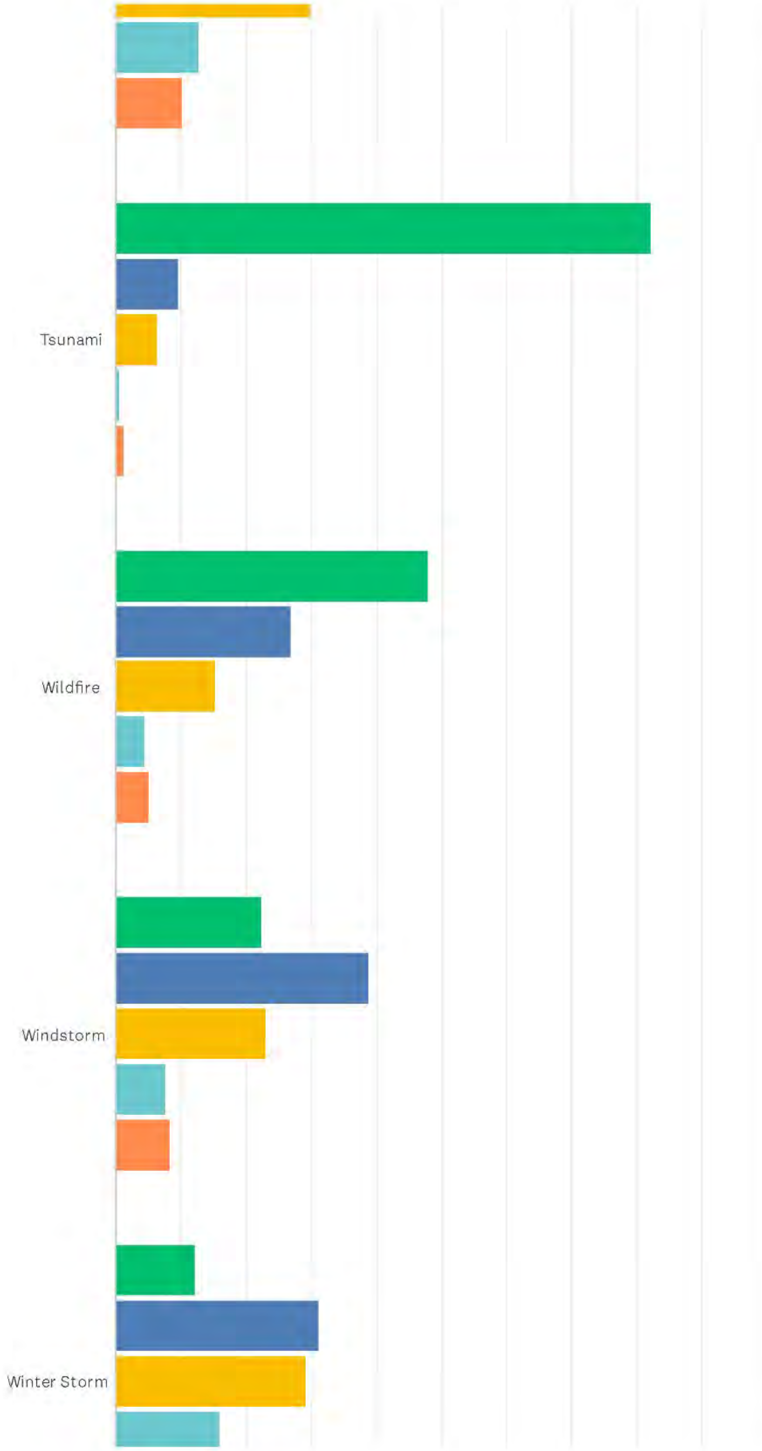
Jackson County TX HMP Update Survey 2021

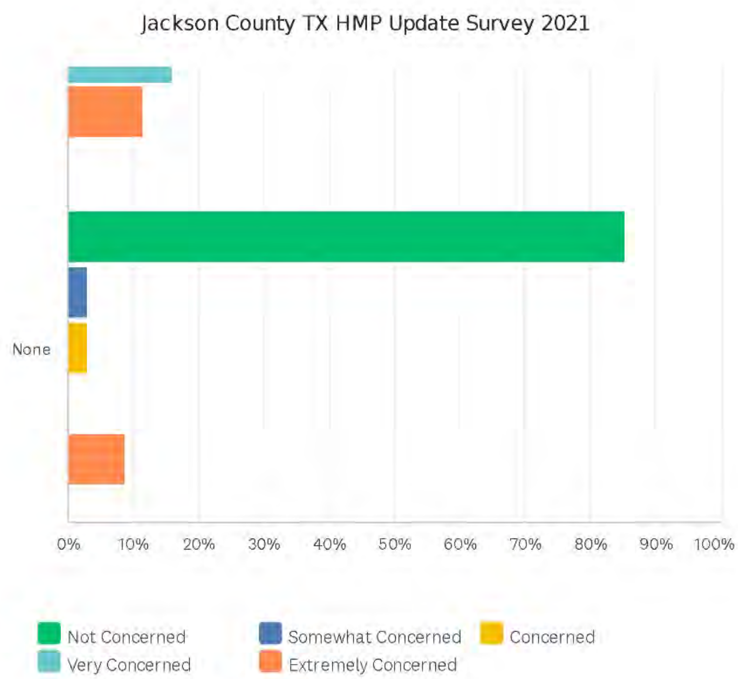



Hurricane and Tropical Storm
Land Subsidence
Landslide/Channel Bank Failure
Lightning

Jackson County TX HMP Update Survey 2021




Tsunami
Wildfire
Windstorm
Winter Storm


Jackson County TX HMP Update Survey 2021
None
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Not Concerned
Somewhat Concerned
Concerned
Very Concerned
Extremely Concerned

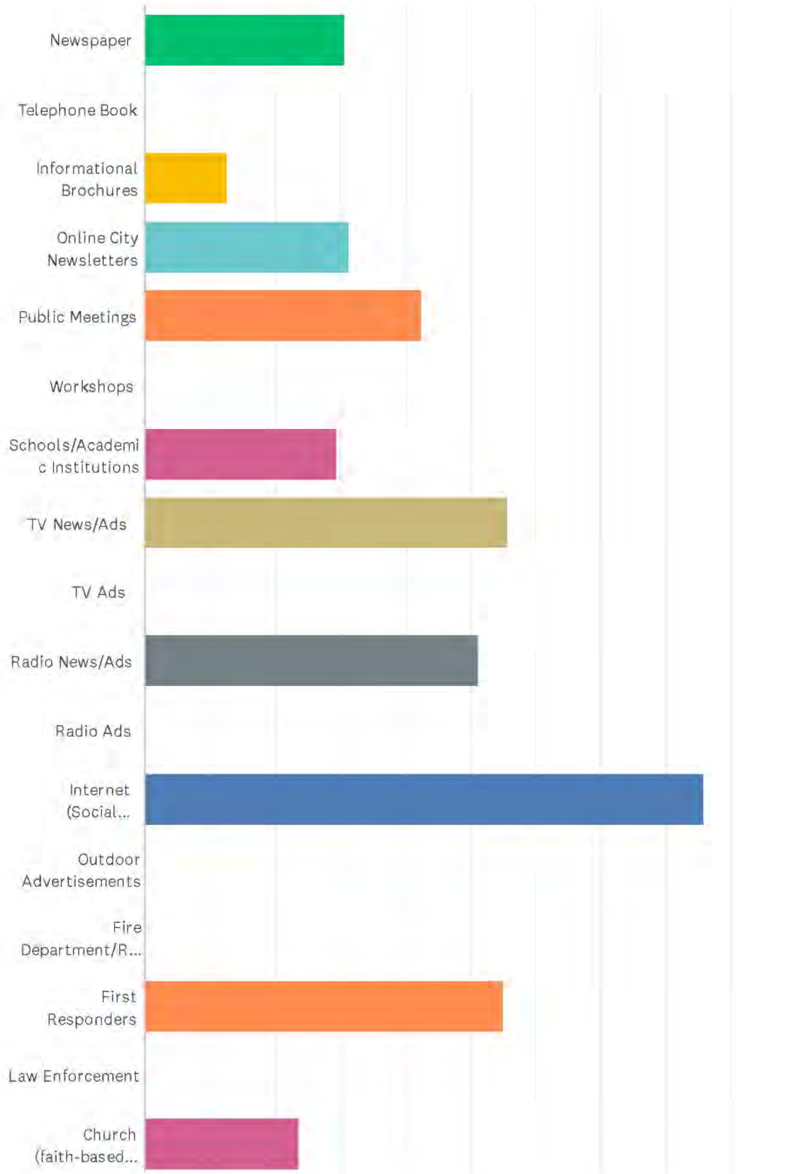
Jackson County TX HMP Update Survey 2021

	NOT CONCERNED	SOMEWHAT CONCERNED	CONCERNED	VERY CONCERNED	EXTREMELY CONCERNED	TOTAL
Coastal Erosion	54.09% 86	24.53% 39	11.32% 18	6.29% 10	3.77% 6	159
Dam Failure	46.50% 73	31.85% 50	12.74% 20	5.10% 8	3.82% 6	157
Drought	12.03% 19	38.61% 61	24.68% 39	16.46% 26	8.23% 13	158
Earthquake	79.11% 125	12.03% 19	6.96% 11	0.00% 0	1.90% 3	158
Expansive Soils	62.58% 97	24.52% 38	10.32% 16	1.29% 2	1.29% 2	155
Extreme Heat	10.76% 17	29.75% 47	25.95% 41	21.52% 34	12.03% 19	158
Flood	5.59% 9	21.74% 35	30.43% 49	21.74% 35	20.50% 33	161
Hail	16.35% 26	40.88% 65	25.16% 40	10.69% 17	6.92% 11	159
Hazardous Material Release	16.98% 27	28.30% 45	20.13% 32	18.24% 29	16.35% 26	159
Hurricane and Tropical Storm	0.62% 1	9.94% 16	31.06% 50	29.19% 47	29.19% 47	161
Land Subsidence	44.52% 69	27.10% 42	23.23% 36	3.23% 5	1.94% 3	155
Landslide/Channel Bank Failure	66.24% 104	21.66% 34	7.01% 11	3.18% 5	1.91% 3	157
Lightning	18.75% 30	35.63% 57	25.00% 40	14.37% 23	6.25% 10	160
Pandemic	13.75% 22	23.75% 38	28.75% 46	15.00% 24	18.75% 30	160
Pipeline Failure	25.32% 40	31.65% 50	17.72% 28	17.09% 27	8.23% 13	158
Terrorism	28.03% 44	28.03% 44	17.20% 27	16.56% 26	10.19% 16	157
Thunderstorm	22.01% 35	30.19% 48	26.42% 42	11.95% 19	9.43% 15	159
Tornado	15.92% 25	31.21% 49	29.94% 47	12.74% 20	10.19% 16	157
Tsunami	82.05% 128	9.62% 15	6.41% 10	0.64% 1	1.28% 2	156
Wildfire	48.08% 75	26.92% 42	15.38% 24	4.49% 7	5.13% 8	156
Windstorm	22.29% 35	38.85% 61	22.93% 36	7.64% 12	8.28% 13	157
Winter Storm	12.10% 19	31.21% 49	29.30% 46	15.92% 25	11.46% 18	157
None	85.29% 29	2.94% 1	2.94% 1	0.00% 0	8.82% 3	34

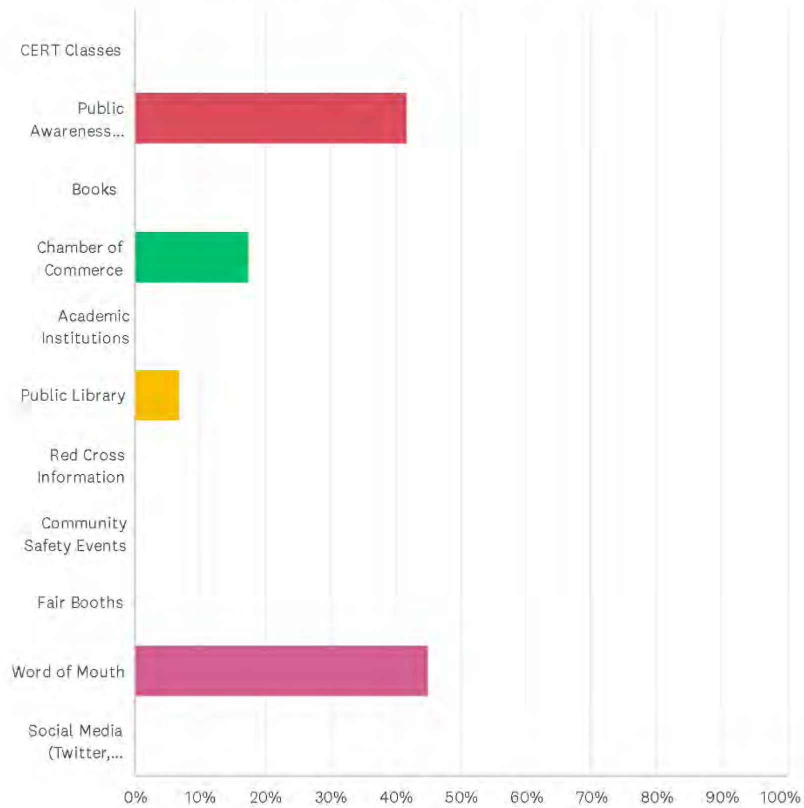
#	OTHER (PLEASE SPECIFY)	DATE
1	Illegal immigrants/gang activity	9/22/2021 5:21 PM

Q8 Which of the following methods do you think are most effective for providing hazard and disaster information? (Check all that apply)

Answered: 160 Skipped: 1



Jackson County TX HMP Update Survey 2021



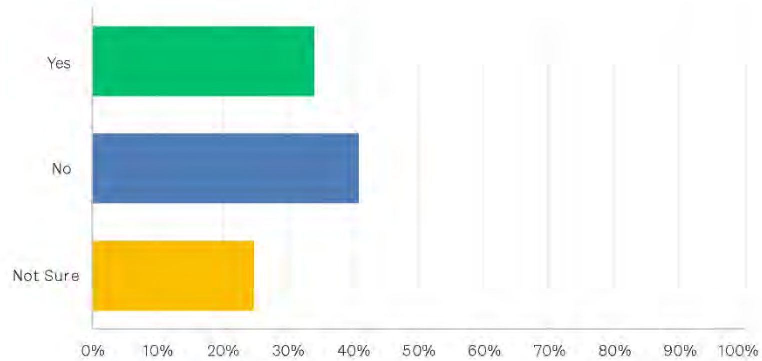
ANSWER CHOICES	RESPONSES	
Newspaper	30.63%	49
Telephone Book	0.00%	0
Informational Brochures	12.50%	20
Online City Newsletters	31.25%	50
Public Meetings	42.50%	68
Workshops	0.00%	0
Schools/Academic Institutions	29.38%	47
TV News/Ads	55.63%	89
TV Ads	0.00%	0
Radio News/Ads	51.25%	82
Radio Ads	0.00%	0
Internet (Social Media/Search Engine)	85.63%	137
Outdoor Advertisements	0.00%	0
Fire Department/Rescue	0.00%	0
First Responders	55.00%	88
Law Enforcement	0.00%	0
Church (faith-based institutions)	23.75%	38
CERT Classes	0.00%	0
Public Awareness Campaign (e.g., Flood Awareness Week, Winter Storm Preparedness Month)	41.88%	67
Books	0.00%	0
Chamber of Commerce	17.50%	28
Academic Institutions	0.00%	0
Public Library	6.88%	11
Red Cross Information	0.00%	0
Community Safety Events	0.00%	0
Fair Booths	0.00%	0
Word of Mouth	45.00%	72
Social Media (Twitter, Facebook, LinkedIn)	0.00%	0
Total Respondents: 160		

#	OTHER (PLEASE SPECIFY)	DATE
1	Cell phone weather alerts	9/22/2021 9:45 PM
2	Text Message	9/19/2021 4:49 PM

3	Judge Sklar	9/17/2021 10:58 AM
4	Emergency Operations Center and County Judge social media	9/16/2021 9:47 AM
5	Law Enforcement Dispatch Centers is best!	9/14/2021 12:29 PM
6	unfortunately, nothing works if people won't listen	9/11/2021 3:48 PM

Q9 Is your property located in or near a FEMA-designated floodplain?

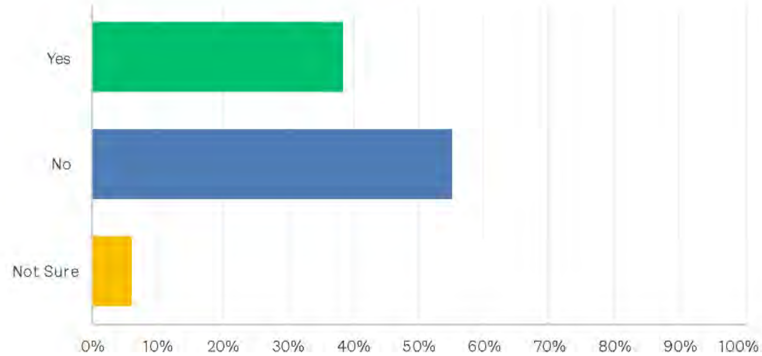
Answered: 161 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	34.16%	55
No	40.99%	66
Not Sure	24.84%	40
TOTAL		161

Q10 Do you have flood insurance?

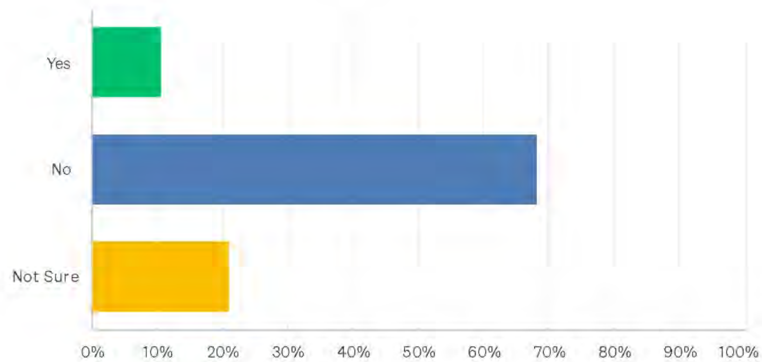
Answered: 161 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	38.51%	62
No	55.28%	89
Not Sure	6.21%	10
TOTAL		161

Q11 Is your property located in an area at risk for wildfires?

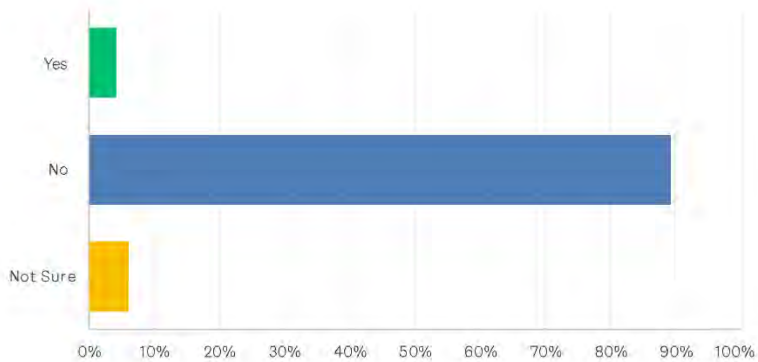
Answered: 161 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	10.56%	17
No	68.32%	110
Not Sure	21.12%	34
TOTAL		161

Q12 Have you ever had problems getting homeowners or renters insurance due to risks from natural hazards?

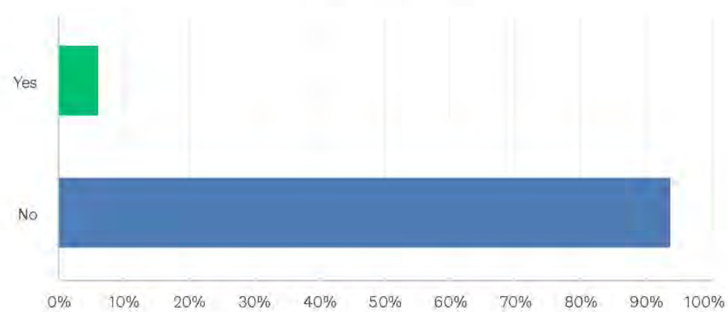
Answered: 161 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	4.35%	7
No	89.44%	144
Not Sure	6.21%	10
TOTAL		161

Q13 Do you have any special access or functional needs within your household that would require early warning or specialized response during disasters?

Answered: 160 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes	6.25%	10
No	93.75%	150
TOTAL		160

Q14 If the answer to question # 13 was “Yes”, would you like County Emergency Management personnel to contact you regarding your access and functional needs? If yes, please enter your contact information in the following text box.

Answered: 10 Skipped: 151

ANSWER CHOICES	RESPONSES	
Name	100.00%	10
Company	0.00%	0
Address	90.00%	9
Address 2	10.00%	1
City/Town	90.00%	9
State/Province	90.00%	9
ZIP/Postal Code	90.00%	9
Country	90.00%	9
Email Address	90.00%	9
Phone Number	80.00%	8

#	NAME	DATE
1	Larry Rausch	9/24/2021 9:41 AM
2	Bonnie thiele	9/22/2021 9:12 PM
3	Amber Stansberry	9/20/2021 10:18 AM
4	Michelle Overstreet	9/17/2021 1:54 PM
5	Chris Pustka	9/17/2021 1:15 PM
6	N/A	9/17/2021 10:28 AM
7	Aldric Edwards	9/16/2021 2:06 PM
8	1	9/14/2021 2:45 PM
9	Wayne Hunt	9/13/2021 7:13 PM
10	Robert Cardenas	9/11/2021 7:16 AM
#	COMPANY	DATE
	There are no responses.	
#	ADDRESS	DATE

1	1228 w bayshore dr	9/24/2021 9:41 AM
2	708 w Brackenridge	9/22/2021 9:12 PM
3	1010 West Gayle Street	9/20/2021 10:18 AM
4	707 Gilbert Rd.	9/17/2021 1:54 PM
5	48 Calle Arroyo	9/17/2021 1:15 PM
6	205 Dugger	9/16/2021 2:06 PM
7	1	9/14/2021 2:45 PM
8	5720 FM 234 N	9/13/2021 7:13 PM
9	920 Victoria Street. Apt 113	9/11/2021 7:16 AM

#	ADDRESS 2	DATE
1	1	9/14/2021 2:45 PM

#	CITY/TOWN	DATE
1	Palacios	9/24/2021 9:41 AM
2	Edna	9/22/2021 9:12 PM
3	Edna	9/20/2021 10:18 AM
4	Edna	9/17/2021 1:54 PM
5	Inez	9/17/2021 1:15 PM
6	Edna	9/16/2021 2:06 PM
7	1	9/14/2021 2:45 PM
8	Edna	9/13/2021 7:13 PM
9	Edna	9/11/2021 7:16 AM

#	STATE/PROVINCE	DATE
1	TX	9/24/2021 9:41 AM
2	Texas	9/22/2021 9:12 PM
3	Texas	9/20/2021 10:18 AM
4	TX	9/17/2021 1:54 PM
5	Tx	9/17/2021 1:15 PM
6	TX	9/16/2021 2:06 PM
7	1	9/14/2021 2:45 PM
8	Texas	9/13/2021 7:13 PM
9	Texas	9/11/2021 7:16 AM

#	ZIP/POSTAL CODE	DATE
1	77465	9/24/2021 9:41 AM
2	77957	9/22/2021 9:12 PM
3	77957	9/20/2021 10:18 AM
4	77957	9/17/2021 1:54 PM
5	77968	9/17/2021 1:15 PM
6	77957	9/16/2021 2:06 PM
7	1	9/14/2021 2:45 PM

8	77057	9/13/2021 7:13 PM
9	77957	9/11/2021 7:16 AM

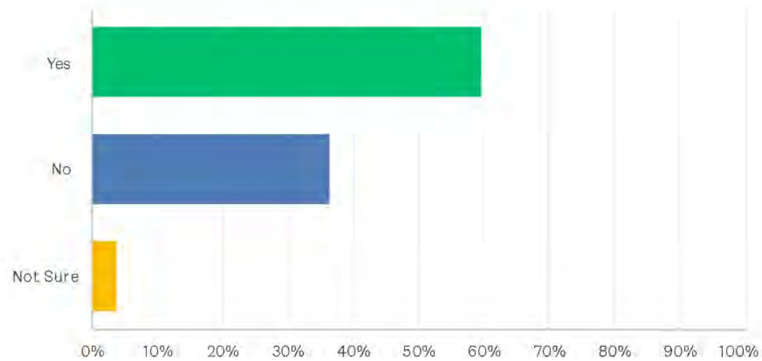
#	COUNTRY	DATE
1	United States	9/24/2021 9:41 AM
2	Usa	9/22/2021 9:12 PM
3	United States	9/20/2021 10:18 AM
4	USA	9/17/2021 1:54 PM
5	USA	9/17/2021 1:15 PM
6	'Merica	9/16/2021 2:06 PM
7	1	9/14/2021 2:45 PM
8	Jackson's.	9/13/2021 7:13 PM
9	USA	9/11/2021 7:16 AM

#	EMAIL ADDRESS	DATE
1	rausch.larry@gmail.com	9/24/2021 9:41 AM
2	thieleb@att.net	9/22/2021 9:12 PM
3	astansberry@ednaisd.org	9/20/2021 10:18 AM
4	mvrstrt@yahoo.com	9/17/2021 1:54 PM
5	judypustka@yahoo.com	9/17/2021 1:15 PM
6	aldricedwards@gmail.com	9/16/2021 2:06 PM
7	1	9/14/2021 2:45 PM
8	w.hunt@co.jackson.tx.us	9/13/2021 7:13 PM
9	cardrk@sbcglobal.net	9/11/2021 7:16 AM

#	PHONE NUMBER	DATE
1	9495052099	9/24/2021 9:41 AM
2	3617812102	9/22/2021 9:12 PM
3	3616494657	9/20/2021 10:18 AM
4	3617826572	9/17/2021 1:54 PM
5	3616499246	9/17/2021 1:15 PM
6	1	9/14/2021 2:45 PM
7	3617814960	9/13/2021 7:13 PM
8	361-649-5617	9/11/2021 7:16 AM

Q15 When you moved into your home, did you consider the impact a natural disaster could have on your home?

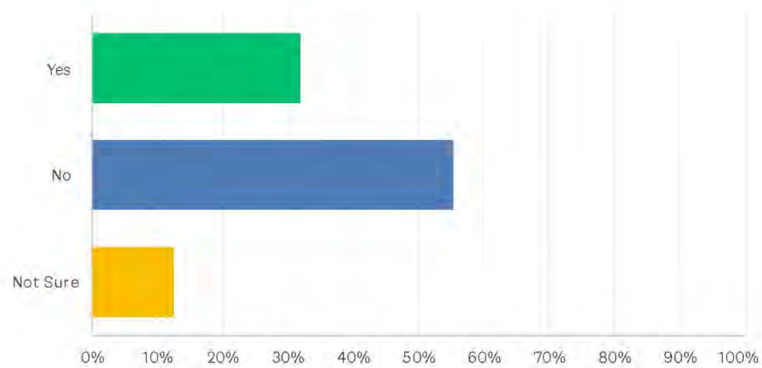
Answered: 159 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	59.75%	95
No	36.48%	58
Not Sure	3.77%	6
TOTAL		159

Q16 Was the presence of a natural hazard risk zone (e.g., dam failure zone, flood zone, landslide hazard area, high fire risk area) disclosed to you by a real estate agent, seller, or landlord before you purchased or moved into your home?

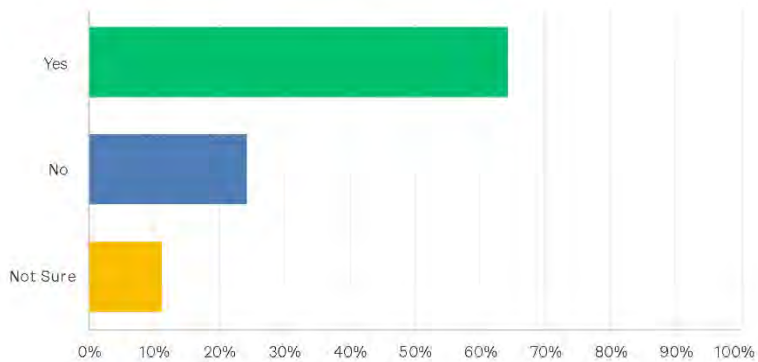
Answered: 159 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	32.08%	51
No	55.35%	88
Not Sure	12.58%	20
TOTAL		159

Q17 Would the disclosure of this type of natural hazard risk information influence your decision to buy or rent a home?

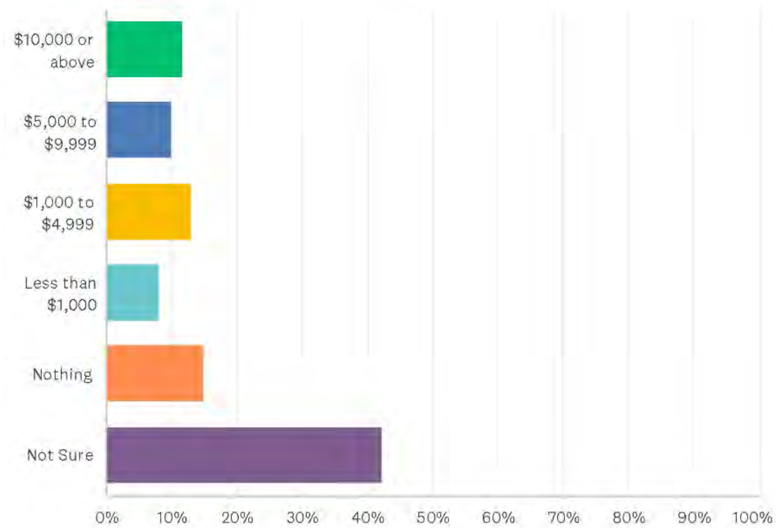
Answered: 160 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes	64.38%	103
No	24.38%	39
Not Sure	11.25%	18
TOTAL		160

Q18 How much money would you be willing to spend to retrofit your home to reduce risks associated with natural disasters? (for example, by clearing brush and plant materials from around your home to create a "defensible space" for wildfire, performing seismic upgrades, or replacing a combustible roof with non-combustible roofing)

Answered: 161 Skipped: 0

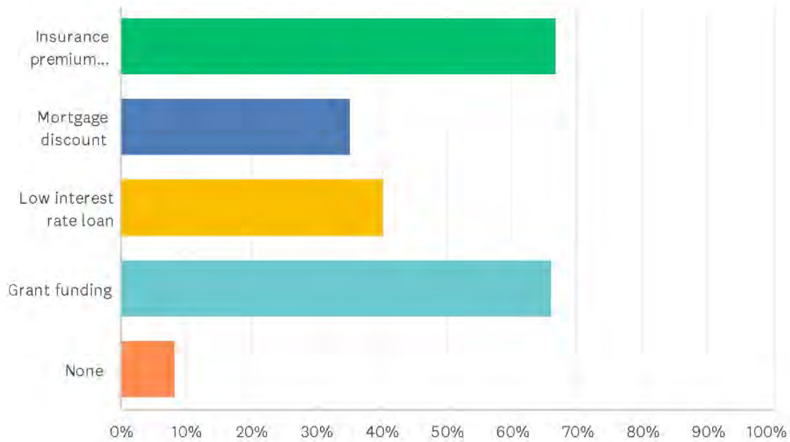


ANSWER CHOICES	RESPONSES	
$10,000 or above	11.80%	19
$5,000 to $9,999	9.94%	16
$1,000 to $4,999	13.04%	21
Less than $1,000	8.07%	13
Nothing	14.91%	24
Not Sure	42.24%	68
TOTAL		161

Q19 Which of the following incentives would encourage you to spend money to retrofit your home to protect against natural disasters? (Check all that apply)

Answered: 156 Skipped: 5

Jackson County TX HMP Update Survey 2021

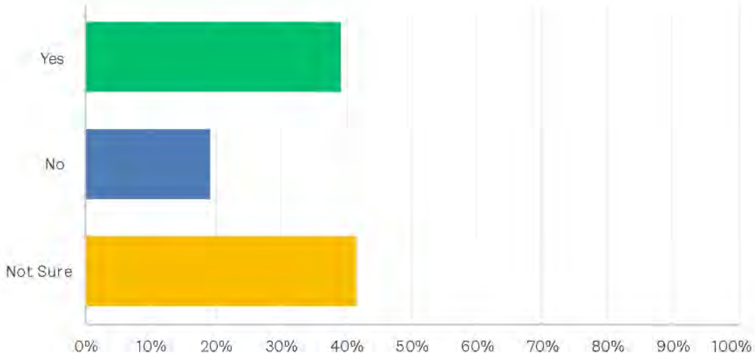


ANSWER CHOICES	RESPONSES	
Insurance premium discount	66.67%	104
Mortgage discount	35.26%	55
Low interest rate loan	40.38%	63
Grant funding	66.03%	103
None	8.33%	13
Total Respondents: 156		

#	OTHER (PLEASE SPECIFY)	DATE
1	I can barely afford my current living expenses, on a teacher's retirement.	9/23/2021 8:08 AM
2	Free	9/15/2021 6:47 PM
3	Not sure	9/13/2021 6:32 PM
4	I will take of my own self without a handout	9/10/2021 2:19 PM

Q20 If your property were located in a designated "high hazard" area or had received repetitive damages from a natural hazard event, would you consider a "buyout" offered by a public agency?

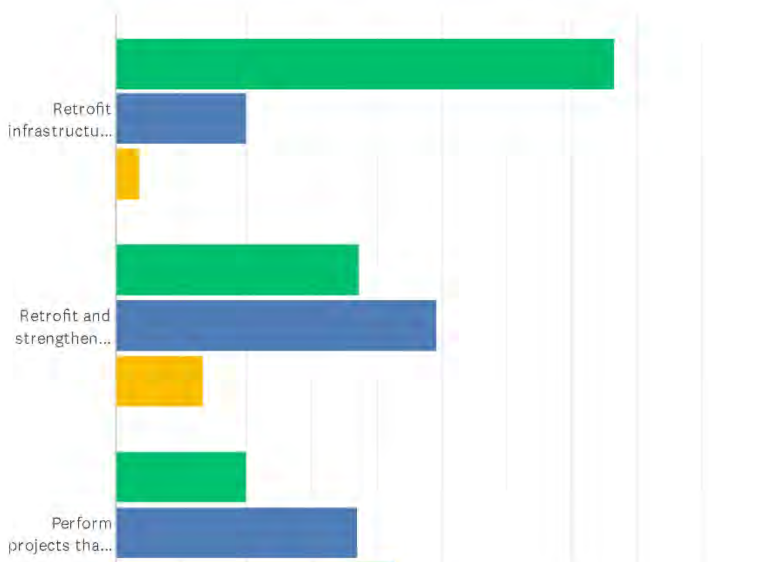
Answered: 161 Skipped: 0



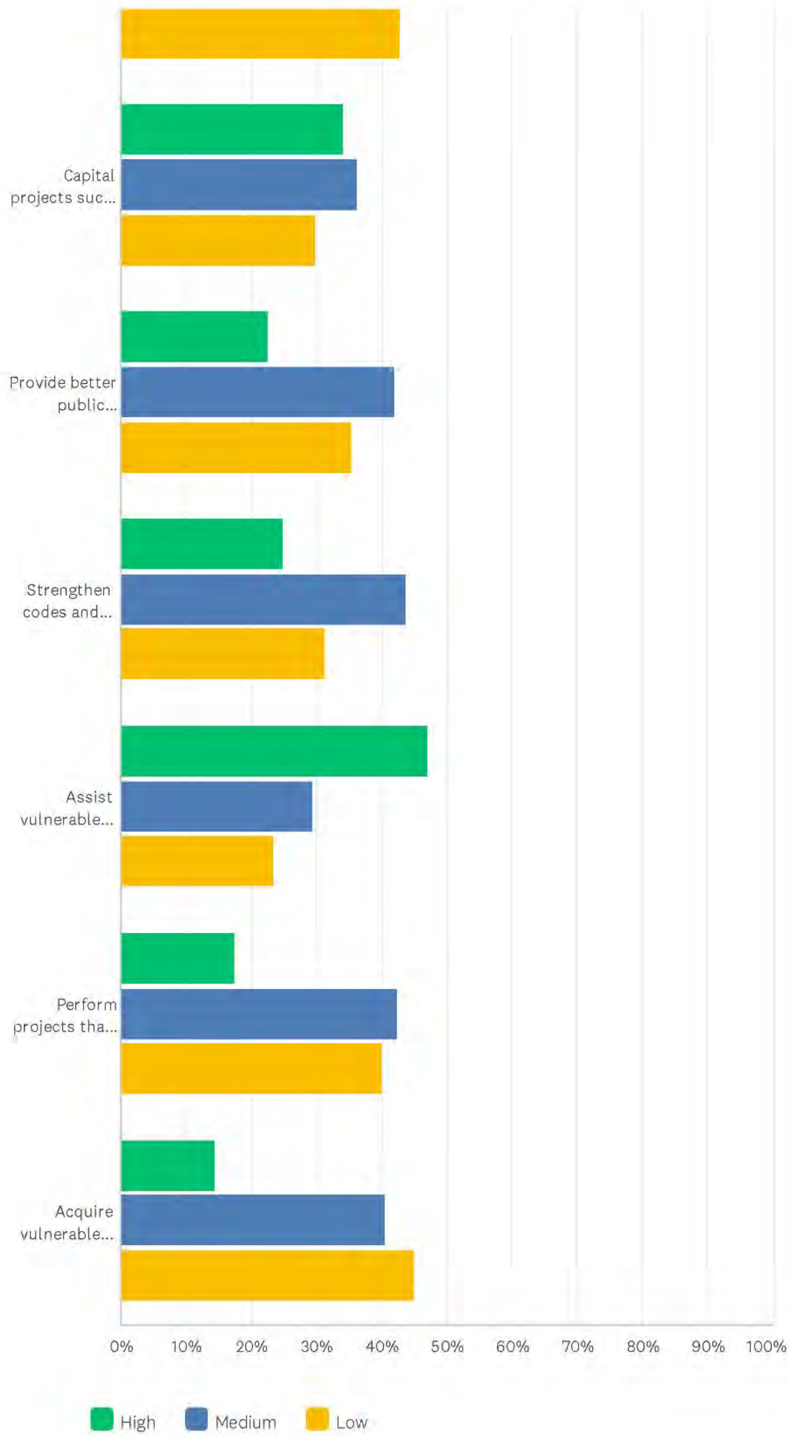
ANSWER CHOICES	RESPONSES	
Yes	39.13%	63
No	19.25%	31
Not Sure	41.61%	67
TOTAL		161

Q21 What types of projects do you believe the County, State, or Federal government agencies should be doing in order to reduce damage and disruption from hazard events within Jackson County? Please rank each option as a high, medium, or low priority.

Answered: 158 Skipped: 3



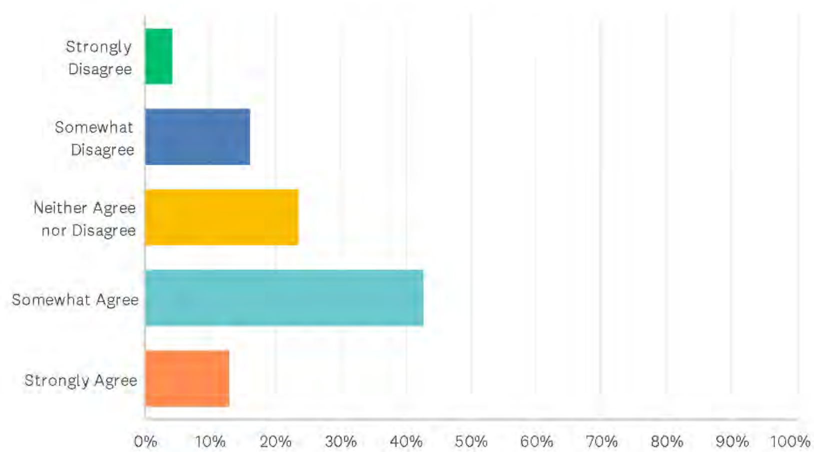
Jackson County TX HMP Update Survey 2021



	HIGH	MEDIUM	LOW	TOTAL
Retrofit infrastructures such as roads, bridges, drainage facilities, levees, water supply, waste water and power supply facilities.	76.47% 65	20.00% 17	3.53% 3	85
Retrofit and strengthen essential facilities such as police, fire, schools and hospitals.	37.31% 25	49.25% 33	13.43% 9	67
Perform projects that restore the natural environments capacity to absorb the impacts from natural hazards.	20.00% 7	37.14% 13	42.86% 15	35
Capital projects such as dams, levees, flood walls, drainage improvements and bank stabilization projects.	34.04% 16	36.17% 17	29.79% 14	47
Provide better public information about risk, and the exposure to hazards within the operational area.	22.58% 7	41.94% 13	35.48% 11	31
Strengthen codes and regulations to include higher regulatory standards in hazard areas.	25.00% 4	43.75% 7	31.25% 5	16
Assist vulnerable property owners with securing funding for mitigation.	47.06% 16	29.41% 10	23.53% 8	34
Perform projects that mitigate the potential impacts from climate change.	17.50% 7	42.50% 17	40.00% 16	40
Acquire vulnerable properties and maintain as open space.	14.49% 10	40.58% 28	44.93% 31	69

Q22 Please indicate how you feel about the following statement: It is the responsibility of government (local, state and federal) to provide education and programs that promote citizen actions that will reduce exposure to the risks associated with natural hazards. (Choose one)

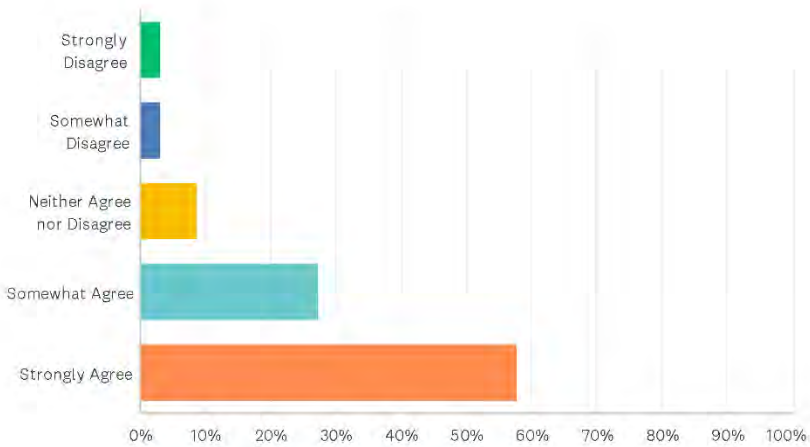
Answered: 161 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Disagree	4.35%	7
Somewhat Disagree	16.15%	26
Neither Agree nor Disagree	23.60%	38
Somewhat Agree	42.86%	69
Strongly Agree	13.04%	21
TOTAL		161

Q23 Please indicate how you feel about the following statement: It is my responsibility to educate myself and take actions that will reduce my exposure to the risks associated with natural hazards. (Choose one)

Answered: 161 Skipped: 0

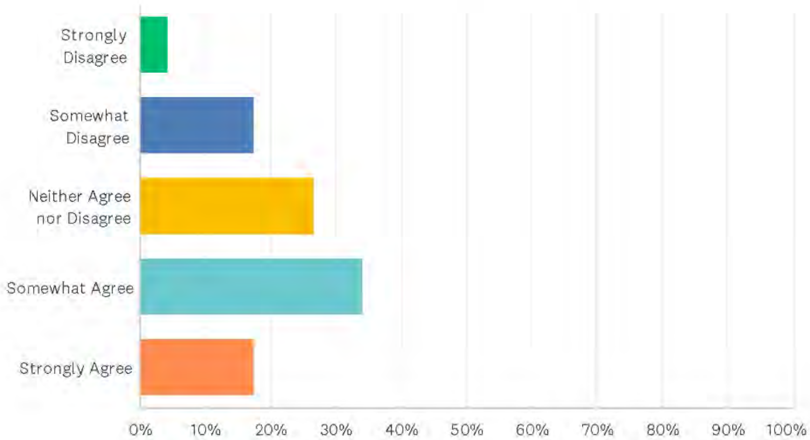


ANSWER CHOICES	RESPONSES	
Strongly Disagree	3.11%	5
Somewhat Disagree	3.11%	5
Neither Agree nor Disagree	8.70%	14
Somewhat Agree	27.33%	44
Strongly Agree	57.76%	93
TOTAL		161

Q24 Please indicate how you feel about the following statement: Information about the risks associated with natural hazards is readily

available and easy to locate. (Choose one)

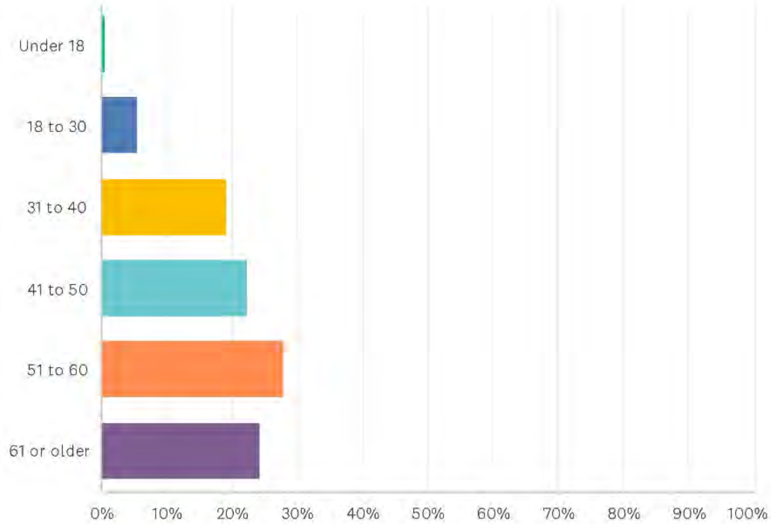
Answered: 161 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Disagree	4.35%	7
Somewhat Disagree	17.39%	28
Neither Agree nor Disagree	26.71%	43
Somewhat Agree	34.16%	55
Strongly Agree	17.39%	28
TOTAL		161

Q25 Please indicate your age range:

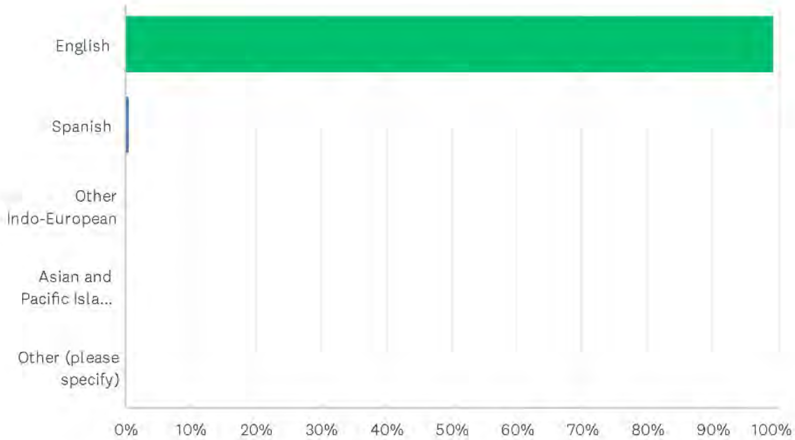
Answered: 161 Skipped: 0



ANSWER CHOICES	RESPONSES	
Under 18	0.62%	1
18 to 30	5.59%	9
31 to 40	19.25%	31
41 to 50	22.36%	36
51 to 60	27.95%	45
61 or older	24.22%	39
TOTAL		161

Q26 Please indicate the primary language spoken in your household:

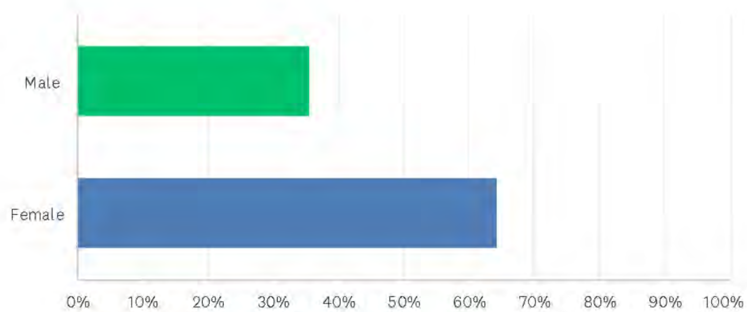
Answered: 158 Skipped: 3



ANSWER CHOICES	RESPONSES	
English	99.37%	157
Spanish	0.63%	1
Other Indo-European	0.00%	0
Asian and Pacific Island Languages	0.00%	0
Other (please specify)	0.00%	0
TOTAL		158

Q27 Please indicate your gender:

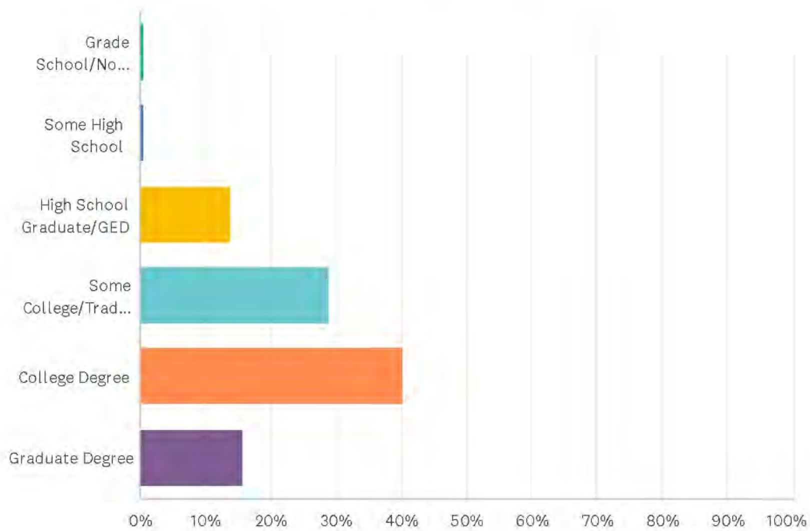
Answered: 160 Skipped: 1



ANSWER CHOICES	RESPONSES	
Male	35.63%	57
Female	64.38%	103
TOTAL		160

Q28 Please indicate your highest level of education:

Answered: 159 Skipped: 2

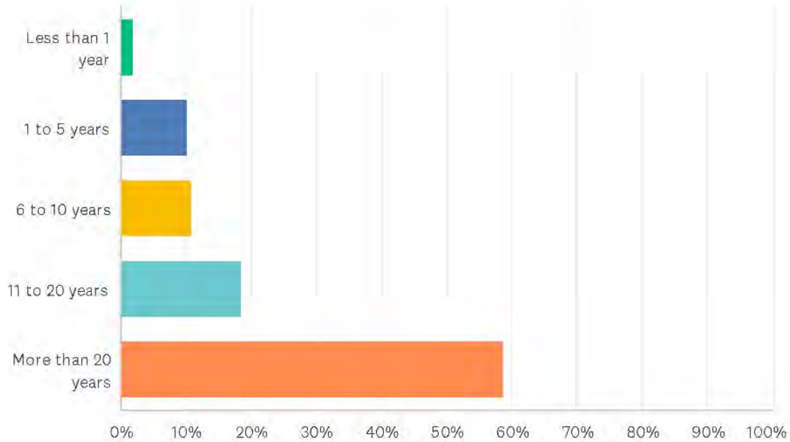


ANSWER CHOICES	RESPONSES	
Grade School/No Schooling	0.63%	1
Some High School	0.63%	1
High School Graduate/GED	13.84%	22
Some College/Trade School	28.93%	46
College Degree	40.25%	64
Graduate Degree	15.72%	25
TOTAL		159

#	OTHER (PLEASE SPECIFY)	DATE
1	MS	10/14/2021 8:12 AM
2	irrelevant	9/22/2021 3:13 PM

Q29 How long have you lived in Jackson County?

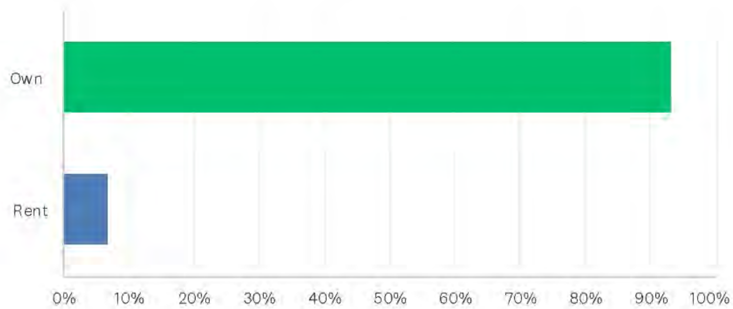
Answered: 157 Skipped: 4



ANSWER CHOICES	RESPONSES	
Less than 1 year	1.91%	3
1 to 5 years	10.19%	16
6 to 10 years	10.83%	17
11 to 20 years	18.47%	29
More than 20 years	58.60%	92
TOTAL		157

Q30 Do you own or rent your place of residence?

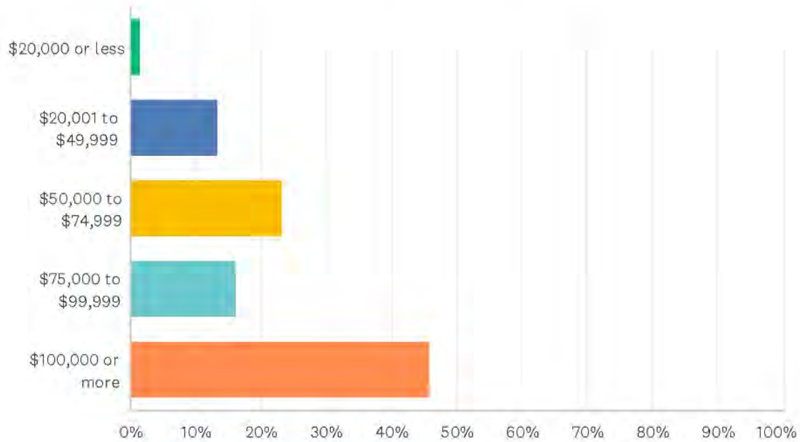
Answered: 160 Skipped: 1



ANSWER CHOICES	RESPONSES	
Own	93.13%	149
Rent	6.88%	11
TOTAL		160

Q31 How much is your gross household income?

Answered: 142 Skipped: 19

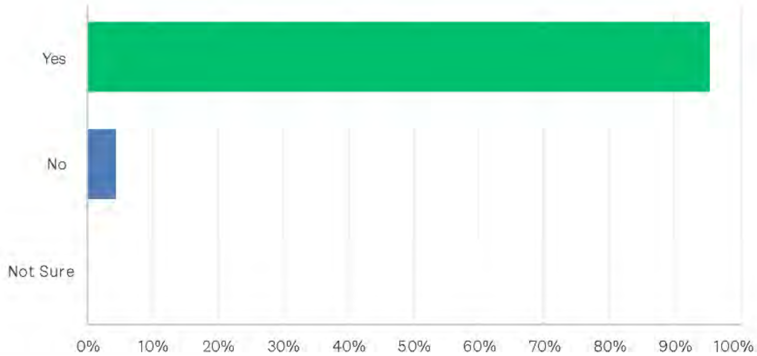


ANSWER CHOICES	RESPONSES	
$20,000 or less	1.41%	2
$20,001 to $49,999	13.38%	19
$50,000 to $74,999	23.24%	33
$75,000 to $99,999	16.20%	23
$100,000 or more	45.77%	65
TOTAL		142

Q32 Do you have regular access to the Internet?

Answered: 159 Skipped: 2

Jackson County TX HMP Update Survey 2021



ANSWER CHOICES	RESPONSES	
Yes	95.60%	152
No	4.40%	7
Not Sure	0.00%	0
TOTAL		159

Q33 Comments

Answered: 21 Skipped: 140

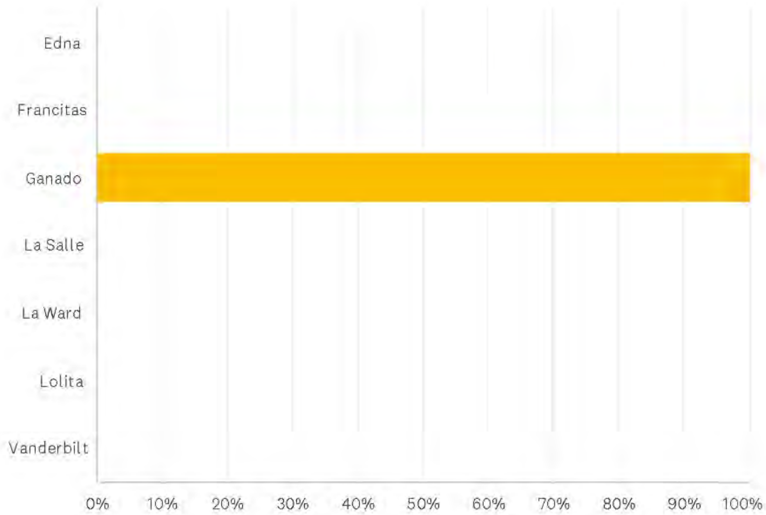
#	RESPONSES	DATE
1	Thank you!	9/27/2021 5:41 PM
2	Vanderbilt need a whole new drainage system. Better communication as land lines suck here and cells have always sucked. Internet is just as spotty and in a storm satellite obviously doesn't function well so people here kind of go through in the dark. Figuratively and literally. Adding to the how neglected all the power and phone poles are and how they don't keep the trees off of any of them. You would think as great and desirable as the school is the county would like to keep it a pleasant and sound place to live	9/22/2021 11:11 PM
3	Question 21 is not set up correctly and would not accept answers so I left it blank.	9/22/2021 8:51 PM
4	None	9/22/2021 5:21 PM
5	Question 21 was dysfunctional .... did not allow selections but within 2 topics	9/22/2021 3:13 PM
6	none	9/20/2021 3:33 PM
7	It would be nice to have a letter sized pamphlet put out by the county with useful contact information, what homeowners can do to prepare for various disasters, and an explanation of what the counties and cities within Jackson County are doing and plan to do to be prepared for disasters.	9/19/2021 4:49 PM
8	Working on the drainage on the North side of town is a top priority.	9/17/2021 3:29 PM
9	None	9/17/2021 10:28 AM
10	It would not allow me to completely answer question 21. I could pick each option only once.	9/15/2021 7:50 PM
11	I think the Jackson County Officials do an excellent job in keeping the county residents informed and take every precaution possible to keep us safe.	9/14/2021 3:45 PM

12	Question #21 is not working properly. If I answer any of the choices, the next time I answer using the same response, the selection from the first choice would move down to the current question I was answering which makes it look like I skipped over the first question.	9/14/2021 1:59 PM
13	None	9/13/2021 7:13 PM
14	None	9/13/2021 6:32 PM
15	None	9/13/2021 4:15 PM
16	Nice survey, with some questions that may be taken in at least two ways. I do not expect that the County will act on anything.	9/11/2021 3:48 PM
17	None	9/10/2021 3:38 PM
18	Done	9/10/2021 3:32 PM
19	Couldn't rank each item on question 21.	9/10/2021 3:31 PM
20	None of your business who much I make	9/10/2021 2:19 PM
21	The dam is load rated for no trucks. When will it be fixed? If not in the next two years, what type of mitigation plan is Jackson County preparing? This information should be provided to everyone living downstream of the dam.	9/10/2021 12:10 PM

Jackson County Survey Results (Spanish)

Q1 ¿En cual ciudad del Condado de Jackson vives?

Answered: 1 Skipped: 0

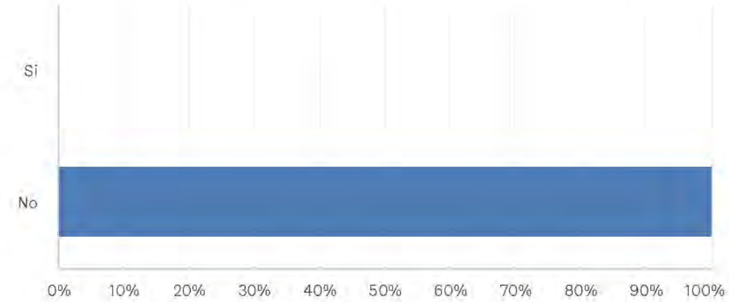


ANSWER CHOICES	RESPONSES	
Edna	0.00%	0
Francitas	0.00%	0
Ganado	100.00%	1
La Salle	0.00%	0
La Ward	0.00%	0
Lolita	0.00%	0
Vanderbilt	0.00%	0
TOTAL		1

#	OTRA (POR FAVOR ESPECIFIQUE)	DATE
	There are no responses.	

Q2 ¿Trabajas en el Condado de Jackson?

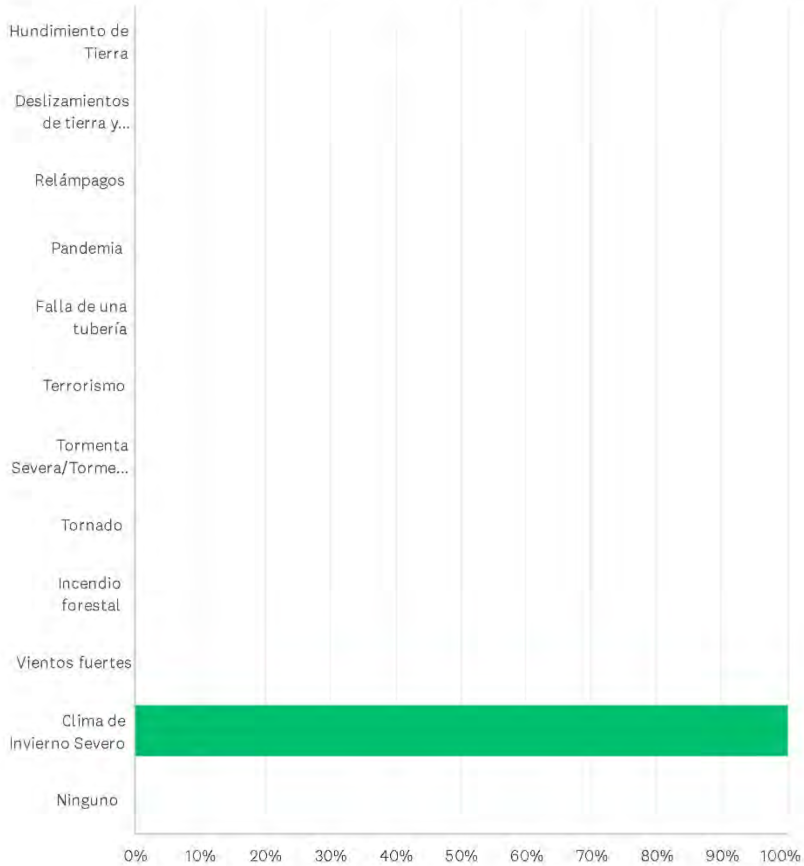
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
Si	0.00%	0
No	100.00%	1
TOTAL		1

Q3 ¿Durante los últimos 20 años usted o alguna otra persona en su casa ha sido directamente afectado por uno de los riesgos a continuación (Por favor, marque todos los que apliquen.)

Answered: 1 Skipped: 0

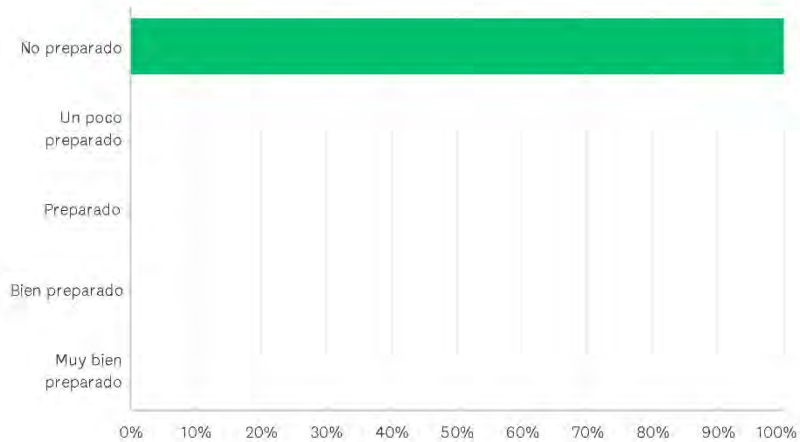

Hundimiento de Tierra
Deslizamientos de tierra y...
Relámpagos
Pandemia
Falla de una tubería
Terrorismo
Tormenta Severa/Torme...
Tornado
Incendio forestal
Vientos fuertes
Clima de Invierno Severo
Ninguno
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

ANSWER CHOICES	RESPONSES	
la erosión costera	0.00%	0
Falla en la represa/dique	0.00%	0
Sequía	0.00%	0
Terremoto	0.00%	0
Suelos Expansivos	0.00%	0
Calor Extremo	0.00%	0
Inundación	0.00%	0
Granizo	0.00%	0
Fuga de materiales peligrosos/tóxicos	0.00%	0
Huracán/Tormenta Tropical	0.00%	0
Hundimiento de Tierra	0.00%	0
Deslizamientos de tierra y aludes de barro	0.00%	0
Relámpagos	0.00%	0
Pandemia	0.00%	0
Falla de una tubería	0.00%	0
Terrorismo	0.00%	0
Tormenta Severa/Tormenta Eléctrica	0.00%	0
Tornado	0.00%	0
Incendio forestal	0.00%	0
Vientos fuertes	0.00%	0
Clima de Invierno Severo	100.00%	1
Ninguno	0.00%	0
Total Respondents: 1		

#	OTRO (POR FAVOR ESPECIFIQUE)	DATE
	There are no responses.	

Q4 ¿Qué tan preparado está usted para un desastre?

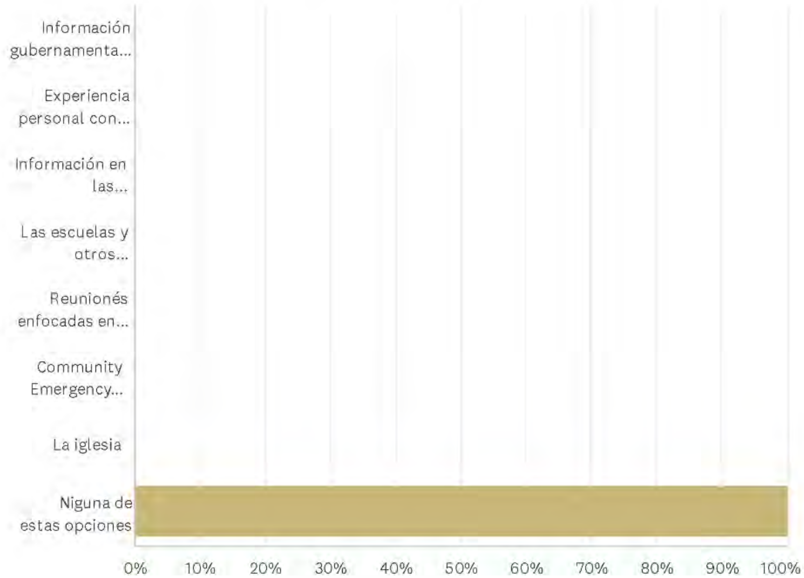
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
No preparado	100.00%	1
Un poco preparado	0.00%	0
Preparado	0.00%	0
Bien preparado	0.00%	0
Muy bien preparado	0.00%	0
TOTAL		1

Q5 ¿Cual de los recursos abajo lo ayudado para preparse para desastres naturales? (Por favor marque todos lo que apliquen.)

Answered: 1 Skipped: 0

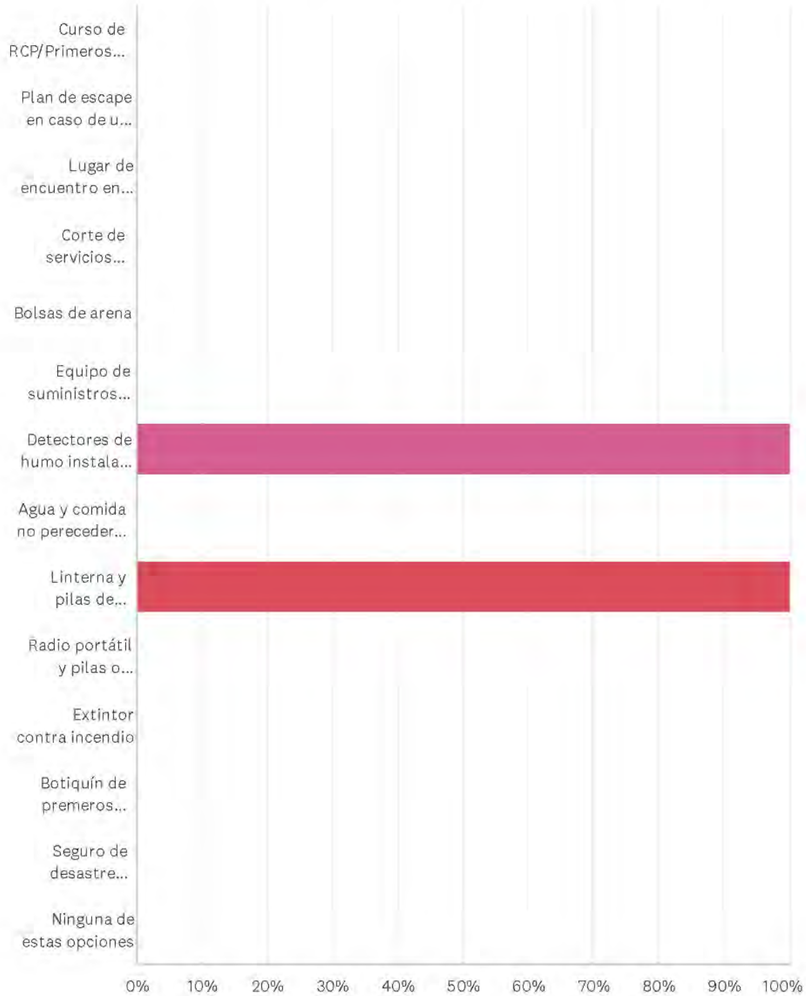


ANSWER CHOICES	RESPONSES	
Información gubernamental sobre preparación para casos de desastre (local, federal, o estadal)	0.00%	0
Experiencia personal con un desastre natural	0.00%	0
Información en las noticias/otro tipo de medias locales	0.00%	0
Las escuelas y otros institutos académicos	0.00%	0
Reunionés enfocadas en preparación para desastres	0.00%	0
Community Emergency Response Training (CERT)	0.00%	0
La iglesia	0.00%	0
Niguna de estas opciones	100.00%	1
Total Respondents: 1		

#	OTRO (POR FAVOR ESPECIFIQUE)	DATE
	There are no responses.	

Q6 ¿Que preparaciones tiene usted o otro miembro de su hogar en caso de un desastre? (Por favor marque todos los que apliquen.)

Answered: 1 Skipped: 0

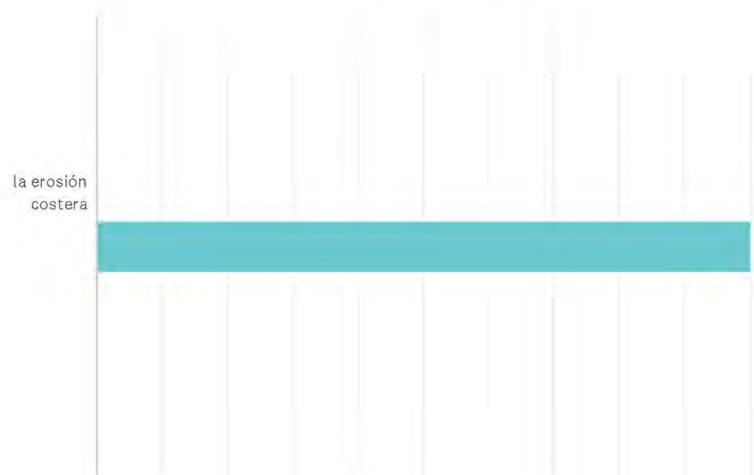

Curso de RCP/Primeros...
Plan de escape en caso de u...
Lugar de encuentro en...
Corte de servicios...
Bolsas de arena
Equipo de suministros...
Detectores de humo instala...
Agua y comida no pereceder...
Linterna y pilas de...
Radio portátil y pilas o...
Extintor contra incendio
Botiquín de premeros...
Seguro de desastre...
Ninguna de estas opciones
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

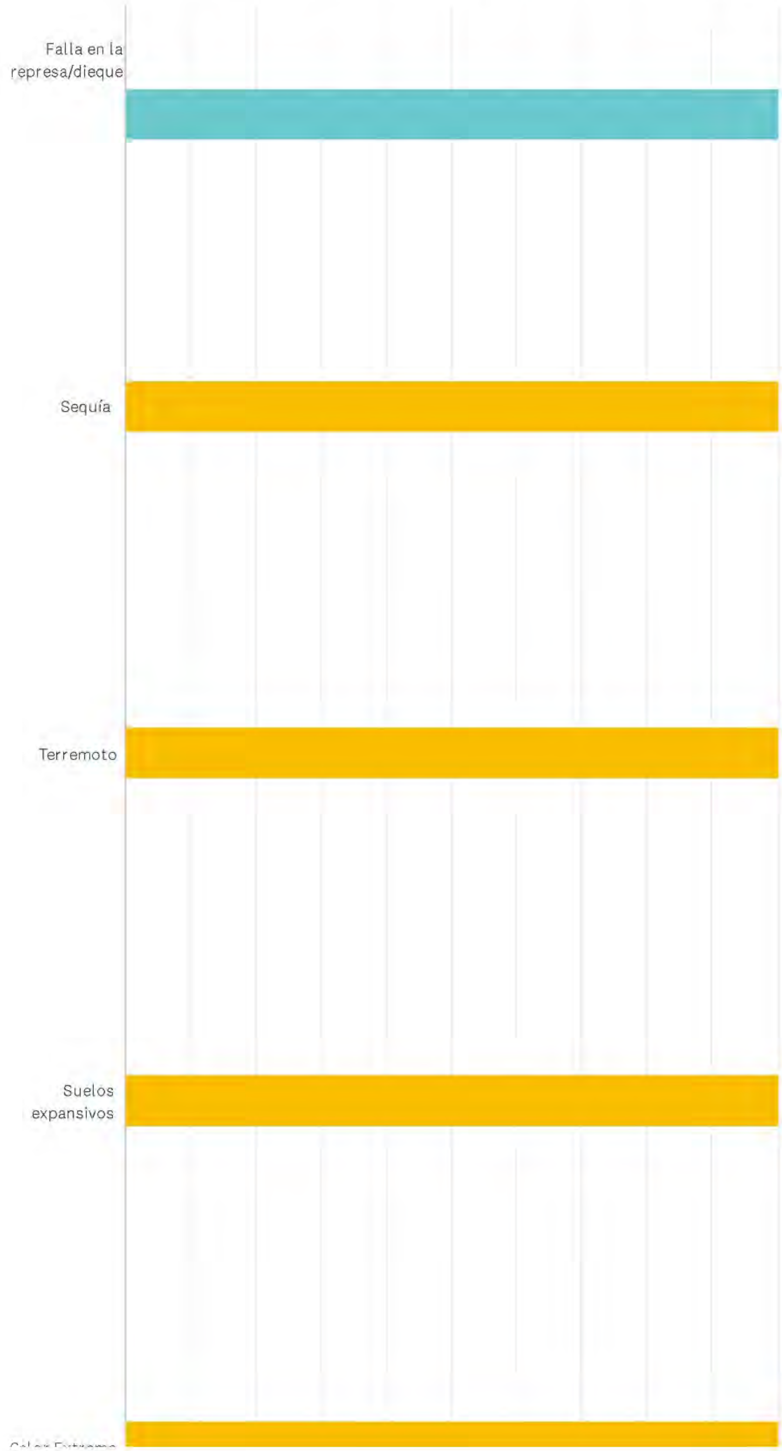
ANSWER CHOICES	RESPONSES	
Curso de RCP/Primeros auxilios	0.00%	0
Plan de escape en caso de un incendio	0.00%	0
Lugar de encuentro en caso de emergencia	0.00%	0
Corte de servicios públicos indentificado	0.00%	0
Bolsas de arena	0.00%	0
Equipo de suministros para caso de desastre	0.00%	0
Detectores de humo instalados en todos los niveles de su hogar	100.00%	1
Agua y comida no perecederos almanecada	0.00%	0
Linterna y pilas de repuesto	100.00%	1
Radio portátil y pilas o baterías de repuesto	0.00%	0
Extintor contra incendio	0.00%	0
Botiquín de premeros auxilios	0.00%	0
Seguro de desastre (contra inundación, incendio, o terremoto)	0.00%	0
Ninguna de estas opciones	0.00%	0
Total Respondents: 1		

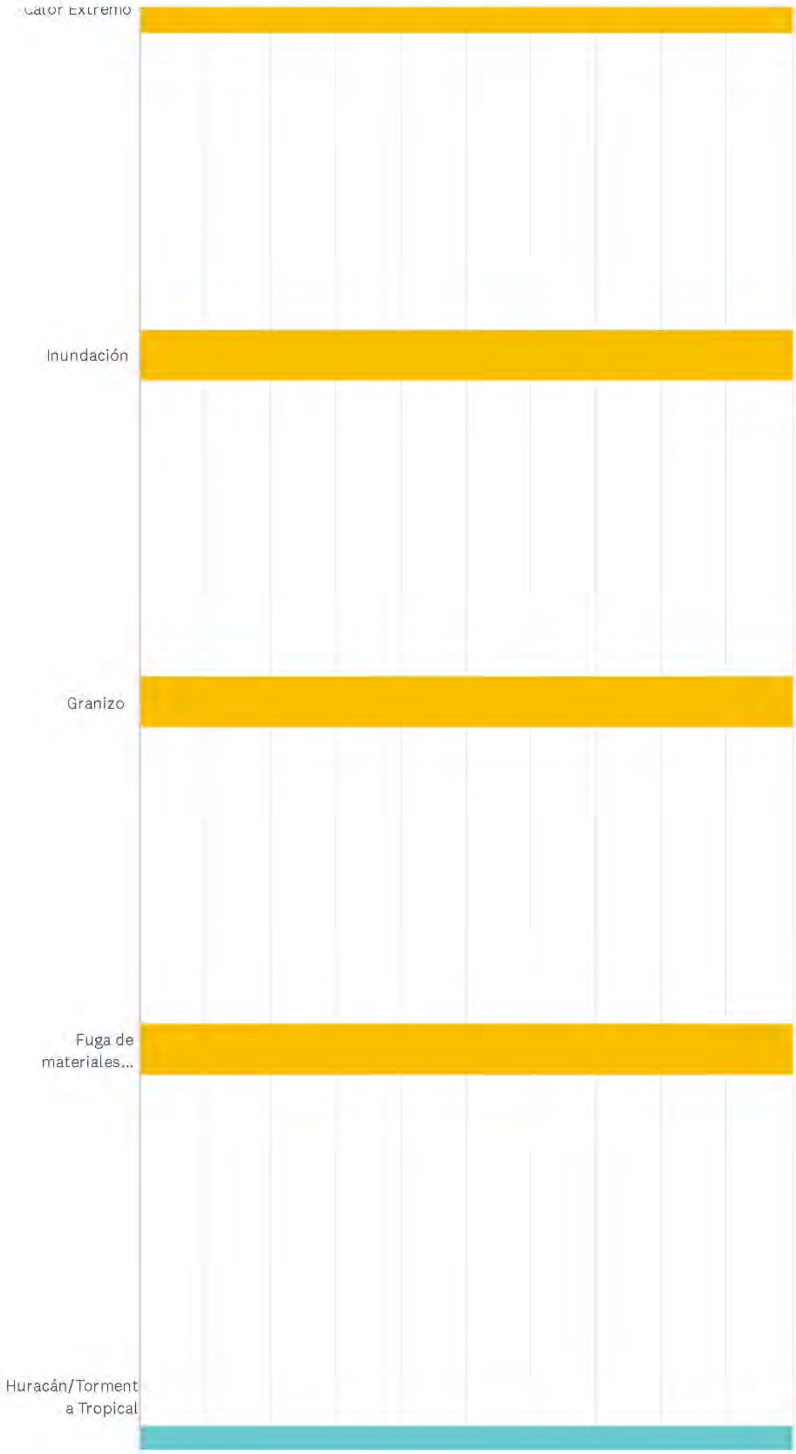
#	OTRO (POR FAVOR ESPECIFIQUE)	DATE
	There are no responses.	

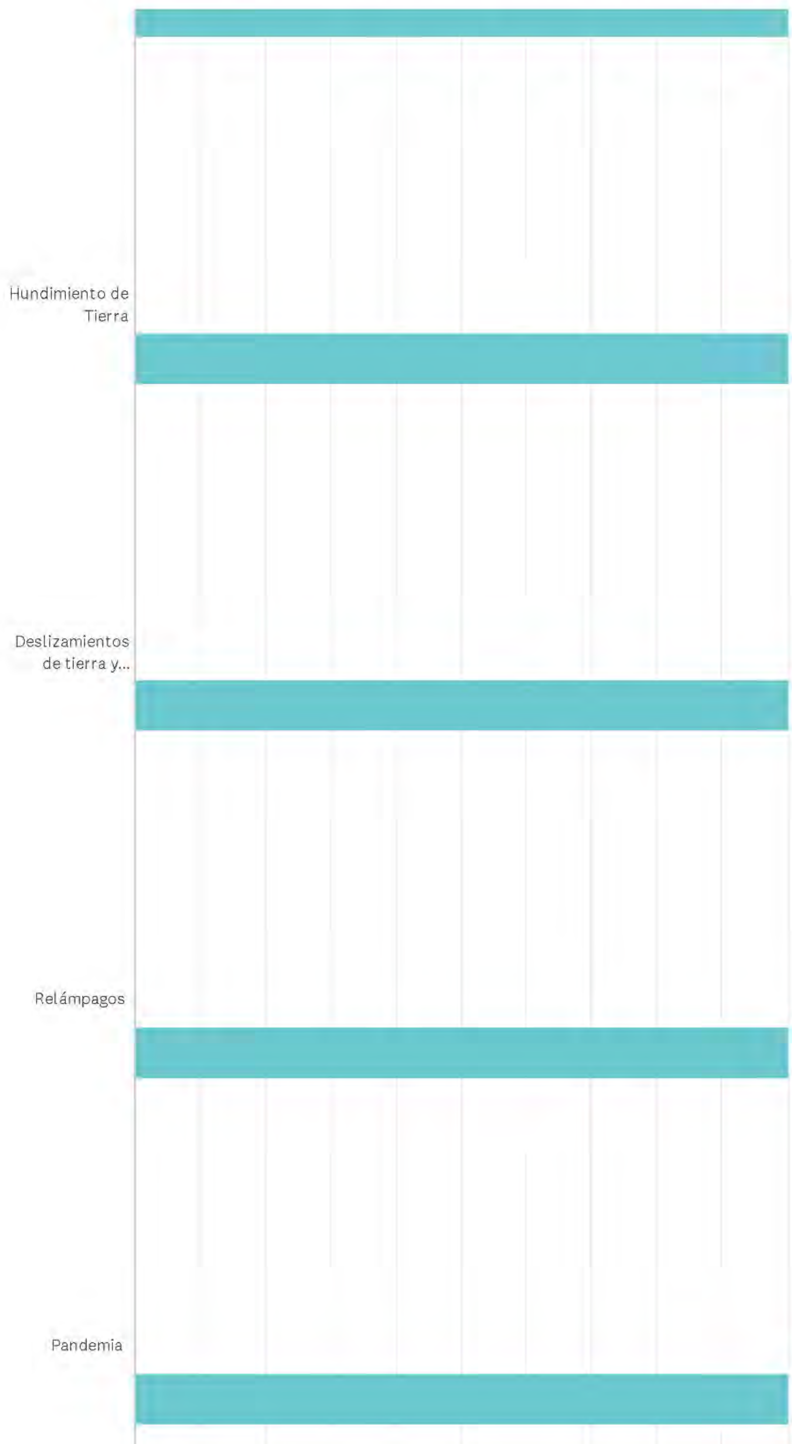
Q7 Por favor, indique su nivel de preocupación sobre los siguientes riesgos naturales que pueden afectar su comunidad:

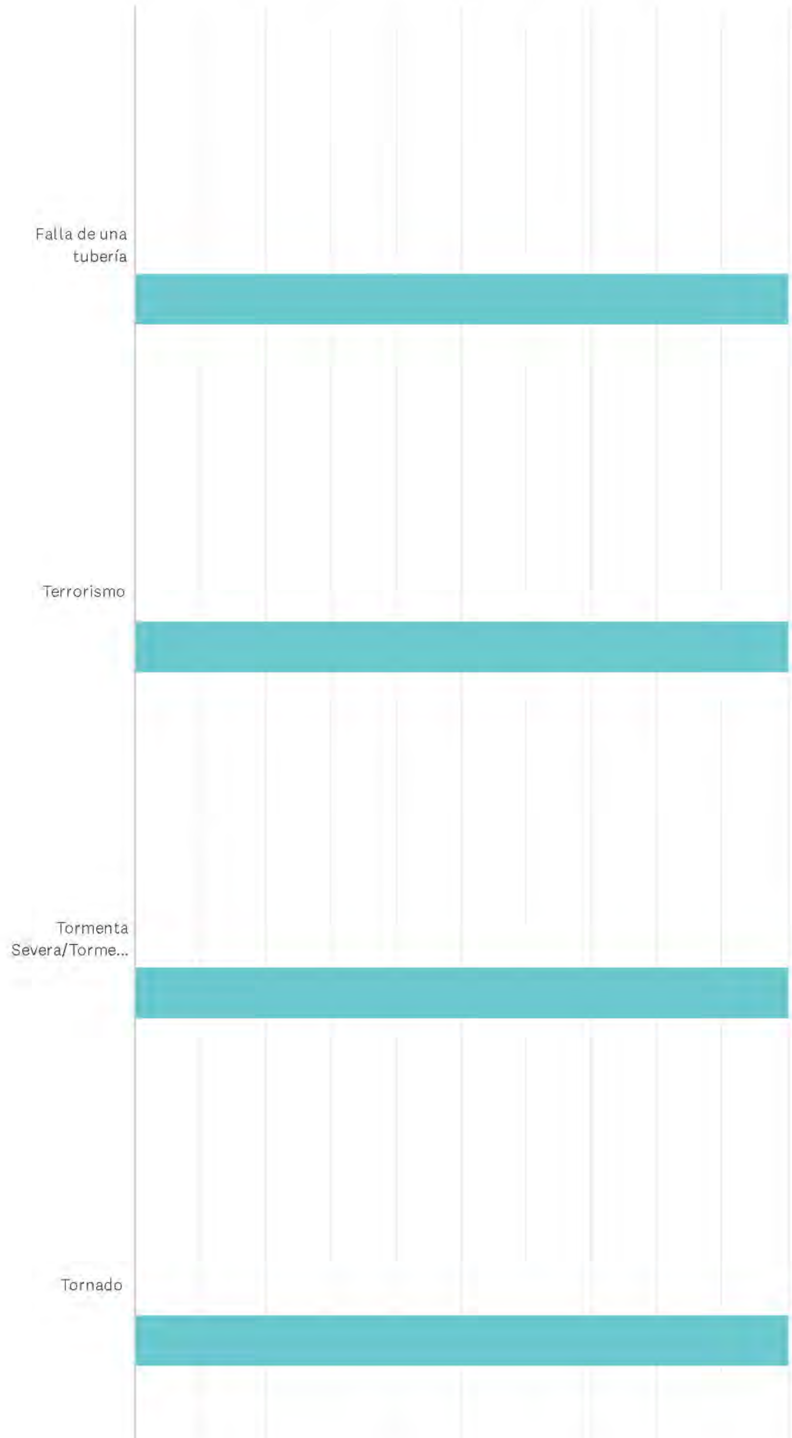
Answered: 1   Skipped: 0

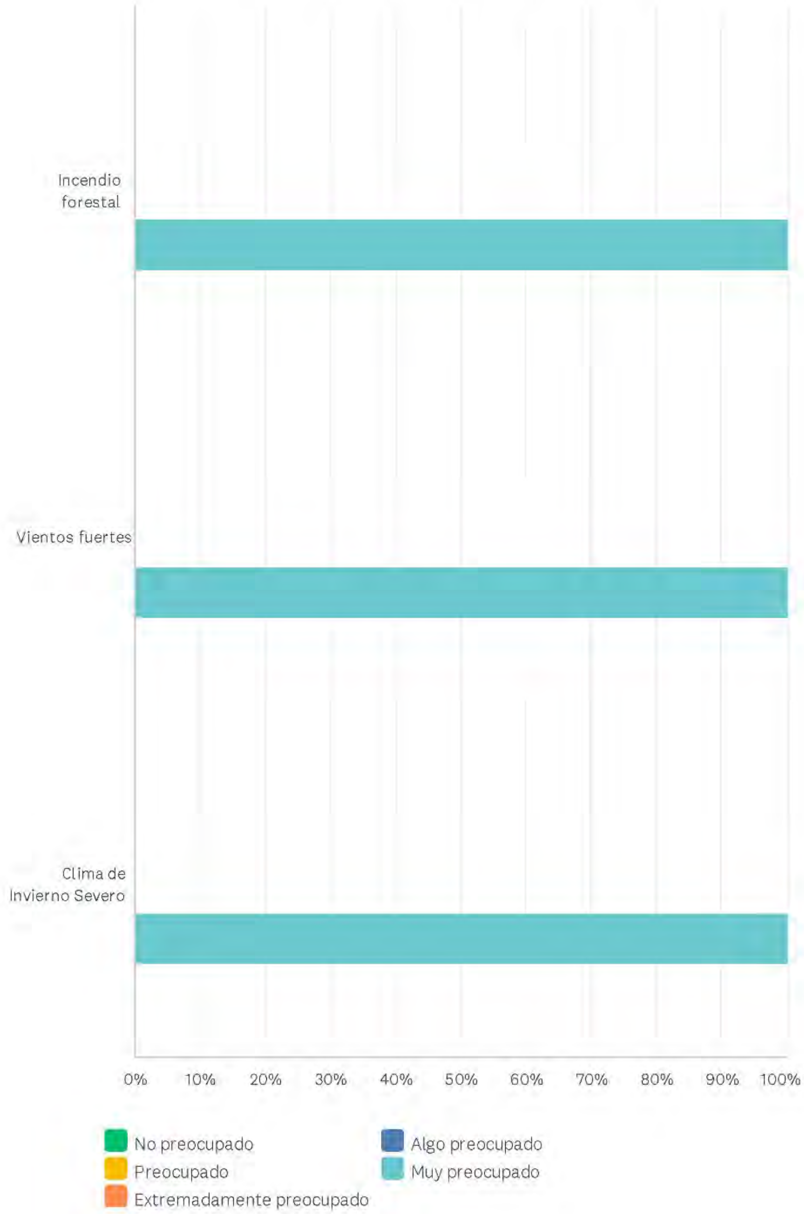



Falla en la represa/dieque
Sequía
Terremoto
Suelos expansivos


Calor Extremo
Inundación
Granizo
Fuga de materiales...
Huracán/Tormenta Tropical


Hundimiento de Tierra
Deslizamientos de tierra y...
Relámpagos
Pandemia

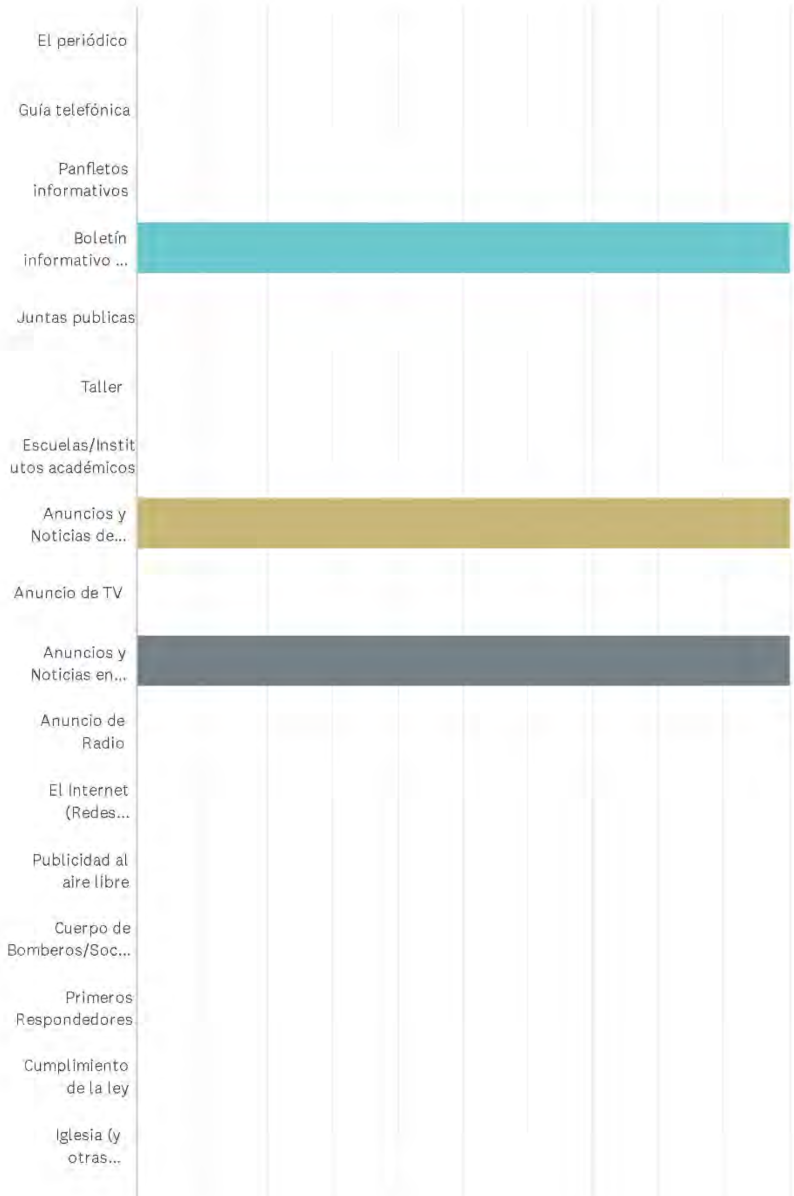

Falla de una tubería
Terrorismo
Tormenta Severa/Torme...
Tornado

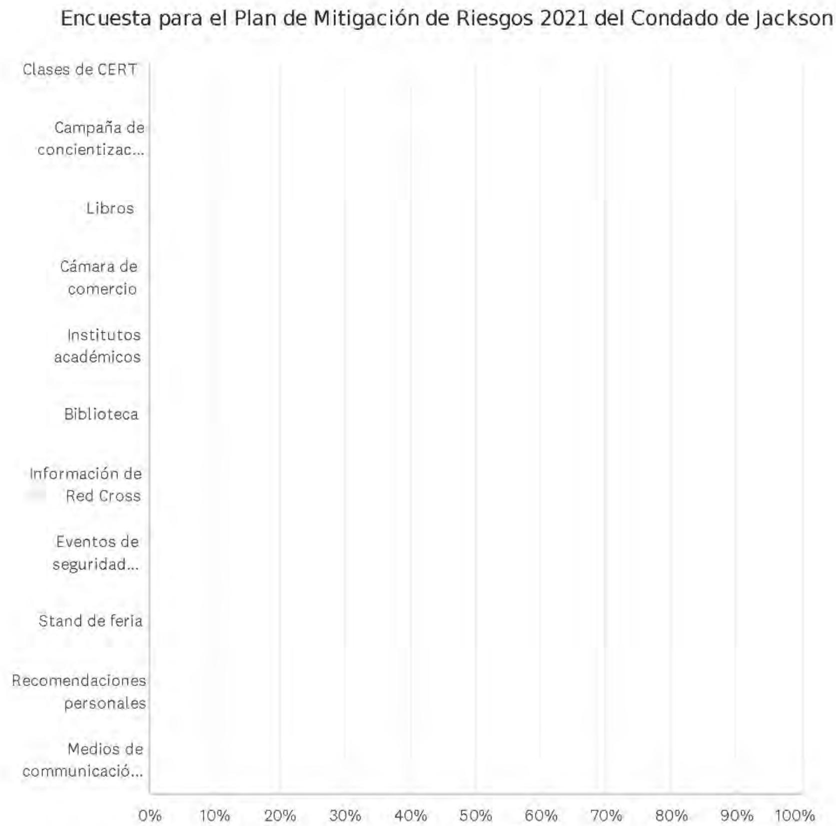

Incendio forestal
Vientos fuertes
Clima de Invierno Severo
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
No preocupado
Algo preocupado
Preocupado
Muy preocupado
Extremadamente preocupado

	NO PREOCUPADO	ALGO PREOCUPADO	PREOCUPADO	MUY PREOCUPADO	EXTREMADAMENTE PREOCUPADO	TOTAL
la erosión costera	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Falla en la represa/dieque	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Sequía	0.00% 0	0.00% 0	100.00% 1	0.00% 0	0.00% 0	1
Terremoto	0.00% 0	0.00% 0	100.00% 1	0.00% 0	0.00% 0	1
Suelos expansivos	0.00% 0	0.00% 0	100.00% 1	0.00% 0	0.00% 0	1
Calor Extremo	0.00% 0	0.00% 0	100.00% 1	0.00% 0	0.00% 0	1
Inundación	0.00% 0	0.00% 0	100.00% 1	0.00% 0	0.00% 0	1
Granizo	0.00% 0	0.00% 0	100.00% 1	0.00% 0	0.00% 0	1
Fuga de materiales peligrosos/tóxicos	0.00% 0	0.00% 0	100.00% 1	0.00% 0	0.00% 0	1
Huracán/Tormenta Tropical	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Hundimiento de Tierra	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Deslizamientos de tierra y aludes de barro	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Relámpagos	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Pandemia	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Falla de una tubería	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Terrorismo	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Tormenta Severa/Tormenta Eléctrica	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Tornado	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Incendio forestal	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Vientos fuertes	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1
Clima de Invierno Severo	0.00% 0	0.00% 0	0.00% 0	100.00% 1	0.00% 0	1

Q8 ¿Cuales de los métodos a continuación son los más efectivos para proveer información sobre los riesgos y desastres? (Por favor marque todos los que apliquen.)

Answered: 1 Skipped: 0



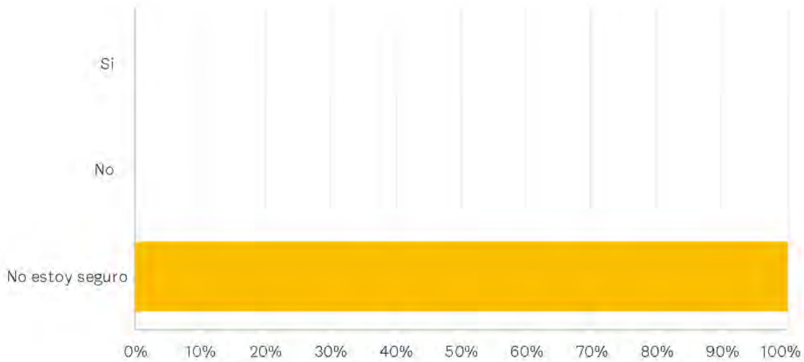

Encuesta para el Plan de Mitigación de Riesgos 2021 del Condado de Jackson
Clases de CERT
Campaña de concientizac...
Libros
Cámara de comercio
Institutos académicos
Biblioteca
Información de Red Cross
Eventos de seguridad...
Stand de feria
Recomendaciones personales
Medios de communicació...
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

ANSWER CHOICES	RESPONSES	
El periódico	0.00%	0
Guía telefónica	0.00%	0
Panfletos informativos	0.00%	0
Boletín informativo de la ciudad en línea	100.00%	1
Juntas publicas	0.00%	0
Taller	0.00%	0
Escuelas/Institutos académicos	0.00%	0
Anuncios y Noticias de televisión	100.00%	1
Anuncio de TV	0.00%	0
Anuncios y Noticias en emisoras de radio	100.00%	1
Anuncio de Radio	0.00%	0
El Internet (Redes sociales/Buscadores)	0.00%	0
Publicidad al aire libre	0.00%	0
Cuerpo de Bomberos/Socorro	0.00%	0
Primeros Respondedores	0.00%	0
Cumplimiento de la ley	0.00%	0
Iglesia (y otras instituciones basadas en fe)	0.00%	0
Clases de CERT	0.00%	0
Campaña de concientización publica (Semana de la concienciación sobre inundaciones, etc.)	0.00%	0
Libros	0.00%	0
Cámara de comercio	0.00%	0
Institutos académicos	0.00%	0
Biblioteca	0.00%	0
Información de Red Cross	0.00%	0
Eventos de seguridad comunitaria	0.00%	0
Stand de feria	0.00%	0
Recomendaciones personales	0.00%	0
Medios de communicación social (Twitter, Facebook, LinkedIn)	0.00%	0
Total Respondents: 1		

#	OTRO (POR FAVOR ESPECIFICIQUE)	DATE
	There are no responses.	

Q9 ¿Su propiedad se encuentra en una zona de inundación de FEMA?

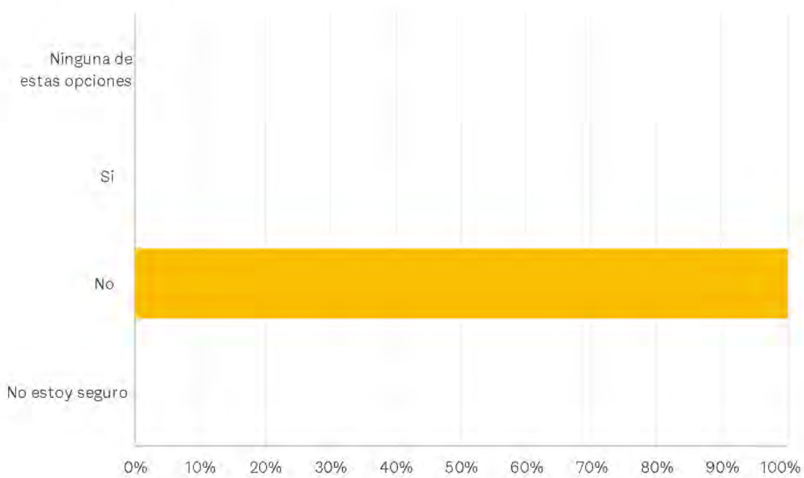
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
Si	0.00%	0
No	0.00%	0
No estoy seguro	100.00%	1
TOTAL		1

Q10 ¿Tiene seguro contra inundaciones?

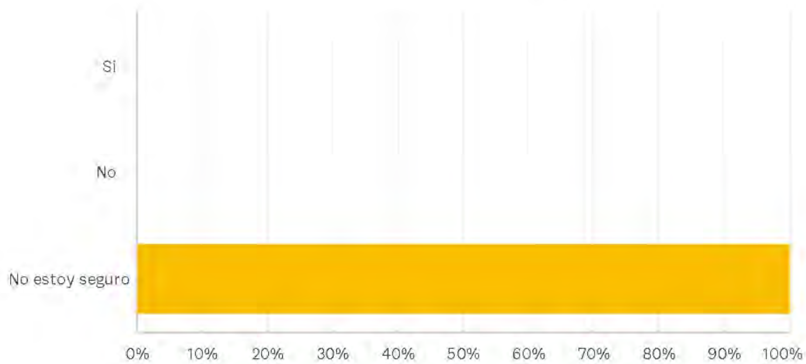
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
Ninguna de estas opciones	0.00%	0
Si	0.00%	0
No	100.00%	1
No estoy seguro	0.00%	0
TOTAL		1

Q11 ¿Su propiedad se encuentra en una zona de alto riesgo para los incendios forestales?

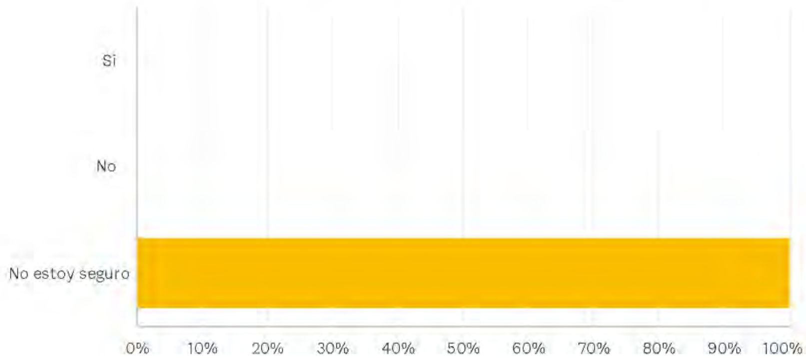
Answered: 1   Skipped: 0



ANSWER CHOICES	RESPONSES	
Si	0.00%	0
No	0.00%	0
No estoy seguro	100.00%	1
TOTAL		1

Q12 ¿Has tenido problemas obteniendo seguro para su hogar debido a riesgos naturales?

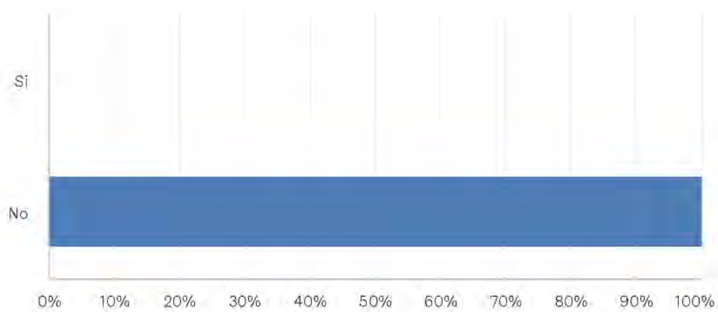
Answered: 1   Skipped: 0



ANSWER CHOICES	RESPONSES	
Si	0.00%	0
No	0.00%	0
No estoy seguro	100.00%	1
TOTAL		1

Q13 ¿Tiene alguna necesidad especial en su hogar que requiere una advertencia rápida o un responso especializado durante un desastre?

Answered: 1   Skipped: 0



ANSWER CHOICES	RESPONSES	
Si	0.00%	0
No	100.00%	1
TOTAL		1

Q14 Si su respuesta fue “Si” para la pregunta #13, quisiera que el Departamento de Emergencias lo contacte sobre su acceso especial y

necesidades? Si ese es el caso por favor llene las información abajo.

Answered: 0 Skipped: 1

ANSWER CHOICES	RESPONSES	
Nombre	0.00%	0
Company	0.00%	0
Dirección	0.00%	0
Dirección 2	0.00%	0
Ciudad/Pueblo	0.00%	0
Estado/Provincia	0.00%	0
ZIP/Código Postal	0.00%	0
País	0.00%	0
Dirección de Correo electrónico	0.00%	0
Número de teléfono	0.00%	0

#	NOMBRE	DATE
	There are no responses.	

#	COMPANY	DATE
	There are no responses.	

#	DIRECCIÓN	DATE
	There are no responses.	

#	DIRECCIÓN 2	DATE
	There are no responses.	

#	CIUDAD/PUEBLO	DATE
	There are no responses.	

#	ESTADO/PROVINCIA	DATE
	There are no responses.	

#	ZIP/CÓDIGO POSTAL	DATE
	There are no responses.	

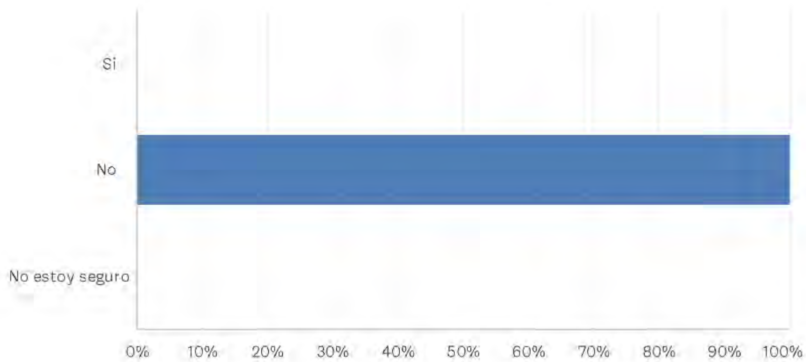
#	PAÍS	DATE
	There are no responses.	

#	DIRECCIÓN DE CORREO ELECTRÓNICO	DATE
	There are no responses.	

#	NÚMERO DE TELÉFONO	DATE
	There are no responses.	

Q15 ¿Cuándo se mudó a su hogar pensó en el impacto que pudieran tener los desastres naturales?

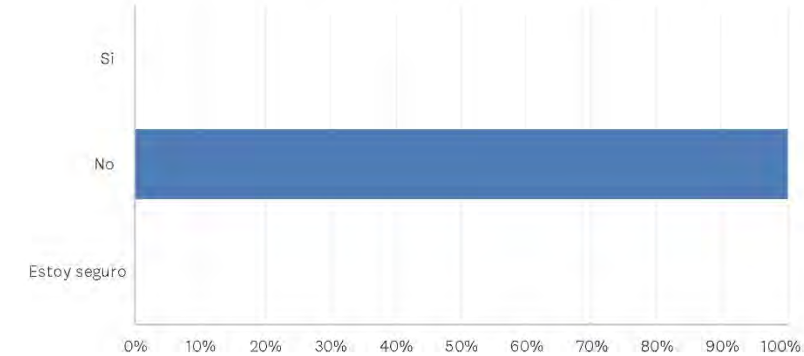
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
Si	0.00%	0
No	100.00%	1
No estoy seguro	0.00%	0
TOTAL		1

Q16 ¿Cuando se mudo a su hogar le informó un agente de bienes raíces, vendedor o propietario sobre la presencia de una zona de riesgo de peligro natural (por ejemplo, zona de falla de presa, zona de inundación, área de riesgo de deslizamiento de tierra, área de alto riesgo de incendio)?

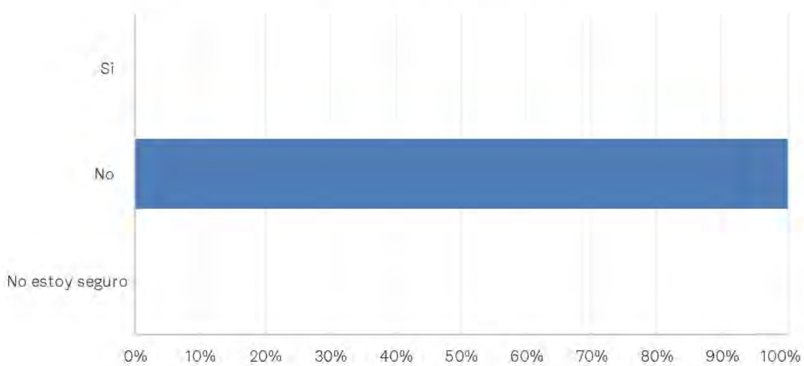
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
Si	0.00%	0
No	100.00%	1
Estoy seguro	0.00%	0
TOTAL		1

Q17 ¿La divulgación de este tipo de información sobre riesgos de peligros naturales influiría en su decisión de comprar o alquilar una casa?

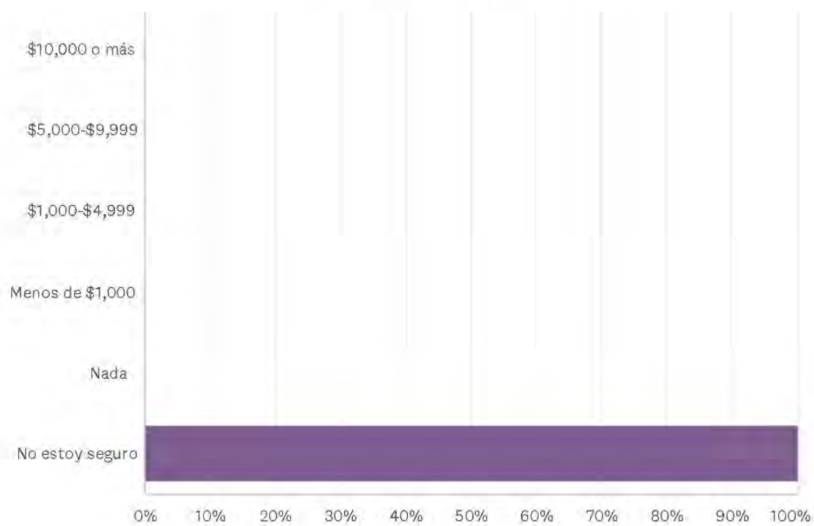
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
Si	0.00%	0
No	100.00%	1
No estoy seguro	0.00%	0
TOTAL		1

Q18 ¿Cuánto dinero estaría dispuesto a gastar para modernizar su casa para reducir los riesgos asociados con los desastres naturales? (por ejemplo, quitando la maleza y los materiales vegetales alrededor de su casa para crear un "espacio defendible" para incendios forestales, realizando mejoras sísmicas o reemplazando un techo combustible con un techo no combustible)

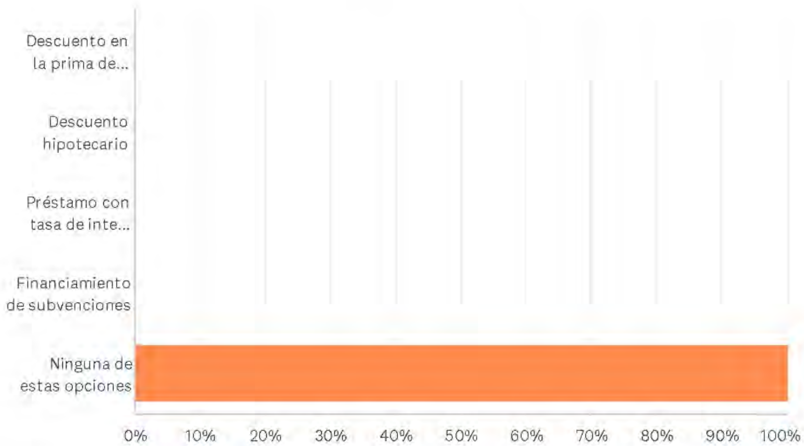
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
$10,000 o más	0.00%	0
$5,000-$9,999	0.00%	0
$1,000-$4,999	0.00%	0
Menos de $1,000	0.00%	0
Nada	0.00%	0
No estoy seguro	100.00%	1
TOTAL		1

Q19 ¿Cuál de los siguientes incentivos lo alentaría a gastar dinero para modernizar su hogar para protegerlo contra desastres naturales? (Marque todos lo que apliquen)

Answered: 1 Skipped: 0

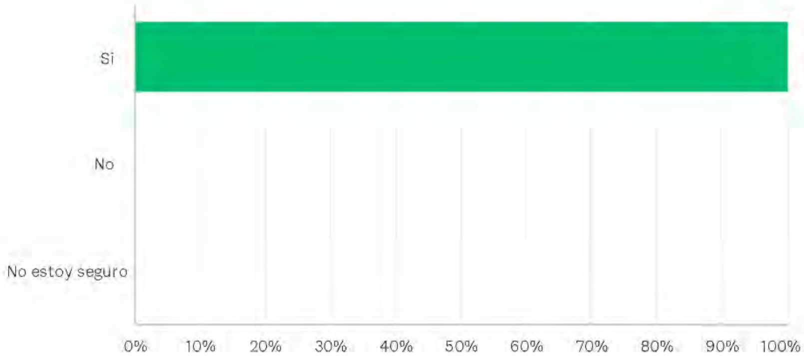


ANSWER CHOICES	RESPONSES	
Descuento en la prima de seguro	0.00%	0
Descuento hipotecario	0.00%	0
Préstamo con tasa de interés baja	0.00%	0
Financiamiento de subvenciones	0.00%	0
Ninguna de estas opciones	100.00%	1
Total Respondents: 1		

#	OTRO (POR FAVOR ESPECIFIQUE)	DATE
	There are no responses.	

Q20 Si su propiedad estuviera ubicada en un área designada de "alto riesgo" o hubiera recibido daños repetidos por un evento de riesgo natural, ¿consideraría una "compra" ofrecida por una agencia pública?

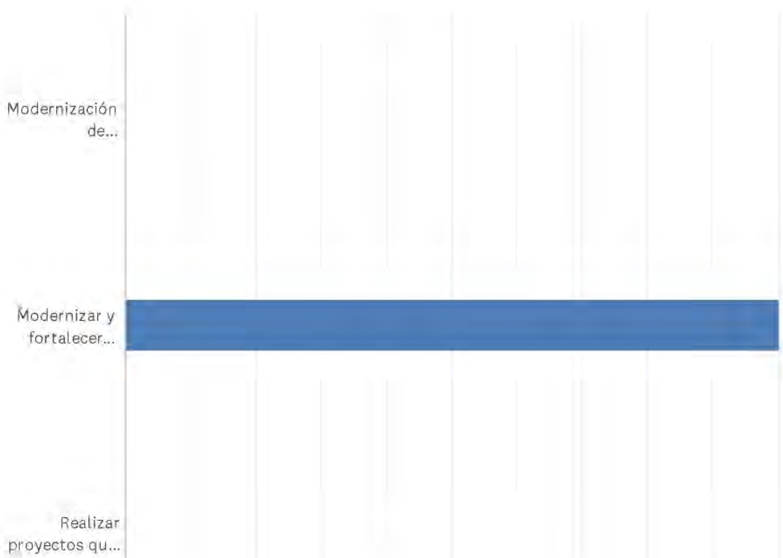
Answered: 1 Skipped: 0

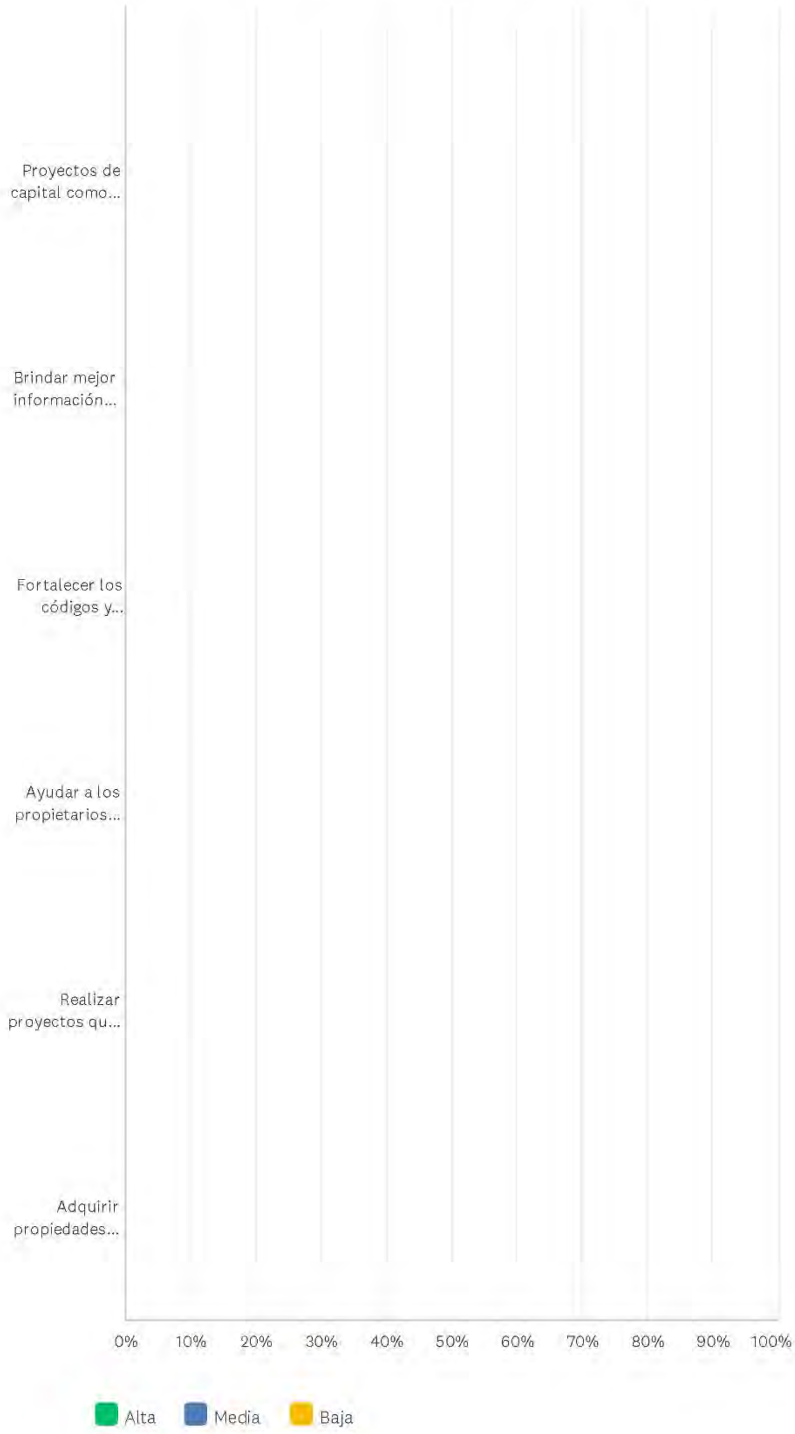


ANSWER CHOICES	RESPONSES	
Si	100.00%	1
No	0.00%	0
No estoy seguro	0.00%	0
TOTAL		1

Q21 ¿Qué tipo de proyectos cree que deberían llevar a cabo las agencias del gobierno federal, estatal o del condado para reducir los daños y las interrupciones causadas por eventos de peligro en el condado de Jackson? Clasifique cada opción como de prioridad alta, media o baja.

Answered: 1 Skipped: 0

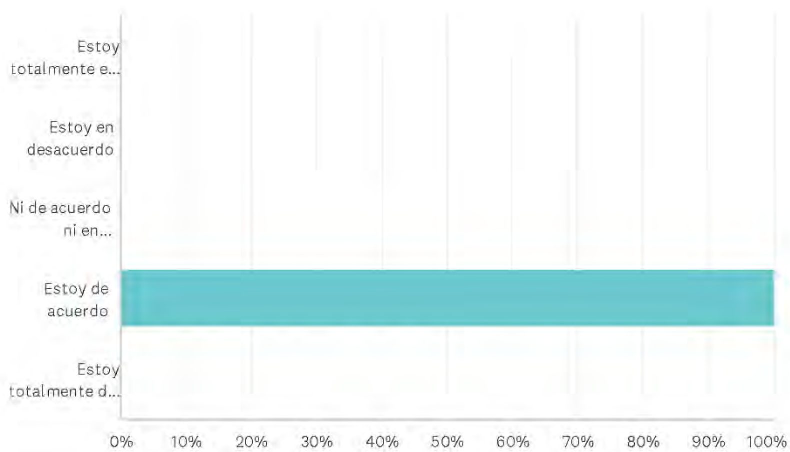



Proyectos de capital como...
Brindar mejor información...
Fortalecer los códigos y...
Ayudar a los propietarios...
Realizar proyectos qu...
Adquirir propiedades...
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Alta
Media
Baja

	ALTA	MEDIA	BAJA	TOTAL
Modernización de infraestructuras como carreteras, puentes, instalaciones de drenaje, diques, suministro de agua, aguas residuales e instalaciones de suministro de energía.	0.00% 0	0.00% 0	0.00% 0	0
Modernizar y fortalecer instalaciones esenciales como estaciones de policias, estaciones de bomberos, escuelas y hospitales.	0.00% 0	100.00% 1	0.00% 0	1
Realizar proyectos que restauren la capacidad de los ambientes naturales para absorber los impactos de los riesgos naturales.	0.00% 0	0.00% 0	0.00% 0	0
Proyectos de capital como presas, diques, muros de inundación, mejoras de drenaje y proyectos de estabilización de bancos.	0.00% 0	0.00% 0	0.00% 0	0
Brindar mejor información pública sobre el riesgo y la exposición a peligros dentro del área operativa.	0.00% 0	0.00% 0	0.00% 0	0
Fortalecer los códigos y regulaciones para incluir estándares regulatorios más altos en áreas de alto riesgo.	0.00% 0	0.00% 0	0.00% 0	0
Ayudar a los propietarios vulnerables a obtener fondos para la mitigación.	0.00% 0	0.00% 0	0.00% 0	0
Realizar proyectos que mitiguen los impactos del cambio climático.	0.00% 0	0.00% 0	0.00% 0	0
Adquirir propiedades vulnerables y mantenerlas como espacio abierto.	0.00% 0	0.00% 0	0.00% 0	0

Q22 Por favor indica su nivel de acuerdo o desacuerdo con la siguiente observación: Es la responsabilidad del gobierno (estadal, local, y federal) proveer educación para los residentes para ayudar a minimizar/eliminar la exposición a los riesgos naturales. (Escoge una.)

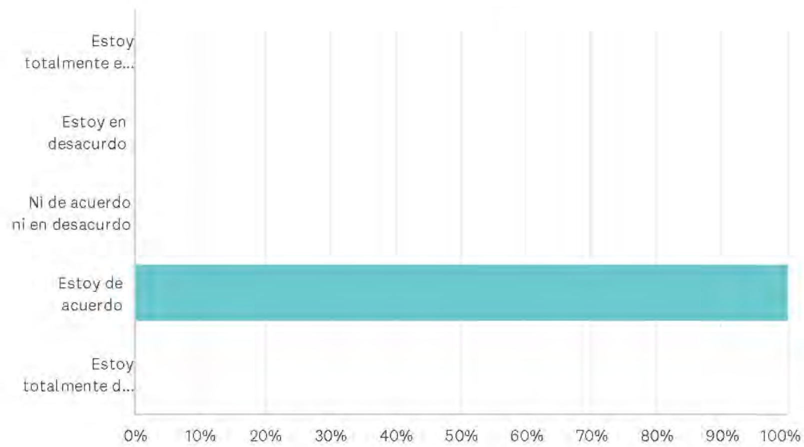
Answered: 1   Skipped: 0



ANSWER CHOICES	RESPONSES	
Estoy totalmente en desacuerdo	0.00%	0
Estoy en desacuerdo	0.00%	0
Ni de acuerdo ni en desacuerdo	0.00%	0
Estoy de acuerdo	100.00%	1
Estoy totalmente de acuerdo	0.00%	0
TOTAL		1

Q23 Por favor indica su nivel de acuerdo o desacuerdo con la siguiente observación: Es mi responsabilidad educarme y tomar los pasos necesarios para minimizar/eliminar mi exposición a los riesgos naturales (Escoge una.)

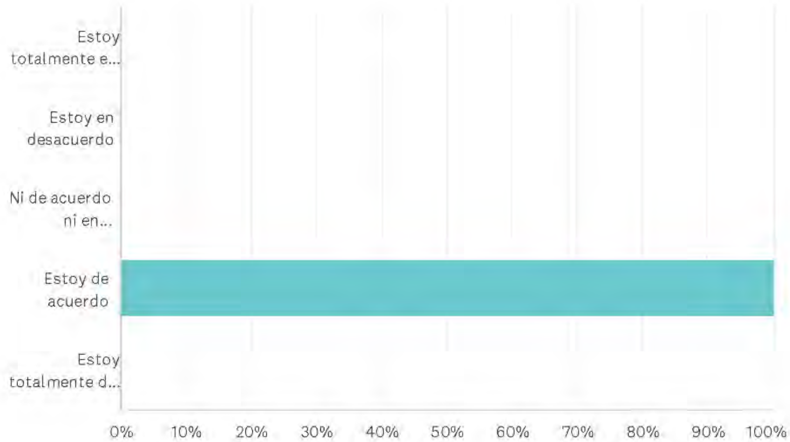
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
Estoy totalmente en desacuerdo	0.00%	0
Estoy en desacurdo	0.00%	0
Ni de acuerdo ni en desacurdo	0.00%	0
Estoy de acuerdo	100.00%	1
Estoy totalmente de acuerdo	0.00%	0
TOTAL		1

Q24 Por favor indica su nivel de acuerdo o desacuerdo con la siguiente observación: Información sobre los riesgos asociados con peligros naturales es disponible y fácil de encontrar. (Escoge una.)

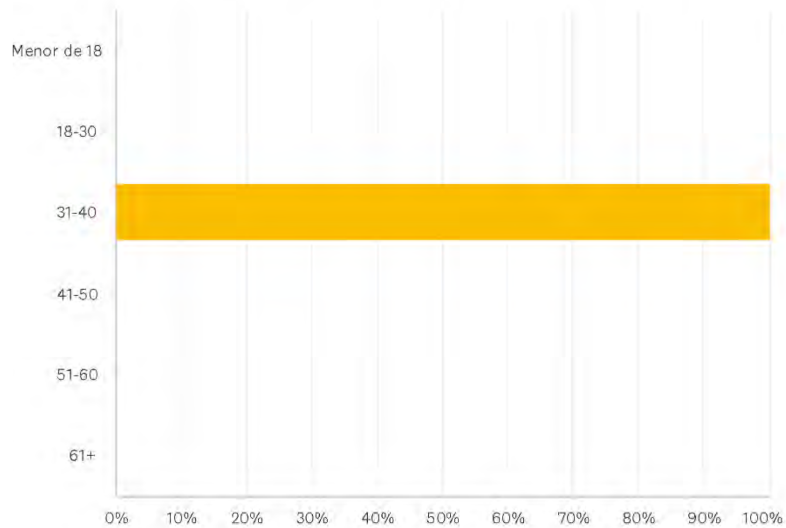
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
Estoy totalmente en desacuerdo	0.00%	0
Estoy en desacuerdo	0.00%	0
Ni de acuerdo ni en desacuerdo	0.00%	0
Estoy de acuerdo	100.00%	1
Estoy totalmente de acuerdo	0.00%	0
TOTAL		1

Q25 ¿A qué grupo etario pertenece?

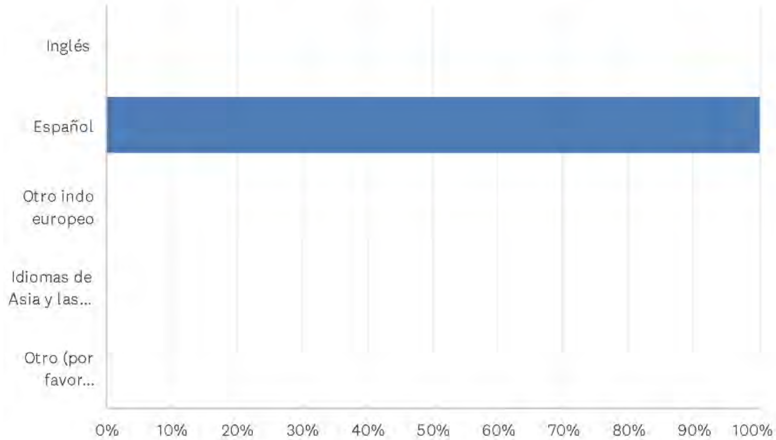
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
Menor de 18	0.00%	0
18-30	0.00%	0
31-40	100.00%	1
41-50	0.00%	0
51-60	0.00%	0
61+	0.00%	0
TOTAL		1

Q26 Idioma principal en su hogar:

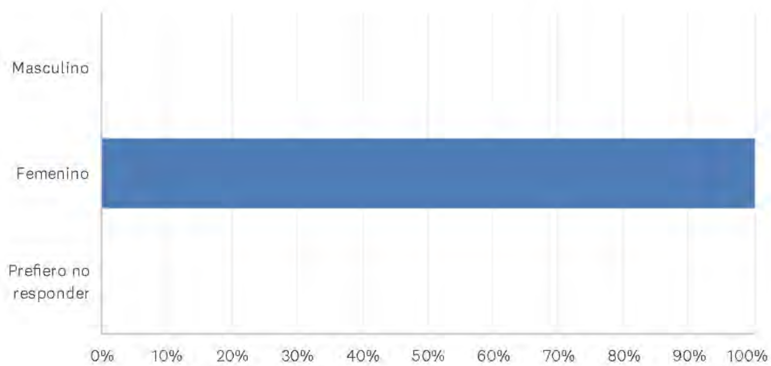
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
Inglés	0.00%	0
Español	100.00%	1
Otro indo europeo	0.00%	0
Idiomas de Asia y las islas del Pacífico	0.00%	0
Otro (por favor especifique)	0.00%	0
TOTAL		1

Q27 ¿Cuál es su género?

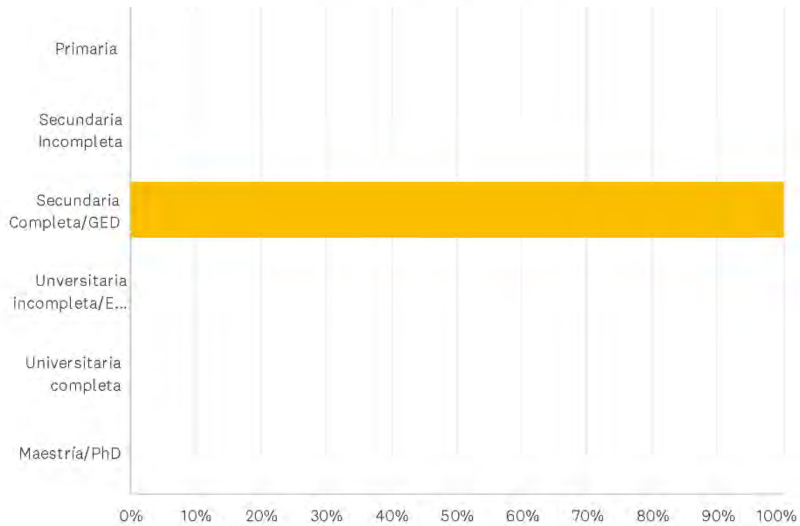
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
Masculino	0.00%	0
Femenino	100.00%	1
Prefiero no responder	0.00%	0
TOTAL		1

Q28 Nivel de educación:

Answered: 1 Skipped: 0

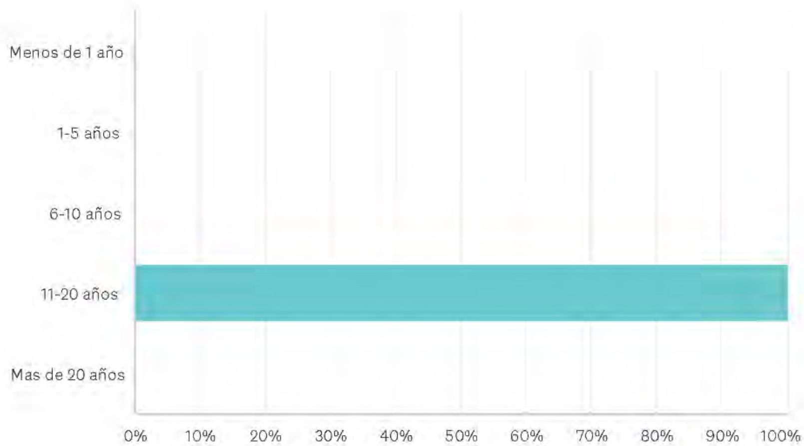


ANSWER CHOICES	RESPONSES	
Primaria	0.00%	0
Secundaria Incompleta	0.00%	0
Secundaria Completa/GED	100.00%	1
Unversitaria incompleta/Escuela de oficio	0.00%	0
Universitaria completa	0.00%	0
Maestría/PhD	0.00%	0
TOTAL		1

#	OTRO (POR FAVOR ESPECIFIQUE)	DATE
	There are no responses.	

Q29 ¿Cuantos años has vivido en el Condado?

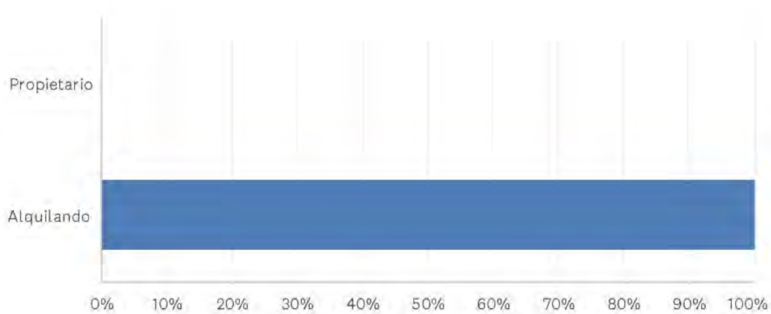
Answered: 1   Skipped: 0



ANSWER CHOICES	RESPONSES	
Menos de 1 año	0.00%	0
1-5 años	0.00%	0
6-10 años	0.00%	0
11-20 años	100.00%	1
Mas de 20 años	0.00%	0
TOTAL		1

Q30 ¿Usted es propietaro o está alquilando su hogar?

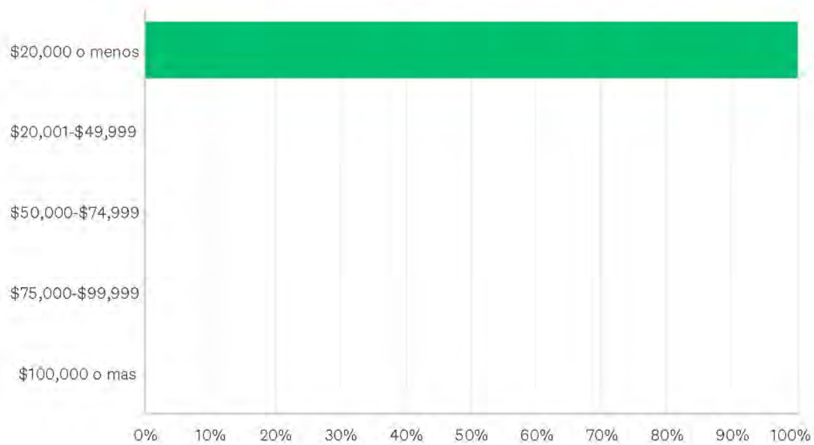
Answered: 1   Skipped: 0



ANSWER CHOICES	RESPONSES	
Propietario	0.00%	0
Alquilando	100.00%	1
TOTAL		1

Q31 ¿Cual es su ingreso familiar anual?

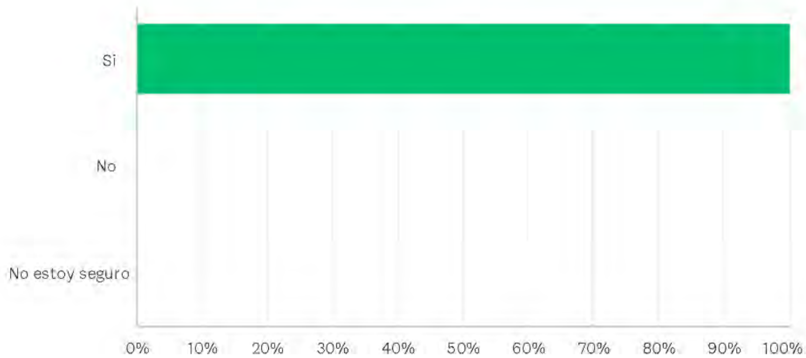
Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
$20,000 o menos	100.00%	1
$20,001-$49,999	0.00%	0
$50,000-$74,999	0.00%	0
$75,000-$99,999	0.00%	0
$100,000 o mas	0.00%	0
TOTAL		1

Q32 ¿Tiene aceso regular al internet?

Answered: 1 Skipped: 0



ANSWER CHOICES	RESPONSES	
Si	100.00%	1
No	0.00%	0
No estoy seguro	0.00%	0
TOTAL		1

Q33 Comentarios Adicionales

Answered: 0 Skipped: 1

#	RESPONSES	DATE
	There are no responses.	

APPENDIX D.

PLAN ADOPTION RESOLUTIONS FROM PLANNING PARTNERS

APPENDIX D.
PLAN ADOPTION RESOLUTIONS FROM PLANNING PARTNERS

RESOLUTION
TEXAS HAZARD MITIGATION PLAN
City of Laward, TEXAS

WHEREAS, Section 322 of the Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5165) requires local governments to develop a hazardous mitigation plan as a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation projects; and,

WHEREAS, the Code of Federal Regulations (CFR) at Title 44, Chapter 1 part 201, requires the County to prepare and adopt a local mitigation plan every five (5) years; and,

WHEREAS, a steering committee comprised of members of the County, and participating incorporated areas within, selected and deemed appropriate by the Commissioners Court in its authority to do so as granted by the people, as well as the local participating governments' leadership was convened in order to assess the risks of hazards facing the County and the Communities, and to make recommendations on actions to be taken to mitigate these hazards; and,

WHEREAS, a Proposal for Professional Services was approved for Scheibe Consulting LLC to update the comprehensive hazard mitigation plan for the County and the participating jurisdictions; and,

WHEREAS, the plan incorporates the comments, ideas and concerns of the community and of the public in general, which this plan is designed to protect, ascertained through a series of public meetings, publication of the draft plan, press releases, and other outreach activities; and

NOW THEREFORE, BE IT RESOLVED by the **Laward City Council** that the 2022, Jackson County, Texas Hazard Mitigation Plan, is hereby approved and adopted by the Laward City Council, Texas and resolves to execute the actions in the plan.

This Resolution shall take effect immediately without reconsideration.

ADOPTED by the Laward City Council on this the 12 day of May, 2022.

Mary Gutierrez
Cleo Sanchez
Debbie Fikes

William R Koch
Mayor

RESOLUTION NO. R-2022-09
City of Edna, Texas

WHEREAS, Section 322 of the Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5165) requires local governments to develop a hazardous mitigation plan as a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation projects; and,

WHEREAS, the Code of Federal Regulations (CFR) at Title 44, Chapter 1 part 201, requires the County to prepare and adopt a local mitigation plan every five (5) years; and,

WHEREAS, a steering committee comprised of members of the County, and participating incorporated areas within, selected and deemed appropriate by the Commissioners Court in its authority to do so as granted by the people, as well as the local participating governments' leadership was convened in order to assess the risks of hazards facing the County and the Communities, and to make recommendations on actions to be taken to mitigate these hazards; and,

WHEREAS, a Proposal for Professional Services was approved for Scheibe Consulting LLC to update the comprehensive hazard mitigation plan for the County and the participating jurisdictions; and,

WHEREAS, the plan incorporates the comments, ideas and concerns of the community and of the public in general, which this plan is designed to protect, ascertained through a series of public meetings, publication of the draft plan, press releases, and other outreach activities; and

NOW THEREFORE, BE IT RESOLVED by the **EDNA CITY COUNCIL** that the 2022, Jackson County, Texas Hazard Mitigation Plan, is hereby approved and adopted by the Edna City Council of Edna, Texas and resolves to execute the actions in the plan.

This Resolution shall take effect immediately without reconsideration.

ADOPTED by the Edna City Council on this the 7th day of April, 2022.

Lance Smiga, Mayor

Dustin Muncrief, Councilperson District 1

Wayne Callis, Councilperson District 2

Chris Jackson, Councilperson District 3

Mike Dodds, Councilperson District 4

Johnny Vasquez, Councilperson District 5

RESOLUTION 2022-01
Jackson County
Hazard Mitigation Plan

WHEREAS, Section 322 of the Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5165) requires local governments to develop a hazardous mitigation plan as a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation projects, and,

WHEREAS, the Code of Federal Regulations (CFR) at Title 44, Chapter 1 part 201, requires the County to prepare and adopt a local mitigation plan every five years; and

WHEREAS, a steering committee composed of members of the County, and participating incorporated areas within, selected, and deemed appropriate by the Commissioners Court in its authority to do so as granted by the people, as well as the local anticipating governments' leadership was convened in order to assess the risks of hazards facing the County and the Communities, and to make recommendations on actions to be taken to mitigate these hazards and,

WHEREAS, a Proposal for Professional Services was approved for Scheibe Consulting LLC to update the comprehensive hazard mitigation plan for the County and the participating jurisdictions; and,

WHEREAS, the plan incorporates the comments, ideas and concerns of the community and the public in general, which this plan is designed to protect, and ascertained through a series of public meetings, publication of the draft plan, press releases, and other outreach activities; and

NOW THEREFORE, BE IT RESOLVED by the GANADO CITY COUNCIL that the 2022, Jackson County, Texas Hazard Mitigation Plan, I hereby approved and adopted by the Ganado City Council of Ganado, Texas and resolves to execute the actions in the plan.

This Resolution shall take effect immediately without reconsideration.

ADOPTED by the Ganado City Council on this the 10th day of May, 2022.

Clinton Pegeler
Mayor

Kristi Rogers
City Secretary

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RESOLUTION
TEXAS HAZARD MITIGATION PLAN
JACKSON COUNTY, TEXAS

WHEREAS, Section 322 of the Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5165) requires local governments to develop a hazardous mitigation plan as a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation projects; and,

WHEREAS, the Code of Federal Regulations (CFR) at Title 44, Chapter 1 part 201, requires the County to prepare and adopt a local mitigation plan every five (5) years; and,

WHEREAS, a steering committee comprised of members of the County, and participating incorporated areas within, selected and deemed appropriate by the Commissioners Court in its authority to do so as granted by the people, as well as the local participating governments' leadership was convened in order to assess the risks of hazards facing the County and the Communities, and to make recommendations on actions to be taken to mitigate these hazards; and,

WHEREAS, a Proposal for Professional Services was approved for Scheibe Consulting LLC to update the comprehensive hazard mitigation plan for the County and the participating jurisdictions; and,

WHEREAS, the plan incorporates the comments, ideas and concerns of the community and of the public in general, which this plan is designed to protect, ascertained through a series of public meetings, publication of the draft plan, press releases, and other outreach activities; and

NOW THEREFORE, BE IT RESOLVED by the Jackson County Commissioners Court that the 2022, Jackson County, Texas Hazard Mitigation Plan, is hereby approved and adopted by the Jackson County Commissioners Court and resolves to execute the actions in the plan.

This Resolution shall take effect immediately without reconsideration.

ADOPTED by the Jackson County Commissioners Court on this the 18th day of May, 2022.

Jill S. Sklar

Jill S. Sklar, County Judge

Wayne Hunt

Wayne Hunt, Commissioner, Pct. 1

Wayne Bubela

Wayne Bubela, Commissioner, Pct. 2

Glenn Martin

Glenn Martin, Commissioner, Pct. 3

Dennis Karl

Dennis Karl, Commissioner, Pct. 4

Jackson County

Hazard Mitigation Plan Update

APPENDIX E.

EXAMPLE PROGRESS REPORT

APPENDIX E.
EXAMPLE PROGRESS REPORT

Jackson County
Hazard Mitigation Plan Update
Annual Progress Report

Reporting Period: 2021-2025

Background: Jackson County and the Cities of Edna, Ganado, and La Ward developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the participating partners organized resources, assessed risks from natural hazards within the planning area, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, the jurisdictions maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under FEMA's Hazard Mitigation Assistance grants. The plan can be viewed online at:

http://www.co.jackson.tx.us/page/jackson.Emergency

Summary Overview of the Plan's Progress: The performance period for the Hazard Mitigation Plan became effective on ______, 2021, with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before ________, 2025. As of this reporting period, the performance period for this plan is considered to be __% complete. The Hazard Mitigation Plan has targeted 65 hazard mitigation actions to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

- ____ out of ____ actions (____ %) reported ongoing action toward completion
- ____ out of ____ actions (____ %) were reported as being complete
- ____out of ____ actions (____%) reported no action taken

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the Jackson County Hazard Mitigation Plan Update. The objective is to ensure that there is a continuing and responsive planning process that will keep the Hazard Mitigation Plan dynamic and responsive to the needs and capabilities of the partner jurisdictions. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area (all of Jackson County)
- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement
- Monitor the incorporation of the Mitigation Plan into planning mechanisms.

The Hazard Mitigation Plan Steering Committee: The Hazard Mitigation Plan Steering Committee, made up of planning partners and stakeholders within the planning area, reviewed and approved this progress report at its annual meeting held on ______ ____, 202_. It was determined through the plan's development process that a Steering Committee would remain in service to oversee the maintenance of the plan. At a minimum, the Steering Committee will provide technical review and oversight on the development of the annual progress report. It is anticipated that there will be turnover in the membership annually, which will be documented in the progress reports. For this reporting period, the Steering Committee membership is as indicated in Table 1.

TABLE 1.
STEERING COMMITTEE MEMBERS

Name	Title	Jurisdiction/Agency

Natural Hazard Events within the Planning Area: During the reporting period, there were __ hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

- ____________________________
- ____________________________
- ____________________________
- ____________________________

Changes in Risk Exposure in the Planning Area: (*Insert a brief overview of any natural hazard event in the planning area that changed the probability of occurrence or ranking of risk for the hazards addressed in the hazard mitigation plan*)

Mitigation Success Stories: (*Insert a brief overview of mitigation accomplishments during the reporting period*)

Review of the Action Plan: Table 2 reviews the action plan, reporting the status of each action. Reviewers of this report should refer to the Hazard Mitigation Plan for more detailed descriptions of each action and the prioritization process.

Address the following in the "status" column of the following table:

- Was any element of the action carried out during the reporting period?
- If no action was completed, why?
- Is the timeline for implementation for the action still appropriate?

If the action was completed, does it need to be changed or removed from the action plan?

TABLE 2.
ACTION PLAN MATRIX

Action No.	Title	Action Taken? (Yes or No)	Timeline	Priority	Status Comments	Status (√, O, X)
JACKSON COUNTY						
1	Purchase and install shutters for Jackson County Hospital District Facility					
2	Flood Plan to include water pumps to vacate standing water from hospital					
3	Parmetto Bend Spillway - Emergency Stop Log Deployment System					
4	Bank Stabilization Project					
5	Planting Vegetation on Slopes					
6	Purchase Flow Water Tanks					
7	Provide for traffic control on non- regulated intersections.					
8	Create and Implement a Drought and Expansive Soils Contingency Plan					
9	Reduce fire fuels and potential fire risk in County					
10	Implement a tree trimming program					
11	Retrofit county courthouse for a hurricane shelter					
12	Develop water conservation and preventative measures program					
13	Install automatic switch for the County Services Building generator					
14	Harden critical facilities					

TABLE 2. ACTION PLAN MATRIX						
Action No.	Title	Action Taken? (Yes or No)	Timeline	Priority	Status Comments	Status (√, O, X)
15	Strengthen County Road 480 with the development of a headwall.					
16	Purchase message board trailers (solar boards) in event of emergency					
17	Purchase Emergency Generator for Jackson County – Pct. 1 Barn					
18	Debris Removal and Drainage Enhancements – Pct. 1 County Roads					
19	Navidad River Property Acquisition					
20	Property Acquisition at Site 5- LaSalle RC&D					
21	Lavaca River Acquisition					
22	Arenosa Creek Acquisition at Site 8 – Gasch/Kutach.					
23	Provide training for elected officials and professional technical staff					
24	Implement major clearing of trees and brush from all main creeks and ditches.					
25	Weather Resistant windows courthouse					
26	Update Flood Damage Prevention Order					
CITY OF EDNA						
1	Purchase 100kw generator for Community Safe Room					
2	Purchase emergency generator for City of Edna Sewer Lift Station					
3	Construction of combined/harden First Responder station for EMS/Fire/Police departments.					
4	Portable electronic road signs/ message boards					

TABLE 2. ACTION PLAN MATRIX						
Action No.	Title	Action Taken? (Yes or No)	Timeline	Priority	Status Comments	Status (√, O, X)
5	Implement a tree trimming program					
6	Retrofit and harden existing public facilities					
7	Floodproof sewage treatment plant					
8	Develop project to divert rainwater and runoff that flows through town					
9	Drainage Improvements – Mexico Street/ MLK Boulevard					
10	Purchase emergency generator for City of Edna Fire/EMS Building, Police Department, City Hall					
11	Drill additional water wells to increase water supply					
12	Install Emergency Notification System					
13	Educate homeowners on hazards					
14	Drainage Improvements throughout City					
15	Update Drainage Master Plan					
16	Update Development Codes, Subdivision Ordinances, and Drainage Criteria					
17	Improve Water/Sewer Infrastructure Throughout City					
18	Improve Wastewater Treatment Plant					
CITY OF GANADO						

TABLE 2. ACTION PLAN MATRIX						
Action No.	Title	Action Taken? (Yes or No)	Timeline	Priority	Status Comments	Status (√, O, X)
1	Install Outdoor Warning Sirens					
2	Clean and remove debris from ditches and creeks in community.					
3	Replace sewer lines.					
4	Create a public educational campaign					
5	Retrofit and harden City Hall and install a safe room.					
6	Construct a new harden Emergency Services Building.					
7	Emergency generators for Sewer Lift Stations					
8	Emergerncy generators for water system					
9	Devers Creek Drainage Improvements					
10	Drainage Improvements					
11	Rehab Water Storage Tanks					
12	Long-term Water Supply Planning					
13	Drainage Master Planning					
14	Update of Subdivision Ord.					
CITY OF LA WARD						
1	Drainage Master Plan					
2	Purchase Back-up generators					

TABLE 2. ACTION PLAN MATRIX						
Action No.	Title	Action Taken? (Yes or No)	Timeline	Priority	Status Comments	Status (√, O, X)
3	Road Reconstruction					
4	Water and Sewer Infrastructure Reconstruction					
5	Educate homeowners on hazards					
6	Update Development Codes, Subdivision Ordinances, and Drainage Criteria					
7	Portable electronic road signs/ message boards					

Completion statues legend:

√ = Project Completed

O = Action ongoing toward completion

X = No progress at this time

Changes That May Impact Implementation of the Plan: (Insert a brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory, and financial capabilities identified during the plan's development)

Recommendations for Changes or Enhancements: Based on the review of this report by the Hazard Mitigation Plan Steering Committee, the following recommendations will be noted for future updates or revisions to the plan:

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

Public review notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the governing boards of all planning partners and local media outlets and the report is posted on the Jackson County Emergency Management website. Any questions or comments regarding the contents of this report should be directed to:*

Insert Contact Info Here