HAZARD ANALYSIS

The *Hazard Analysis* section provides information on historical hazard occurrences in the Houston-Galveston Area Council (H-GAC) region for the following hazards[1]:

- **Flood (Riverine and Coastal)**
- **Hurricanes and Tropical Storms**
- **Severe Thunderstorms**
- **Tornadoes**
- **Wildfire**
- **Drought**
- **Excessive Heat**
- **Winter Storms**
- **Hail**
- **Coastal Erosion**
- **Dam/Levee Failure**
- **Earthquakes**
- **Sinkholes**
- **Subsidence**
- **Tsunami**

Flood

There are numerous rivers and streams that wind through the counties and jurisdictions in the region, setting the stage for potential flooding during heavy rain events. Flash flooding can, and does, develop quickly in the region, endangering life and property and requiring rescue.

Notable flood events recorded by the National Climatic Data Center for the period of October 1994 through November 2003 are listed in **Table 4.2-1**. NCDC records of events prior to October 1994 are incomplete.

Detailed flood mapping for each county has been included in *Section 4.3*. These maps show the extent of the flood hazard within each County.

This photo of Buffalo Bayou, looking upstream from Main Street in the Houston area, illustrates the extent of flooding from Tropical Storm Allison on June 9, 2001.

[1] The *Hazard Analysis* section relied on the use of best available historical data to assist in the approximation of risk. In most cases this data comes from the National Climatic Data Center and does not provide great detail on the impacts to each jurisdiction. Future updates of this plan will seek to improve this data for jurisdictions. The overall risk assessment process involved combining this qualitative approach with a more in-depth vulnerability assessment resulting in annualized loss estimates for those hazards posing a greater threat to the H-GAC region. Specific hazards addressed using this method included flood, hurricane winds, tornado, drought, hail, thunderstorms and earthquake.

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Table 4.2-1
Recent Flood Events in the H-GAC Region (1994-2003)

County	Date	Deaths	Property Damage	Details
Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, Wharton	10/16/1994-10/18/1994	17	$900,000,000	Total rainfall generally ranged from 10 to 20 inches with Liberty recording 30.5 inches of rain during the storm. Over 13,000 people had to be evacuated during the floods and more than 22,000 homes were damaged.
Austin, Brazoria, Brazos, Chambers, Colorado, Fort Bend, Grimes, Harris, Jackson, Liberty, Madison, Matagorda, Montgomery, Waller, Wharton	10/17/1998-10/18/1998	8	$418,000	Many areas received in excess of 10 inches. Over 16 inches of rain fell along the Wharton/Colorado county line. Three hundred and fifty to 375 homes were impacted, four were destroyed, 143 sustained major damage, and 209 received minor damage. Hundreds of livestock were lost and 7,500 acres of crop land were damaged.
Austin, Brazoria, Brazos, **Colorado, Fort Bend, Harris**, Jackson, **Liberty**, Madison, **Matagorda, Montgomer**y, Polk, San Jacinto, **Walker, Waller, Wharton**	11/12/1998-11/14/1998	0	$239,000	Rainfall amounts across the area averaged 5 to 7 inches with large areas receiving 7 to 9 inches. Isolated locations received more than 10 inches of rain. Homes flooded in several communities, including Plum Grove, Patton Village, Magnolia Gardens, Banana Bend, Highland Shores and Friendswood.
Brazoria, Fort Bend, Galveston, Harris	08/28/2001-08/31/2001	0	$1,463,000	Heavy rainfall caused street flooding and water in some homes. Some roads were closed.
Harris	09/18/1996	0	$1,500,000	Widespread street flooding in downtown Houston and Pasadena. Homes and businesses in Pasadena were flooded.
Harris	05/24/1997	0	$250,000	Severe flooding in Houston. 50-75 homes received flood damage.
Harris	03/19/1999	0	$300,000	Widespread flooding in southwest Houston. Numerous streets in the Alief and Bellaire areas were flooded. Several on ramps to US 59, Loop 610, and US 90, as well as the intersection of I-10 and Beltway 8, were impassable due to high water.
Harris, Liberty	05/19/2000	0	$10,400,000	Major flooding on Greens, Airtex, Rankin, and Aldine-Westfield Roads in Harris County. Four homes were damaged. At least 262 homes, 42 businesses, and several schools were damaged in Liberty County.
Brazoria, Galveston, Harris	09/13/2000	0	$350,000	Brazoria--Several roads and a railroad underpass were impassable in Freeport and Clute. Galveston-- Street flooding in Galveston, League City and Texas City.

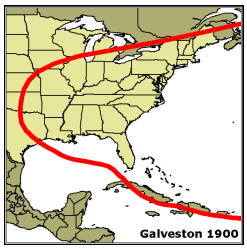
County	Date	Deaths	Property Damage	Details
Liberty	10/22/2000	0	$500,000	Several homes flooded in the Rye and Moss Hill areas. Part of FM 787 was washed out in Romayor. SH 146 flooded north of Moss Hill.
Walker	11/3/2000	0	$500,000	FM 2989 closed. Major street flooding in Huntsville. Subdivisions flooded in Riverside area.
Brazoria	09/2/2001	0	$80,000	Homes flooded in Danbury. Numerous streets flooded, including Highway 6 between Manvel and Alvin and Highway 36 in Damon.
Galveston	05/17/2002	0	$150,000	Streets flooded with 2-3 feet of water, 50 homes and businesses flooded.
Brazoria, Galveston, Harris	08/15/2002	0	$325,000	Several Brazoria County homes and roads around Alvin received high water. In Galveston County, flood waters inundated cars and businesses. Several streets were closed. Numerous roads in Harris County were flooded.
Matagorda, Brazoria	09/06/2002-09/07/2002	0	$920,000	Matagorda County--Homes in Sargent were flooded. Brazoria County--Waist deep water and flooding in Sweeny. Homes flooded in Wharton.
Brazoria, Galveston, Harris	10/24/2002	0	$250,000	In Brazoria County, flooding occurred in and around Pearland. Roads near I-45 throughout northern Galveston County flooded. Flooding occurred on Almeda, El Dorado and Beamer Roads.
Fort Bend, Harris, Liberty	10/28/2002	0	$775,000	Flooding at Highway 36 and Highway 90 in Fort Bend County. Widespread flooding across Harris County, resulting in many streets becoming impassable. Countywide flooding occurred in Liberty County.
Entire region	11/17/2003	0	Unknown	As much as 9 inches of rain fell in the area causing several spots of localized flooding. There were also thirteen tornadoes reported.

Hurricanes and Tropical Storms

Southeast Texas has experienced numerous hurricane and tropical storm landfalls, as described below.[2]

The Galveston Hurricane caused extensive damage with its hurricane-force wind and storm surge, as illustrated in this photo of ruined homes. (NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory)

Galveston Hurricane 1900



This killer weather system was first detected over the tropical Atlantic on August 27, 1900. While the history of the track and intensity is not fully known, the system reached Cuba as a tropical storm on September 3 and moved into the southeastern Gulf of Mexico on the 5th. A general west-northwestward motion occurred over the Gulf accompanied by rapid intensification. By the time the storm reached the Texas coast south of Galveston late on September 8, it was a Category 4 hurricane. After landfall, the cyclone turned northward through the Great Plains. The system became extratropical and turned east-northeastward on September 11, passing across the Great Lakes, New England, and southeastern Canada. It was last witnessed over the north Atlantic on September 15.

This hurricane was the deadliest weather disaster in United States history. Storm tides of eight to 15 feet inundated Galveston Island, as well as other portions of the nearby Texas coast. High tides were largely responsible for the 8,000 deaths (estimates range from 6,000 to 12,000) attributed to the storm. The damage to property was estimated at $30 million.

Hurricane Carla 1961

Carla made landfall near Port Lavaca on September 14. Carla was among the largest hurricanes of historical record (number 2 behind the Great New England Hurricane of 1938). The storm produced numerous tornadoes, gusts reaching 175 MPH, torrential rains, and a 22 foot storm surge at Port O'Connor. Hurricane force wind gusts were seen along almost the entire Texas Coast. The path of devastation extended from Victoria to Dallas. A death toll of only 34 people in Texas can be attributed in part to what was the largest peace time evacuation of in U.S. history. A quarter million people fled the middle and upper Texas coasts, moving inland to safety.

Twenty-six tornadoes were spawned by Hurricane Carla, one of which damaged 120 buildings and killed six in Galveston. Structures located outside of the protective seawall were severely damaged by the storm surge.[3] Texas City saw 90 percent of its homes flooded. Surfside, near Freeport, received extensive damage. The trail of destruction extended south to Point Isabel, where four to five foot storm surges were observed. Seventy-five percent of Port O'Connor was destroyed.

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[2] Historic hurricane track graphics provided by the National Hurricane Center.
[3] The Galveston Island seawall was constructed following the Galveston Hurricane of 1900.

Hurricane Beulah 1967

At the time, Hurricane Beulah was the third largest hurricane on record, following Carla in 1961 and the Great New England Hurricane of 1938. Beulah, which struck the coast near Brownsville on September 20, 1967, turned to the southwest, paralleling the coastline.

Hurricane-force winds extended up the coast to Corpus Christi, which received gusts up to 86 MPH. Winds gusted to 110 MPH at the local Army Corp of Engineers office. The storm surge reached 20 feet along lower sections of Padre Island. Storm surge and wind-driven waves cut 31 new inlets through the island. Citrus fruit and tree damage totaled $15 million in the Lower Rio Grande Valley.

One hundred and fifteen tornadoes were spawned by the system, the most ever known to be generated by a tropical storm (five times the previous record set by Isbell in 1964). Most of the tornadoes were confined to the coast of Texas and were rather weak. One tornado touched down in Palacios on the morning of the 20th, killing four people and injuring six others. Fifteen people died in Texas during Beulah. Five were killed by a tornado and 10 died due to drowning. A total of 110 boats were damaged or destroyed by the storm. Damages were estimated conservatively at $100 million.

Flooding along the Texas coast following the passage of Hurricane Beulah on September 20, 1967 caused significant damage to this business district. (NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory)

Hurricanes Fern and Edith 1971

Hurricane Fern paralleled the Texas coast and made landfall as a tropical storm on the 11th. Major flooding occurred along portions of the Frio, Lavaca, Nueces, San Antonio, Guadalupe, Mission, and Aransas Rivers. Wind gusts over 100 MPH blew away the anemometer at Port O'Connor on the 10th. Gusts exceeding 60 MPH were seen from Galveston down the coast south of Corpus Christi. Five tornadoes were generated by Fern. The highest recorded storm surge reached six feet at Freeport. Damages totaled $30 million, $5 million of which occurred in Sinton. Two people died during the storm.

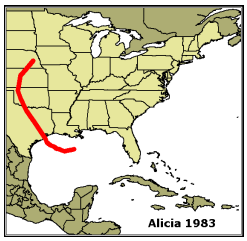
Edith made landfall as a Category 2 hurricane on the 16th. A six foot storm surge overran Highway 87 between Sabine Pass and High Island. Galveston and Port Arthur reported wind gusts of 53 and 47 MPH respectively.

Tropical Storm Claudette 1979

Tropical Storm Claudette made landfall near Galveston and made a loop just after landfall, stalling over southeast Texas from July 24 to July 27. Winds gusted to 60 MPH. Tides in Chocolate Bayou reached five feet above normal. Rainfall amounts greater than 10 inches fell within 40 miles of the coast from Matagorda Bay to Sabine Pass. Twenty four hour rainfall totals reached 45 inches in Alvin, establishing a new U.S. rainfall record. This caused widespread and

unprecedented flooding across the area. Most streams did not return to their banks until the 30th. Fifteen thousand homes and hundreds of businesses were flooded. The rice crop was beaten into the soil by the heavy rain. Six counties in southeast Texas were declared major disaster areas. In Austin, two inches of rain fell within an hour on the 27th and caused flash flooding. Claudette produced $750 million in damages, putting it on the National Hurricane Center's list of history's most damaging tropical cyclones in the United States.

Hurricane Alicia 1983



Alicia formed over the north central Gulf of Mexico on August 15, 1983. It drifted slowly westward and northwestward while steadily strengthening on the 16th and 17th. This motion brought Alicia over the western end of Galveston Island as a Category 3 hurricane on August 18. Alicia moved northwestward into Oklahoma as a tropical depression on August 19, and then turned northward before dissipating over Nebraska on the 21st.

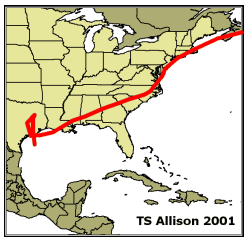
The Coast Guard cutter Buttonwood moored at Galveston reported sustained winds of 96 MPH with gusts reaching 125 MPH. Hobby Airport at Houston, Texas reported 94 MPH sustained winds with gusts to 107 MPH. Wind gusts of hurricane force in downtown Houston littered the streets with broken glass as windows broke in numerous high-rise buildings. Additionally, 23 tornadoes were reported from Alicia. Alicia was responsible for 21 deaths and $2 billion in damages.

Tropical Storm Frances 1998

On September 10, 1998, Tropical Storm Frances formed in the western Gulf of Mexico approximately 250 miles south of Galveston. On September 12, Frances moved inland just southwest of Victoria and remained nearly stationary throughout the day, moving to the north northeast that evening. At 7 p.m. ET, Frances was downgraded to a Tropical Depression as it moved to the northeast of Victoria.

Most of the damage along the coast was attributed to the high tides that persisted for nearly two days. The high tides in Galveston Bay increased flooding problems experienced further inland by the heavy rains. Over four inches of rain fell over the Houston/ Galveston County Warning area. More than 10 inches of rain fell along the coastal counties of Matagorda, Brazoria, Galveston and Chambers. Inland counties, including Harris, Polk, San Jacinto and Washington received similar rainfall totals. With tides already running four to six feet above normal, rainfall runoff that normally drained into area bays, backed up, resulting in more widespread flooding of inland creeks and bayous. Galveston, Harris, Brazoria, and Matagorda Counties were declared disaster areas. Total damages exceeded $286 million dollars. Most of this damage was along the coast and around Galveston Bay where high tides and winds destroyed dunes and personal property. Nearly 100 single family homes were destroyed along the upper Texas coast by the high tides and battering waves. Three deaths can be attributed to Tropical Storm Frances.

Tropical Storm Allison 2001

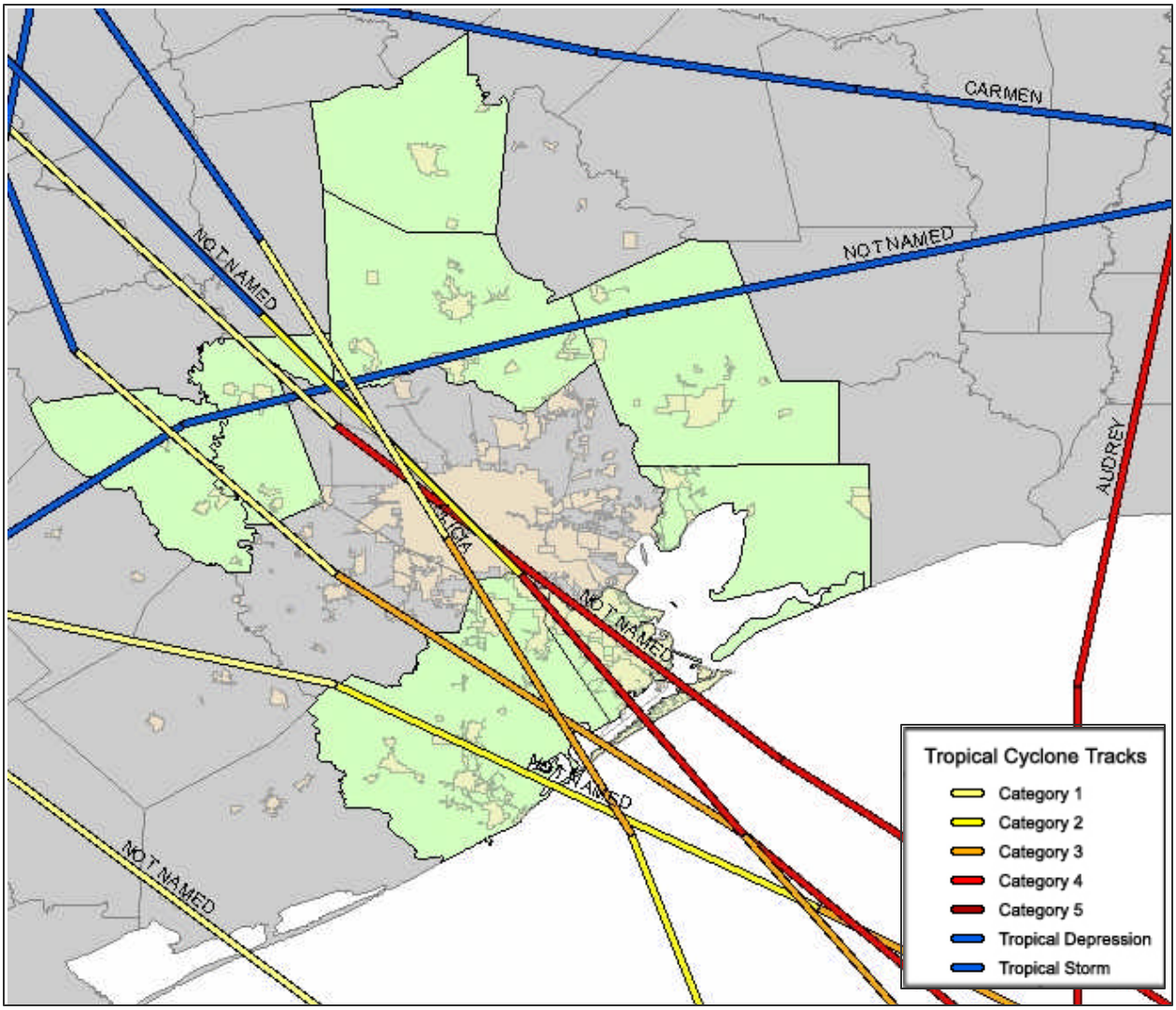


Tropical Storm Allison, which began as an area of disturbed weather over the northwestern Gulf of Mexico on June 5, 2001, rapidly developed into a tropical storm. The storm made landfall near Freeport, Texas later that day. Allison weakened to a depression on the 6th, while drifting northward. The storm then made a slow loop over southeastern Texas from the 7th to the 9th. The cyclone moved into the Gulf of Mexico on the 10th and acquired subtropical characteristics. It then moved east-northeastward over southeastern Louisiana on the 11th, where it re-intensified into a subtropical storm. Allison then weakened to a subtropical depression on the 12th while continuing east-northeastward. This track carried it to southeastern North Carolina by the 14th where it stalled. The cyclone then drifted northeastward on the 15th and 16th. This was followed by a faster northeastward motion on the 17th as the center emerged in the Atlantic. Allison regained subtropical storm strength later that day before becoming extratropical on the 18th southeast of Cape Cod. The system dissipated southeast of Nova Scotia the next day.

Allison brought tropical-storm-force winds and above normal tides to portions of the Texas and Louisiana coasts. However, the greatest damages sustained were due to the widespread heavy rains and resulting floods along the entire path of the cyclone. Houston, Texas, was the worst affected area, as the Port of Houston reported 37 inches of rain. Several other locations reported more than 30 inches. The storm also spawned 23 tornadoes. Allison was responsible for 41 deaths and at least $5 billion in damage in the United States, making it the deadliest and costliest U.S. tropical storm of record.

Figure 4.2-1 shows the tracks of major hurricanes that have impacted the region. While the coastal portions of the region are more at risk to the effects of hurricanes than the other parts of the region, the entire region is in a hurricane hazard area and can be expected to experience hurricanes in the future.

Figure 4.2-1
Major Hurricane Tracks



Source: National Hurricane Center

Severe Thunderstorms

According to the National Climatic Data Center, the H-GAC planning area experienced 1,238 thunderstorm wind events from 1950 through February of 2003 (see **Table 4.2-2**). These events caused five deaths, 52 injuries, over $150 million in property damage, and more than $2 million in crop damage (NCDC, 2003).

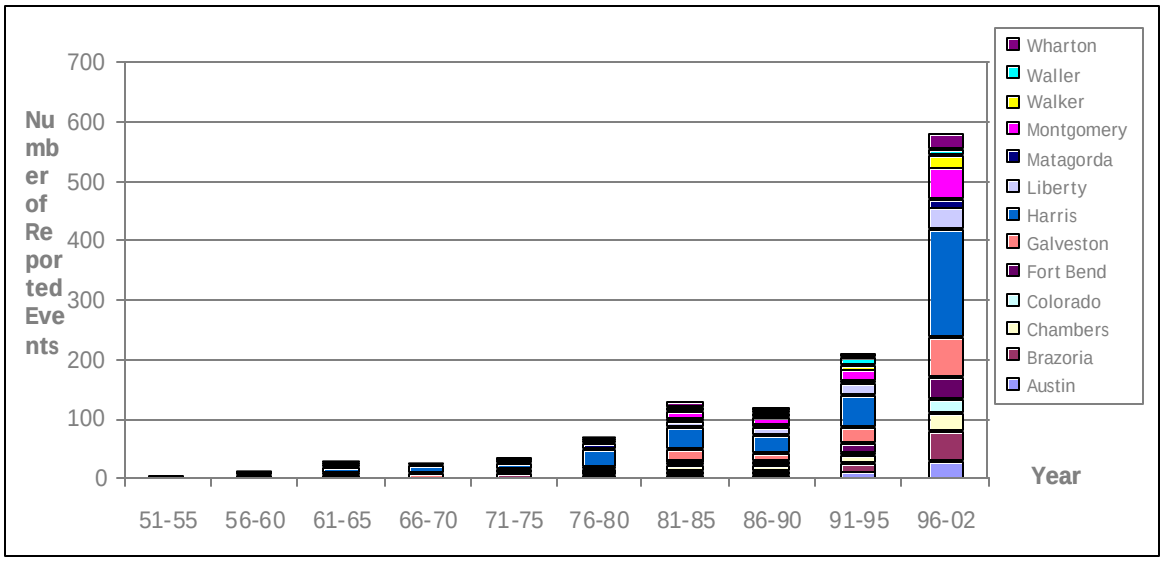
Table 4.2-2
Thunderstorm Wind Activity in the H-GAC Region (1950-2003)

County	# of Recorded Thunderstorms Wind Events 1950 – 02/28/2003	Total Property Damage Recorded	Total Crop Damage Recorded	Deaths	Injuries
Austin	47	$963,000	$250,000	0	0
Brazoria	97	$2,684,000	$5,000	0	5
Chambers	60	$785,000	$3,000	0	0
Colorado	46	$899,000	$0	0	4
Fort Bend	80	$3,660,000	$2,000,000	0	0
Galveston	143	$52,321,000	$0	0	5
Harris	374	$84,443,000	$100,000	2	25
Liberty	80	$734,000	$0	0	1
Matagorda	63	$441,000	$0	3	3
Montgomery	103	$1,295,000	$0	0	0
Walker	46	$586,000	$0	0	6
Waller	31	$228,000	$0	0	0
Wharton	68	$1,205,000	$10,000	0	3
TOTAL	**1,238**	**$150,244,000**	**$2,368,000**	**5**	**52**

Source: National Climatic Data Center

Figure 4.2-2 shows the historical frequency of events by county. **No one portion of the region is more at risk to severe thunderstorms than any other part of the region, therefore the entire region is in a severe thunderstorm hazard area and can be expected to experience severe thunderstorms in the future.**

Figure 4.2-2
Historical Frequency of Thunderstorm Events by County



Tornadoes

When compared with other states, Texas ranks #1 in the number of tornado events; #1 in tornado deaths; #1 in tornado injuries; and #1 in total damages. These rankings are based upon data collected for all states and territories for tornado events between 1950 and 1994 (SPC, 2003).

According to the National Climatic Data Center, the Houston-Galveston Area Council region experienced 726 reported tornado events from 1950 through February of 2003 (See **Table 4.2-3**). These events caused 34 deaths, 737 injuries and approximately $609,819,000 in property damage (NCDC, 2003).

This Texas school was severely impacted by a tornado. (FEMA News Photo)

Table 4.2-3
Tornado Activity in the H-GAC Region (1950-2003)

County	# of Recorded Tornadoes 1950 - 2/28/2003	Total Property Damage Recorded	Deaths	Injuries
Austin	26	$8,028,000	0	6
Brazoria	75	$6,366,000	0	44
Chambers	29	$1,105,000	4	3
Colorado	31	$25,614,000	1	12
Fort Bend	38	$8,458,000	1	13
Galveston	114	$33,008,000	9	238
Harris	202	$501,789,000	12	313
Liberty	49	$9,219,000	0	38
Matagorda	40	$4,326,000	4	25
Montgomery	43	$7,737,000	0	10
Walker	13	$1,553,000	1	18
Waller	13	$725,000	1	6
Wharton	53	$1,891,000	1	11
TOTAL	**726**	**$609,819,000**	**34**	**737**

Source: National Climatic Data Center

Notable Tornados

09/12/1961 Galveston County
An F4 tornado caused eight deaths and 200 injuries.

09/20/1967 Wharton and Matagorda County
Three tornadoes in Matagorda County (F0, F1 and F3) caused a total of $25,000 in damage. The F3 tornado caused four deaths and seven injuries. In Wharton County, a tornado of unknown intensity caused one death, one injury, and $25,000 in property damage.

03/08/1976 Brazoria County
An F3 tornado injured 18 people and caused $2.5 million in property damages.

01/31/1983 Austin and Montgomery Counties
Several tornadoes (F1 and F2) caused four injuries and $5 million in property damage.

05/20-21/1983 Austin, Liberty and Harris Counties
Twenty tornadoes, ranging from F0, F1 and F3, caused a total of three deaths and 14 injuries. Austin County property damages were estimated at over $2.7 million; Liberty County property damages approximated $5 million; and Harris County property damages were estimated at over $5 million.

11/16/1987 Galveston and Harris Counties
Two F1 tornadoes caused four injuries and approximately $5 million in property damages.

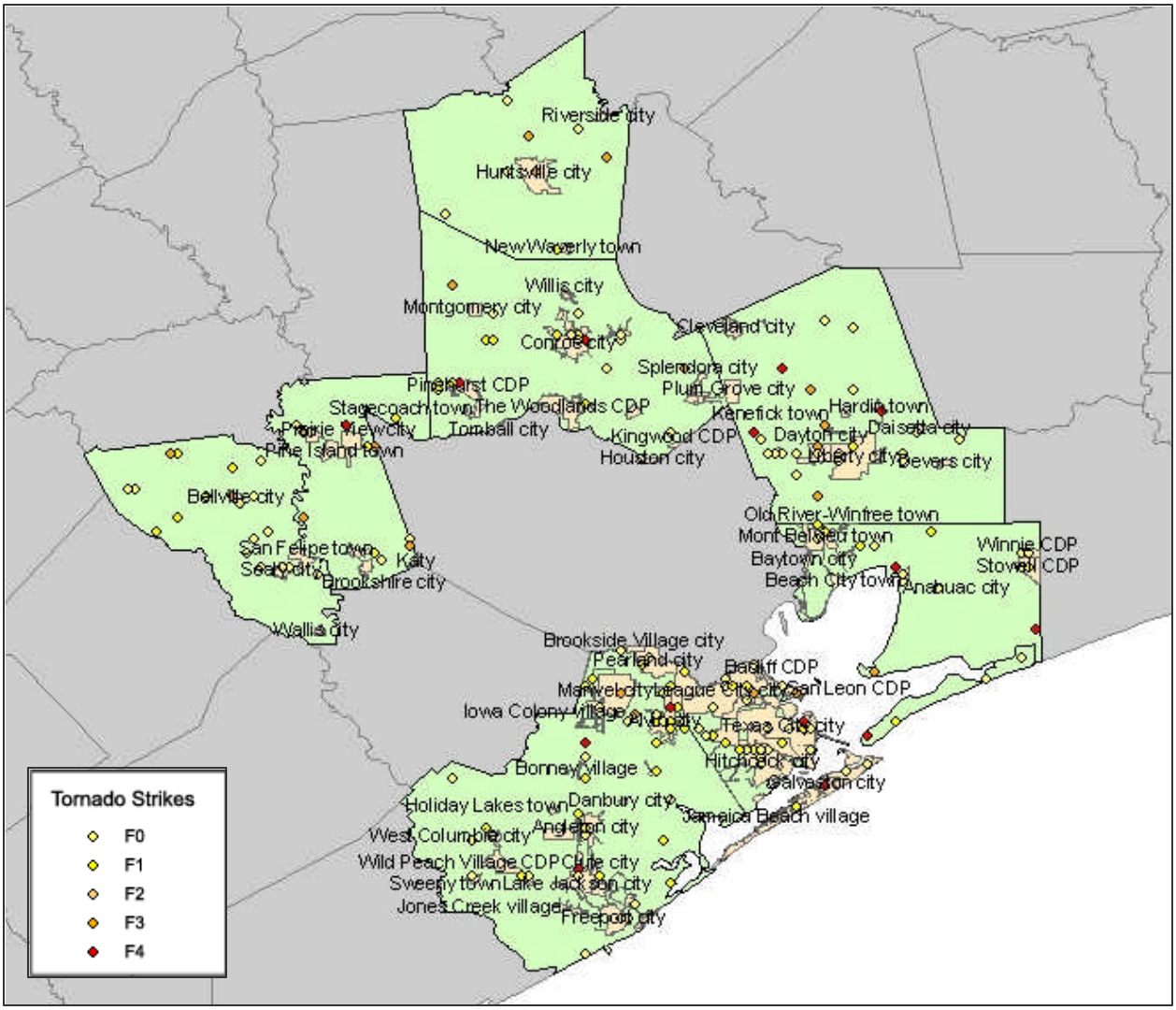
01/14/1991 Colorado County
An F1 tornado caused one death, eleven injuries, and approximately $25 million in damage.

01/21/1992 Liberty, Harris, and Fort Bend Counties
Several tornadoes, ranging from F1 to F4, caused a total of 34 injuries (32 in Harris County). Harris County property damages were estimated at $350 million; Liberty County property damages were estimated at $5 million; and Fort Bend County damages approximated $2.5 million.

11/17/2003 Harris County and surrounding areas
Thirteen tornadoes were reported as a bizarre storm blew through the areas also dumping as much as nine inches of rain.

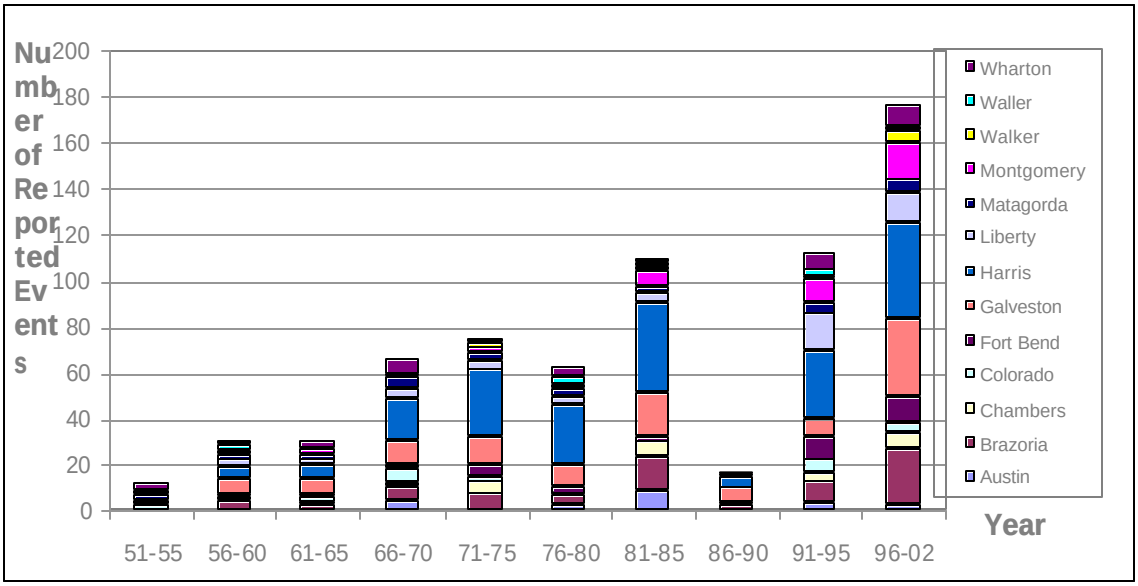
Figure 4.2-3 and **Figure 4.2-4** show historical tornado occurrences and tornado frequency by county. More detailed maps can be found in Section 4.3 (**Figures 4.3-6 through 4.3-13**). **No one portion of the region is more at risk to tornadoes than any other part of the region, therefore the entire region is in a tornado hazard area and can be expected to experience tornadoes in the future.**

Figure 4.2-3
Historical Tornado Occurrences



Source: National Climatic Data Center

Figure 4.2-4
Frequency of Tornado Events



Wildfire

According to the Texas Forest Service, approximately 90 percent of all Texas wildfires are human-caused, due primarily to unchecked burning of debris. Of the 13 counties covered in this Plan, over half have low risk for urban and wildland fires (**Table 4.2-5** and **Figure 4.2-5**). According to the National Climatic Data Center, there are no recorded instances of wildfire occurrence in the Houston-Galveston area since 1950. **Table 4.2-4** provides summary statistics for each county on the number of wildfire suppressed by the Texas Forest Service since 1998.

Table 4.2-4
Number of Wildfires Suppressed by Texas Forest Service Since 1998

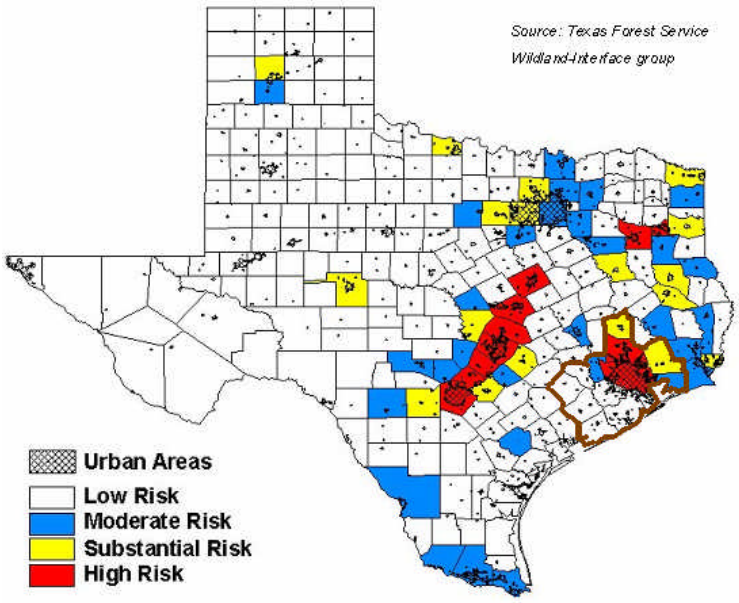
County	1998	1999	2000	2001	2002	2003	2004	2005 (YTD)
Austin	1	3	0	1	0	0	0	0
Brazoria	0	0	0	0	0	0	0	0
Chambers	0	1	4	0	0	0	0	0
Galveston	0	0	0	0	0	0	0	0
Liberty	15	13	44	5	1	4	1	0
Montgomery	58	80	170	31	61	32	33	6
Walker	37	23	59	9	39	16	17	4
Waller	4	8	15	0	3	2	0	1

Source: Texas Forest Service

Table 4.2-5
Risk for Urban and Wildland Fires

County	Risk for Urban and Wildland Fires
Austin	Low
Brazoria	Low
Chambers	Moderate
Galveston	Low
Liberty	Substantial
Montgomery	High
Walker	Substantial
Waller	Moderate

Figure 4.2-5
Wildfire Risk



Drought

Recent drought events which have affected the Houston-Galveston Area Council region include:

Summer 1996

Austin, Brazoria, Brazos, Burleson**, Chambers, Colorado, Fort Bend, Galveston,** Grimes**, Harris,** Houston, Jackson**, Liberty,** Madison**, Matagorda, Montgomery,** Polk, San Jacinto**,** Trinity**, Walker, Waller,** Washington**, and Wharton Counties**

From April through June 1996, rainfall totals in the Houston area ran more than 10 inches below normal. Other areas to the west and north reported rainfall totals 75 percent below the normal for the first six months of the year. Damage from the extended drought began to reach record proportions as many crops were lost and livestock were sold due to the lack of available fodder. Property damages and agricultural losses reached $10 million and $100 million in southeast Texas respectively.

May – August 1998

Austin, Brazoria, Brazos, Burleson**, Chambers, Colorado, Fort Bend, Galveston,** Grimes**, Harris,** Houston, Jackson**, Liberty,** Madison**, Matagorda, Montgomery,** Polk, San Jacinto**,** Trinity**, Walker, Waller,** Washington**, and Wharton Counties**

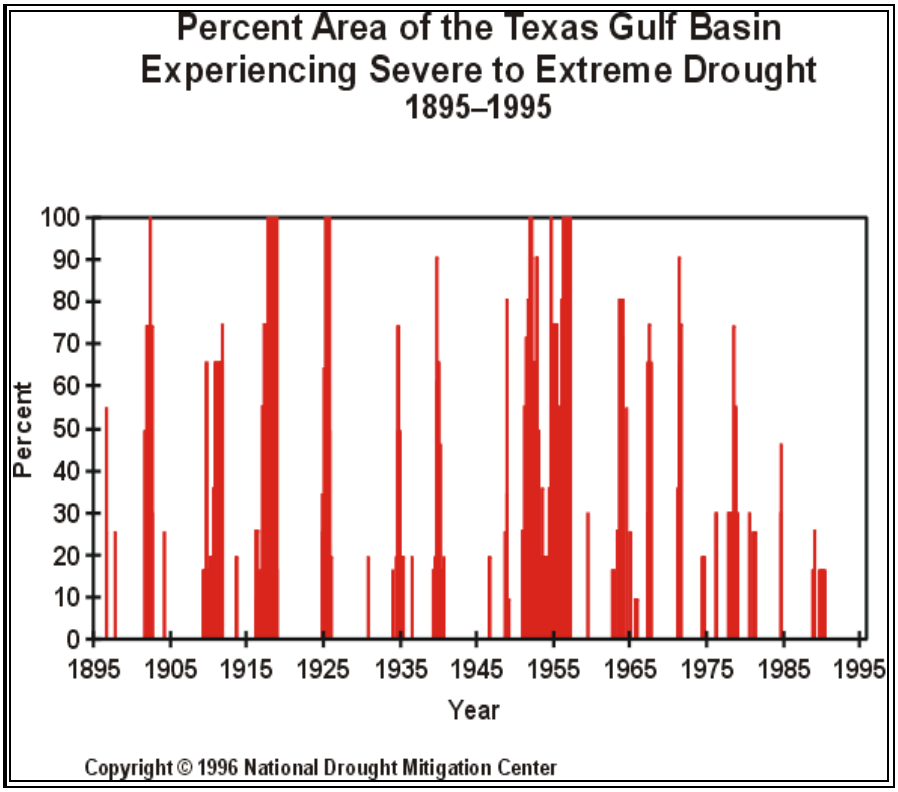
Over 20 people across the region lost their lives due to the extreme heat, and property and crop damage averaged $8.3 million per county.

Summer 2000

Austin, Brazoria, Brazos, Burleson, **Chambers, Colorado, Fort Bend, Galveston,** Grimes, **Harris,** Houston, Jackson**, Liberty,** Madison**, Matagorda, Montgomery,** Polk, San Jacinto, Trinity**, Walker, Waller,** Washington**, and Wharton Counties**.
The combination of excessive heat and dryness resulted in several wildfires during the first week of the month, including a 4,500 acre fire in Liberty County and a 1,965 acre fire in Trinity County.[4] By the end of September, damage estimates to cotton, wheat, and forage crops reached $102.3 million in southeast Texas.

No one portion of the region is more at risk to drought than any other part of the region, therefore the entire region is in a drought hazard area and can be expected to experience droughts in the future. Table 4.2-6 shows the historical frequency of drought events in the Texas Gulf Basin from 1895-1995.

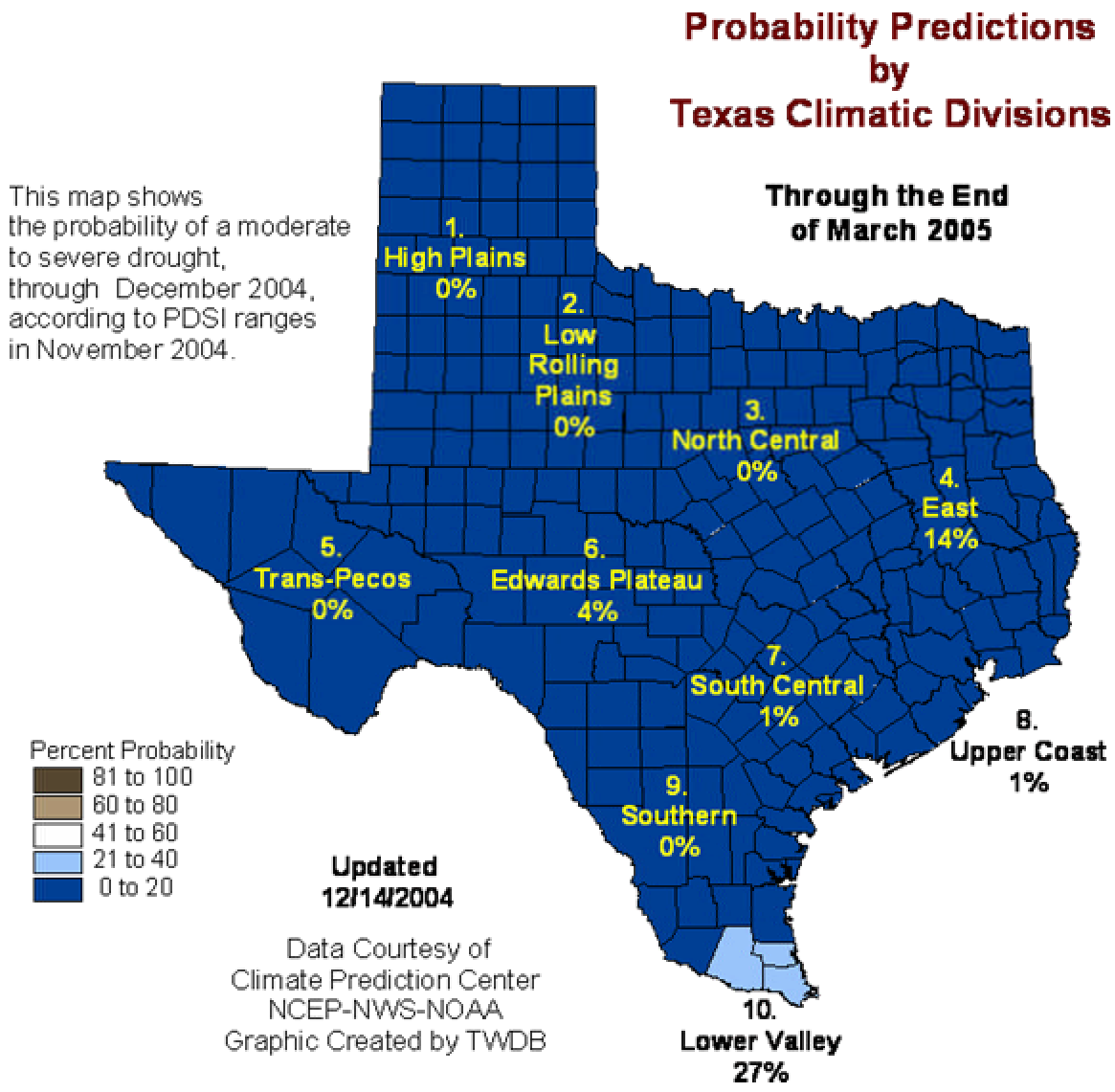
Figure 4.2-6
Historical Frequency of Events by County



[4] These events were not reported to the National Climatic Data Center, and are therefore not referenced under the Wildfire heading in this section.

The drought hazard is difficult to map because drought affects large areas, most times uniformly. The Texas Water Development Board maintains the Texas Water Information Network website (www.txwin.net) where Palmer Drought Severity Index maps are available for public view. There are also Texas Palmer Drought Probability Prediction maps on this site that show drought probability percentages for the upcoming months. It is updated regularly (**Figure 4.2-7**). **There is no need to map jurisdictional drought hazards because drought impacts the region uniformly.**

Figure 4.2-7
Texas Palmer Drought Probability Prediction



Excessive Heat

Since 1995 there have been 6 excessive heat events in the region recorded with the National Climatic Data Center. There were 38 deaths associated with these events and 200 injuries. There was no property damage recorded for these events, as is generally the case with excessive heat events.

The entire region and all of its participating jurisdictions are impacted by excessive heat on an annual basis. Therefore the excessive heat hazard area comprises the entire region. However, because there is generally little property damage associated with excessive heat events a detailed vulnerability assessment will not be conducted for excessive heat in the *Vulnerability Assessment* section of this plan.

Winter Storms

The following winter storm events have been recorded by the National Climatic Data Center in the H-GAC planning area since 1996[5] (**Table 4.2-6**). Winter storm risk maps are not readily available for this region of Texas. **Winter storms affect the region uniformly so all jurisdictions are considered to be in a winter storm hazard area and are equally vulnerable to the potential impact of a winter storm.**

Table 4.2-6
Winter Storm Activity in the H-GAC Region (1994-2000)

Location or County	Date	Type	Deaths/ Injuries	Property Damage	Crop Damage	Description
Harris, Montgomery, Waller, Walker	02/09/1994	Ice Storm	0 0	$20,000	$200,000	
Austin, Brazoria, Brazos, Burleson, **Chambers, Colorado, Fort Bend, Galveston**, Grimes, **Harris**, Houston, Jackson, **Liberty**, Madison, **Matagorda, Montgomery**, Polk, San Jacinto, Trinity, **Walker, Waller**, Washington, **Wharton**	01/12/1997	Ice Storm	3 0	$800,000	$0	Trees, power lines and roadways were affected by freezing rain and sleet. Over 1,100 traffic accidents were reported in Southeast Texas, which accounted for three deaths.
Austin, Brazos, Burleson, Grimes, Washington, Madison, Polk, San Jacinto, **Walker**	12/22/1998-12/23/1998	Winter Storm	0 0	$135,000	$0	Freezing drizzle and rain with a few reports of snow and sleet.
Brazos, Burleson, **Colorado**, Grimes, Houston, Madison, Trinity, **Walker**, Washington	12/13/2000	Ice Storm	0 0	$1,000,000	$0	Numerous trees and power lines downed.

[5] Historical records of winter storms prior to 1996 are incomplete.

Location or County	Date	Type	Deaths/ Injuries	Property Damage	Crop Damage	Description
Chambers, Fort Bend, Galveston, **Harris** , Jackson, Matagorda, Wharton	12/12/2004	Heavy Snow	0 0	$0	$0	Snowfall amounts ranges from one inch to 16 inches across the region.
		TOTAL	**3**	**$1,955,000**	**$200,000**	

Hail

According to the National Climatic Data Center, the H-GAC planning area experienced 857 hail events from 1950 through February of 2003 (see **Table 4.2-7**), with some hail stones reaching three inches in diameter. These events caused over $43 million in property damage (NCDC, 2003).

Table 4.2-7
Hail Activity in the H-GAC Region (1950-2003)

County	# of Recorded Hail Events	Total Property Damage Recorded	Total Crop Damage Recorded	Largest Recorded Diameter (Inches)
Austin	41	$766,000	$100,000	2.00
Brazoria	76	$395,000	$0	2.50
Chambers	46	$182,000	$0	1.75
Colorado	46	$650,000	$0	2.75
Fort Bend	60	$2,724,000	$0	2.75
Galveston	76	$554,000	$0	3.00
Harris	277	$21,943,000	$0	2.75
Liberty	46	$180,000	$0	2.75
Matagorda	21	$113,000	$0	2.00
Montgomery	60	$10,544,000	$0	2.75
Walker	30	$173,000	$5,000	1.75
Waller	32	$261,000	$0	3.00
Wharton	46	$5,384,000	$5,000,000	1.50
TOTAL	**857**	**$43,869,000**	**$5,105,000**	**-**

Source: National Climatic Data Center

Figure 4.2-8 shows the location of past hail events and **Figure 4.2-9** shows the historical frequency of events by county. **No one portion of the region is more at risk to hail than any other part of the region, therefore the entire region is in a hail hazard area and can be expected to experience hail events in the future.**

Figure 4.2-8
Locations of Past Hail Events

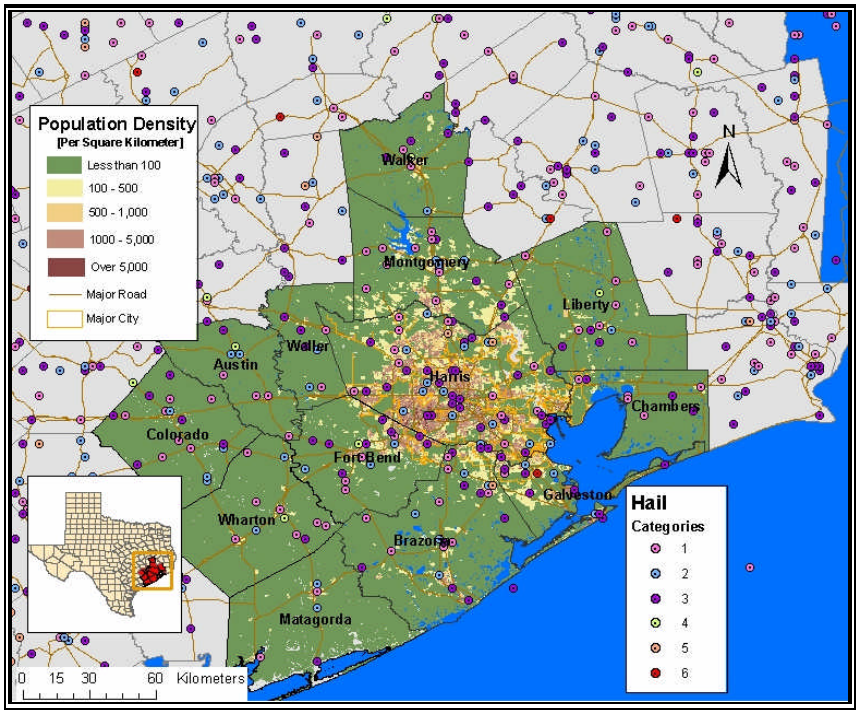
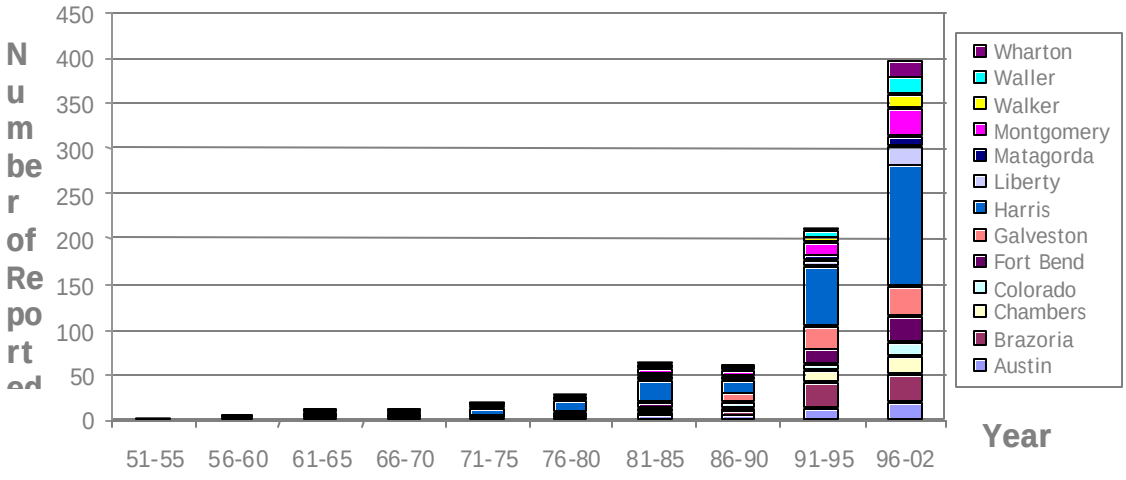


Figure 4.2-9
Historical Frequency of Hail Events by County

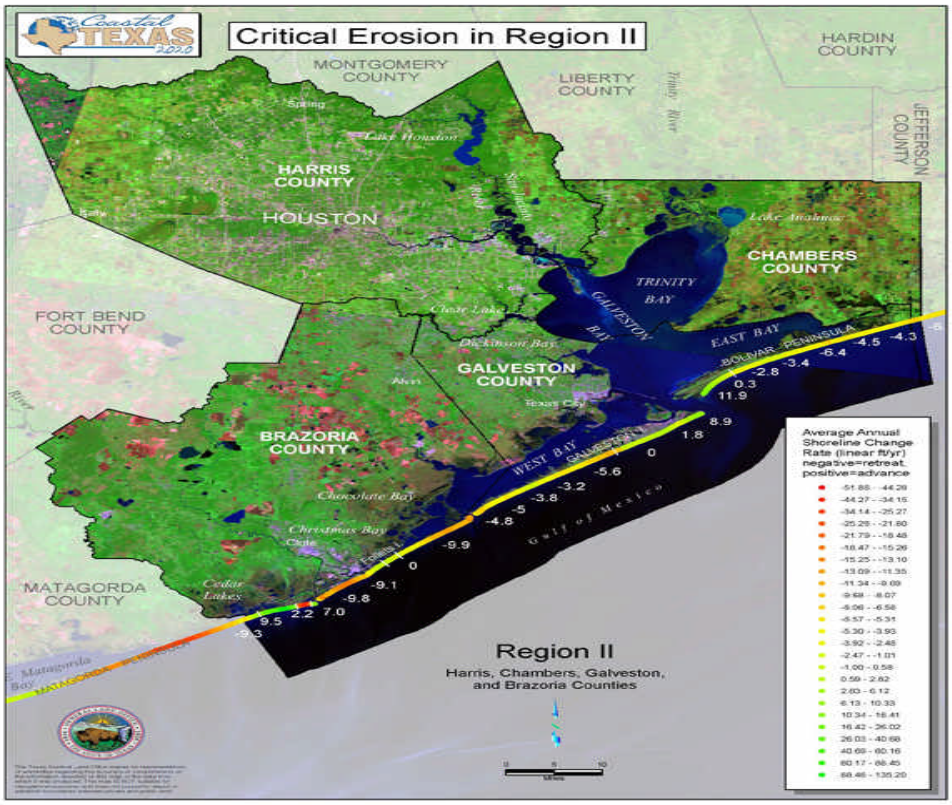


Coastal Erosion

According to the Texas General Land Office (GLO), Texas has one of the highest erosion rates in the country and estimates that over 27,000 acres of gulf shoreline were lost to erosion from the mid-1800s through 1982. Erosion rates along the Texas coastline range from seven to 24 feet per year. Texas bay shores are eroding at rates from one to 10 feet a year. In Galveston Bay, the GLO estimates that 2.2 feet of shoreline is lost each year due to erosion. The City of Galveston is protected by a seawall, but the natural beach in front of the seawall has eroded away. However, other coastal shoreline areas in the region are not protected and are vulnerable to significant erosion.

Figure 4.2-10 shows the coastal erosion rates for the counties in the Houston-Galveston region.

Figure 4.2-10
Coastal Erosion Map



Source: Texas General Land Office

Because coastal erosion occurs over time, there is no database of previous coastal erosion events. Hurricanes and tropical storms can cause higher coastal erosion rates than normal so the discussion of previous hurricanes and tropical storms found earlier in this section can also serve as a partial listing of coastal erosion events.

Dam/Levee Failure

According to the National Inventory of Dams, there are 335 known dams in the Houston-Galveston Area (see **Table 4.2-8**). Approximately 30 percent of dams in the area are classified as facing a high or significant hazard potential. However, there is no record of significant dam failure in the H-GAC planning area. **As a result of the heightened concern regarding terrorism and potential terrorist targets, dam location/inundation maps are not included in this Plan.** Information on the specific location of dams within the region can be obtained by visiting the US Army Corps of Engineers National Dam Inventory website at http://crunch.tec.army.mil/nid/webpages/nid.cfm. Dam hazard definitions, as accepted by the National Interagency Committee on Dam Safety, are as follows:

1. LOW HAZARD POTENTIAL - Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the dam owner's property.

2. SIGNIFICANT HAZARD POTENTIAL - Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environment damage, disruption of lifeline facilities, or other concerns. Significant hazard potential classification dams are often located in rural or agricultural areas but could be located in areas that contain large populations and significant infrastructure.

3. HIGH HAZARD POTENTIAL - Dams assigned the high hazard potential classification are those where failure or misoperation will likely cause the loss of human life.

Table 4.2-8
County Dam Hazard Data

County	High Risk	Significant Risk	Low Risk	Undetermined Risk	Total Dams
Austin	0	2	17	0	19
Brazoria	6	13	35	0	54
Chambers	0	0	12	0	12
Colorado	1	1	14	0	16
Fort Bend	0	2	17	0	19
Galveston	1	0	0	0	1
Harris	6	9	23	0	38
Liberty	1	9	20	0	30
Matagorda	1	1	4	0	6
Montgomery	23	13	36	1	73
Walker	7	3	39	1	50
Waller	1	1	7	0	9
Wharton	0	0	8	0	8
TOTAL	**47**	**54**	**232**	**2**	**335**

Earthquakes

Though earthquakes are not likely to affect Texas, their effects have been felt throughout history. **Table 4.2-9** lists recorded earthquakes in the H-GAC region.

Table 4.2-9
Recorded Earthquakes in the H-GAC Region

Date of Occurrence	Modified Mercalli Intensity (If Known)	Location	County	Miles from Epicenter
08/16/1931	III	Angleton	Brazoria	860
08/16/1931	III	Houston	Harris	854
01/7/1956	IV	Galveston Island	Galveston	Unknown

Source: National Geophysical Data Center

The entire region falls in a "very low" earthquake hazard are and therefore, no earthquake hazard maps will be included in this section. See **Figure 4.1-4** for a national earthquake hazard zone map.

Sinkholes

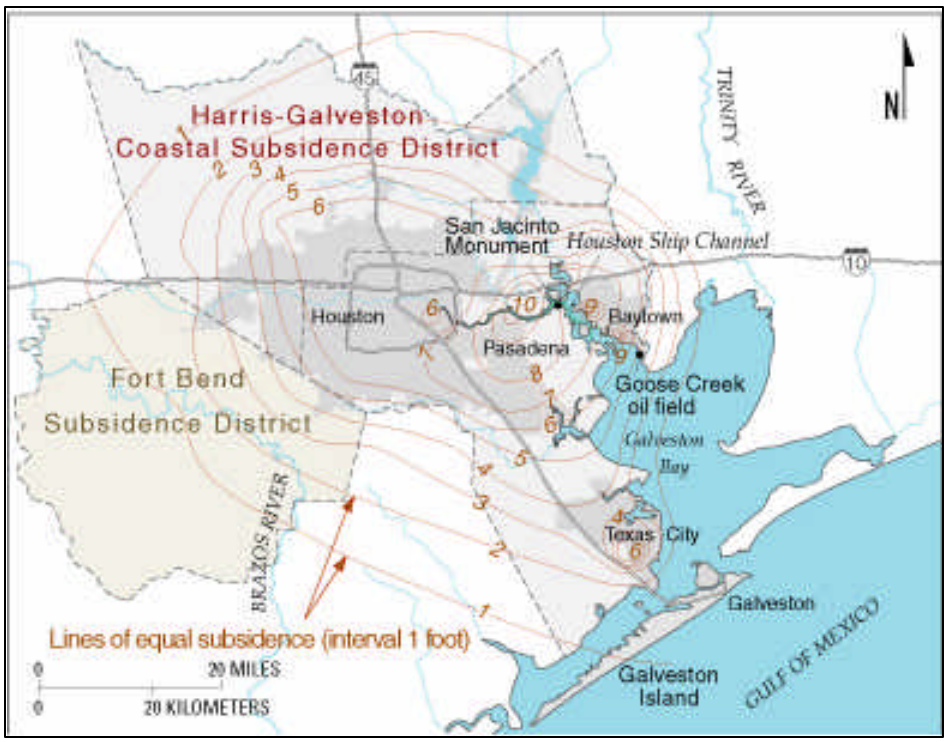
There are no recorded previous occurrences of sinkholes in the region; therefore, a vulnerability assessment for sinkholes will not be conducted and they will not be mentioned again in this plan.

Subsidence

Until recently, the Houston area relied upon groundwater to meet the drinking water and industrial process water needs of our communities. Extracting large volumes of groundwater over long periods of time has resulted in the unintended consequence of ground subsidence in our region. Loss in ground surface elevation ranges from 1-10 feet, and is centered near major industrial areas (i.e., Houston Ship Channel and Texas City). This subsidence has resulted in shoreline and emergent wetlands loss along the wetted perimeter of Galveston Bay and affected flooding patterns. In response to the problems associated with subsidence, the majority of the Houston region has converted to surface water systems, and subsidence has returned to natural rates. Shoreline erosion, habitat loss, and flooding impacts continue to be an issue.

While there is no database of previous subsidence occurrences (like coastal erosion, subsidence occurs over time), the USGS has been able to map the level of subsidence across the region over time.

Figure 4.2-11
Subsidence Rates in the Houston-Galveston Area (1906-1995)



Source: USGS

Tsunami

Though tsunamis are more likely to affect Pacific Rim states, historical evidence does show that tsunamis have affected the Eastern United States and Gulf of Mexico, including Texas. Only the coastal areas in the H-GAC region are in a tsunami hazard area.

Forty tsunamis and tsunami-like waves have been documented in the Eastern United States since 1600. The following Texas tsunami evidence was gathered from the National Geophysical Data Center (Tsunami Event Database):

October 24, 1918: A small tsunami, reported to have originated with an earthquake near Puerto Rico, ran ashore in Galveston. Wave height was unknown. No damages, deaths or injuries were recorded.

May 2, 1922: Three tsunami waves ran ashore in Galveston within a 45-minute period, followed eight hours later by a similar but smaller train of waves. The maximum water height of the highest wave was 0.6 meters above sea level. Researchers maintain that there is some question regarding the origin and nature of these tsunamis, noting that the waves were probably erroneously ascribed to a small earthquake in Puerto Rico.

Extent of Hazards

The hazards identified in Section 4.1 Hazard Identification and further analyzed in this section all affect a certain extent of the participating jurisdictions. **Table 4.2-10** provides a summary of the extent that can be expected to be impacted by each identified hazard.

For the purposes of this plan, hazard extent has been classified in the following categories:

Large:	More than 50% of the area affected
Moderate:	Between 10 and 50% of area affected
Small:	Less than 10% of area affected

Table 4.2-10
Summary of Extent of Hazard Impacts

Jurisdiction	Flood	Hurricanes and Coastal Storms	Severe Thunderstorms and Tornadoes	Wildfires	Drought	Excessive Heat	Winter Storms	Hail	Dam/Levee Failure	Earthquakes	Subsidence/Sinkholes	Erosion	Tsunamis
Austin County	Moderate	Moderate	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of Bellville	Moderate	Moderate	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of Brazos Country	Moderate	Moderate	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of Industry	Small	Moderate	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of San Felipe	Moderate	Moderate	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of Sealy	Moderate	Moderate	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of Wallis	Moderate	Moderate	Small	Small	Small	Large	Large	Small	Small	Small	Small	Small	NA
Brazoria County	Large	Large	Moderate	Small	Small	Large	Large	Small	Moderate	Small	Small	Large	Small
City of Alvin	Moderate	Large	Large	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Angleton	Moderate	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Bailey's Prairie	Large	Large	Small	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Bonney	Small	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Brazoria	Moderate	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Brookside Village	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Clute	Moderate	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Danbury	Moderate	Large	Large	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Freeport	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Large	Small

Jurisdiction	Flood	Hurricanes and Coastal Storms	Severe Thunderstorms and Tornadoes	Wildfires	Drought	Excessive Heat	Winter Storms	Hail	Dam/Levee Failure	Earthquakes	Subsidence/Sinkholes	Erosion	Tsunamis
City of Hillcrest Village	Moderate	Large	Large	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Holiday Lakes	Large	Large	Small	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Iowa Colony	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Jones Creek	Moderate	Large	Large	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Lake Jackson	Moderate	Large	Large	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Liverpool	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Manvel	Moderate	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
City of Oyster Creek	Moderate	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	Small
City of Quintana	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Large	Small
City of Richwood	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	Na
City of Surfside Beach	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Large	Small
City of Sweeny	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Moderate	na
Chambers County	Large	Large	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Large	Small
City of Anahuac	Large	Large	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Large	Small
City of Beach City	Large	Large	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Large	Small
City of Cove	Large	Large	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Moderate	Small
City of Mont Belvieu	Large	Large	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Small	na
City of Old River-Winfree	Large	Large	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Moderate	na
Galveston County	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Large	Small
City of Bayou Vista	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Large	Small
City of Clear Lake Shores	Large	Large	Small	Small	Small	Large	Large	Small	Small	Small	Small	Large	Small
City of Dickinson	Moderate	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Large	Small
City of Galveston	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Large	Small
City of Hitchcock	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Large	Na
City of Jamaica Beach	Large	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Large	Small
City of Kemah	Large	Large	Small	Small	Small	Large	Large	Small	Small	Small	Small	Large	Small
City of La Marque	Moderate	Large	Moderate	Small	Small	Large	Large	Small	Small	Small	Small	Large	Na
City of Tiki Island	Large	Large	Small	Small	Small	Large	Large	Small	Small	Small	Small	Large	Small

Jurisdiction	Flood	Hurricanes and Coastal Storms	Severe Thunderstorms and Tornadoes	Wildfires	Drought	Excessive Heat	Winter Storms	Hail	Dam/Levee Failure	Earthquakes	Subsidence/Sinkholes	Erosion	Tsunamis
Liberty County	Large	Moderate	Moderate	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Moderate	NA
City of Ames	Small	Small	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of Cleveland	Moderate	Small	Small	Moderate	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of Daisetta	Moderate	Small	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of Dayton	Large	Moderate	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Moderate	NA
City of Dayton Lakes	Large	Moderate	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Moderate	NA
City of Devers	Small	Small	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of Hardin	Small	Small	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of Kenefick	Large	Moderate	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Moderate	NA
City of Liberty	Large	Moderate	Moderate	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Moderate	NA
City of North Cleveland	Moderate	Small	Small	Moderate	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of Plum Grove	Large	Moderate	Small	Moderate	Small	Large	Large	Small	Small	Small	Small	Moderate	NA
Montgomery County	Moderate	Small	Moderate	Large	Small	Large	Large	Small	Large	Small	Small	Small	NA
City of Conroe	Moderate	Small	Moderate	Moderate	Small	Large	Large	Small	Large	Small	Small	Small	NA
City of Magnolia	Small	Small	Moderate	Moderate	Small	Large	Large	Small	Small	Small	Small	Small	NA
City of Montgomery	Moderate	Small	Small	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Small	NA
City of Oak Ridge North	Moderate	Small	Small	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Small	NA
City of Panorama Village	Moderate	Small	Moderate	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Small	NA
City of Patton Village	Moderate	Small	Small	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Small	NA
City of Shenandoah	Moderate	Small	Small	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Small	NA
City of Splendora	Moderate	Small	Moderate	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Small	NA
City of Willis	Moderate	Small	Small	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Small	NA
City of Woodbranch	Moderate	Small	Small	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Small	NA
Town of Cut and Shoot	Moderate	Small	Moderate	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Small	NA
Town of Roman Forest	Small	Small	Small	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Small	NA
Town of Stagecoach	Moderate	Small	Small	Moderate	Small	Large	Large	Small	Moderate	Small	Small	Small	NA
Town of Woodloch	Moderate	Small	Small	Moderate	Small	Large	Large	Small	Small	Small	Small	Small	NA

Jurisdiction	Flood	Hurricanes and Coastal Storms	Severe Thunderstorms and Tornadoes	Wildfires	Drought	Excessive Heat	Winter Storms	Hail	Dam/Levee Failure	Earthquakes	Subsidence/Sinkholes	Erosion	Tsunamis
Walker County	Moderate	Moderate	Moderate	Large	Moderate	Large	Large	Small	Small	Small	Small	Small	NA
City of Huntsville	Moderate	Small	Moderate	Moderate	Moderate	Large	Large	Small	Small	Small	Small	Small	NA
City of New Waverly	Moderate	Small	Moderate	Moderate	Moderate	Large	Large	Small	Small	Small	Small	Small	NA
City of Riverside	Moderate	Small	Large	Moderate	Moderate	Large	Large	Small	Small	Small	Small	Small	NA
													NA
Waller County	Large	Moderate	Moderate	Moderate	Moderate	Large	Large	Small	Small	Small	Small	Small	NA
City of Brookshire	Moderate	Moderate	Moderate	Moderate	Moderate	Large	Large	Small	Small	Small	Small	Small	NA
City of Hempstead	Moderate	Small	Moderate	Moderate	Moderate	Large	Large	Small	Small	Small	Small	Small	NA
City of Pattison	Small	Moderate	Moderate	Moderate	Moderate	Large	Large	Small	Small	Small	Small	Small	NA
City of Pine Island	Small	Small	Moderate	Moderate	Moderate	Large	Large	Small	Small	Small	Small	Small	NA
City of Prairieview	Moderate	Small	Moderate	Moderate	Moderate	Large	Large	Small	Small	Small	Small	Small	NA
City of Waller	Moderate	Small	Moderate	Moderate	Moderate	Large	Large	Small	Small	Small	Small	Small	NA
Houston-Galveston Area Council of Governments	Moderate	Moderate	Moderate	Moderate	Moderate	Large	Large	Small	Small	Small	Small	Small	Small

Potential Impact of Hazards

All of the identified hazards impact jurisdictions differently. As a result, some jurisdictions are more vulnerable to certain hazards. **Table 4.2-11** provides a summary of the potential impact that each jurisdiction can expect to experience for each hazard[6].

For the purposes of this plan potential impact has been classified in the following categories:

Catastrophic: High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of facilities for 30 days or more.

Critical: Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than one week.

Limited: Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than one day.

Minor: Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of facilities.

The potential impact for certain hazards can vary drastically. For example, a Category 1 Hurricane will not impact a jurisdiction as much as a Category 4 or 5 will. Therefore, for the purposes of this plan, the potential impact for each hazard will be based upon the average expected event that can occur in this region based upon previous occurrences.

Table 4.2-11
Summary of Potential Impacts of Hazards

Jurisdiction	Flood	Hurricanes and Tropical Storms	Severe Thunderstorms	Tornadoes	Wildfires	Drought	Excessive Heat	Winter Storms	Hail	Dam/Levee Failure	Earthquakes	Subsidence/Sinkholes	Coastal Erosion	Tsunamis
Austin County	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	Limited	Minor	NA	NA	NA
City of Bellville	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
City of Brazos Country	Minor	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
City of Industry	Minor	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
City of San Felipe	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
City of Sealy	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
City of Wallis	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA

[6] The expected potential impact is based on the average expected hazard event for the jurisdiction, not the worst case scenario.

Jurisdiction	Flood	Hurricanes and Tropical Storms	Severe Thunderstorms	Tornadoes	Wildfires	Drought	Excessive Heat	Winter Storms	Hail	Dam/Levee Failure	Earthquakes	Subsidence/Sinkholes	Coastal Erosion	Tsunamis
Brazoria County	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	Limited	Minor	Limited	Limited	Limited
City of Alvin	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Angleton	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Bailey's Prairie	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Bonney	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Brazoria	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Brookside Village	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Clute	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Danbury	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Freeport	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	Minor	Minor
City of Hillcrest Village	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Holiday Lakes	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Iowa Colony	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Jones Creek	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Lake Jackson	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Liverpool	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Manvel	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Oyster Creek	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	Minor	Minor
City of Quintana	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	Critical	Critical
City of Richwood	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Surfside Beach	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	Critical	Critical
City of Sweeny	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
Chambers County	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	Limited	Minor	Limited	Minor	Minor
City of Anahuac	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	Minor	Minor
City of Beach City	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	Critical	Critical
City of Cove	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	Minor	Minor
City of Mont Belvieu	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Old River-Winfree	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA

Jurisdiction	Flood	Hurricanes and Tropical Storms	Severe Thunderstorms	Tornadoes	Wildfires	Drought	Excessive Heat	Winter Storms	Hail	Dam/Levee Failure	Earthquakes	Subsidence/Sinkholes	Coastal Erosion	Tsunamis
Galveston County	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	Limited	Minor	Limited	Limited	Limited
City of Bayou Vista	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	Critical	Minor	Limited	Minor	Minor
City of Clear Lake Shores	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	Minor	Minor
City of Dickinson	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	Minor	Minor
City of Galveston	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	Limited	Limited
City of Hitchcock	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Jamaica Beach	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	Critical	Critical
City of Kemah	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	Minor	Minor
City of La Marque	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Tiki Island	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	Critical	Minor	Limited	Limited	Limited
Liberty County	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	Limited	Minor	Limited	NA	NA
City of Ames	Minor	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Cleveland	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Daisetta	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Dayton	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Dayton Lakes	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Devers	Minor	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Hardin	Minor	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Kenefick	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Liberty	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of North Cleveland	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Plum Grove	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
Montgomery County	Critical	Catastrophic	Minor	Critical	Critical	Minor	Critical	Critical	Minor	Limited	Minor	Limited	NA	NA
City of Conroe	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	Limited	Minor	Limited	NA	NA
City of Magnolia	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Montgomery	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Oak Ridge North	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA

Jurisdiction	Flood	Hurricanes and Tropical Storms	Severe Thunderstorms	Tornadoes	Wildfires	Drought	Excessive Heat	Winter Storms	Hail	Dam/Levee Failure	Earthquakes	Subsidence/Sinkholes	Coastal Erosion	Tsunamis
City of Panorama Village	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Patton Village	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Shenandoah	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	Limited	Minor	Limited	NA	NA
City of Splendora	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Willis	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
City of Woodbranch	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
Town of Cut and Shoot	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
Town of Roman Forest	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
Town of Stagecoach	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
Town of Woodloch	Critical	Catastrophic	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	Limited	NA	NA
Walker County	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	Limited	Minor	NA	NA	NA
City of Huntsville	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
City of New Waverly	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
City of Riverside	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
Waller County	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	Limited	Minor	NA	NA	NA
City of Brookshire	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
City of Hempstead	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
City of Pattison	Minor	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
City of Pine Island	Minor	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
City of Prairieview	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
City of Waller	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	NA	Minor	NA	NA	NA
Houston-Galveston Area Council	Critical	Critical	Minor	Critical	Minor	Minor	Critical	Critical	Minor	Limited	Minor	Limited	Limited	Limited

Data Sources

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