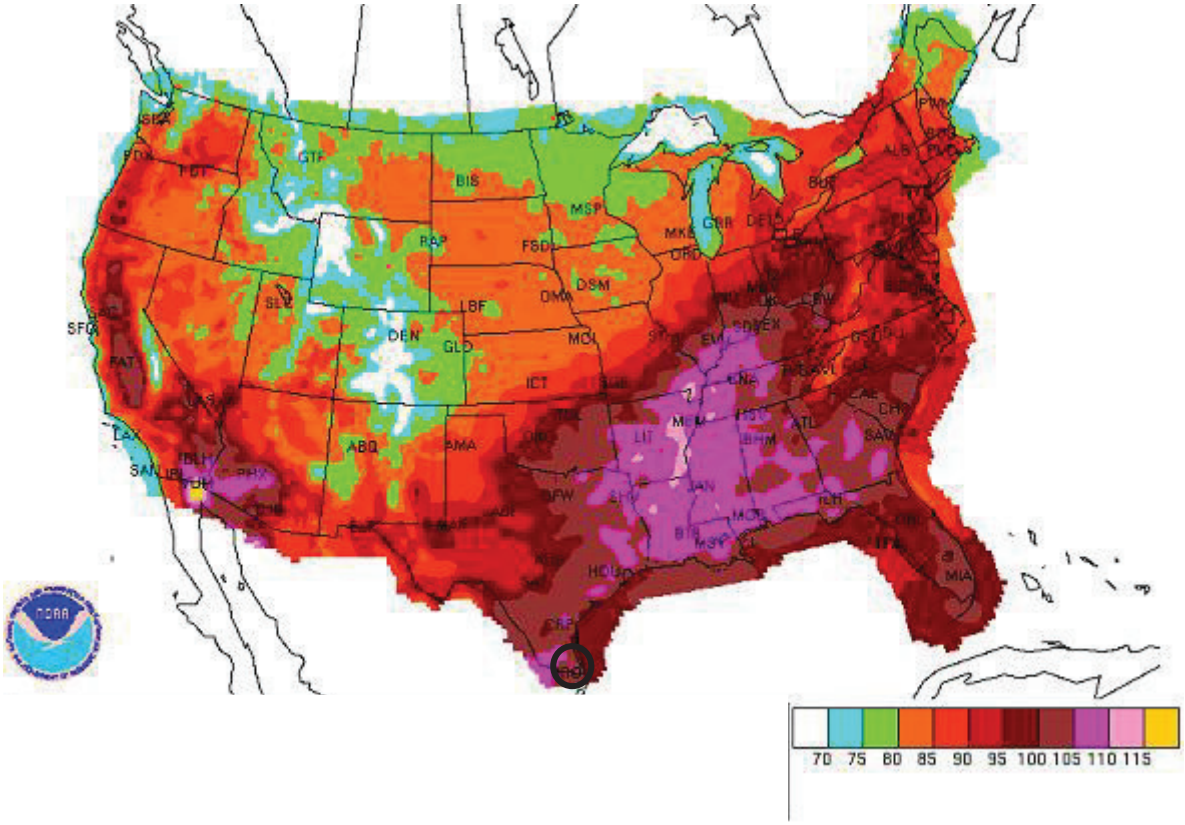
Figure 8-2. Average Daily Maximum Heat Index Days[2]



Historical Occurrences

Every summer, the hazard of heat-related illness becomes a significant public health issue throughout much of the US. Mortality from all causes increases during heat waves, and excessive heat is an important contributing factor to deaths from other causes, particularly among the elderly. Preliminary data suggest that by August 21, 2009, record high summer temperatures in Texas resulted in more than 120 heat-related deaths statewide. The United States Immigration and Naturalization Service reported that 51 foreign nationals died along the Texas/Mexico border though none of the reported deaths occurred in Cameron County. Table 8-2 depicts historical occurrences of mortality from heat from 1994 to 2004 from the Texas Department of State Health Services, and 2005 to 2015 from the NCDC database.

[2] *Source: NRDC and the black circle indicates the Council of Cities planning area.*

Table 8-2. Extreme Heat Related Deaths in Texas

YEAR	DEATHS
1994	1
1995	12
1996	10
1997	2
1998	66
1999	22
2000	71
2001	20
2002	1
2003	0
2004	3
2005	49
2006	2
2007	2
2008	7
2009	6
2010	4
2011	20
2012	2
2013	2
2014	0
2015	5

Because the Texas Department of State Health Services reports on total events statewide, previous occurrences for extreme heat are derived from the NCDC database. According to heat related incidents located

solely within Cameron County there are five heat waves[3] on record for Cameron County, including all participating jurisdictions, (Table 8-3). The NCDC does not provide extreme heat events at a jurisdiction level. Damages are reported on a county-wide basis. Where available, damages are assigned to the planning area as a percentage of the county total.

Table 8-3. Historical Extreme Heat Events, 1996-2015

JURISDICTION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Cameron County	5/22/2008	0	0	$0	$0
Cameron County	6/12/2009	0	0	$0	$0
Cameron County	7/6/2009	0	0	$0	$0
Cameron County	7/30/2009	0	0	$0	$0
Cameron County	8/20/2009	0	0	$0	$0

Significant Past Events

July 31, 2009

Heat index values held between 103°F and 108°F for most July days in the Rio Grande Valley between Cameron and Zapata County. The heat index rose above critical values towards the end of the month. At the Lower Rio Grande Valley National Wildlife Refuge along the extreme southeast Hidalgo and southwest Cameron County line, heat index peaked at 11. Duration of the critical heat index was from 2 to 4 hours each afternoon; overnight temperatures largely remained near or above 80°F.

Probability of Future Events

According to historical records, the planning area has experienced 5 events in a 19 year reporting period. This provides a frequency of occurrence of 1 event every three years. This frequency supports a likely probability of future events.

Vulnerability and Impact

There is no defined geographic boudary for extreme heat events. While the Council of Cities is exposed to extreme temperatures; existing buildings, infrastructure and critical facilities are not likely to sustain

[3] *Even though the County experiences heat waves each summer, NCDC data only records events reported. Based on reports, only five events are on record.*

significant damage from extreme heat events. Therefore, any estimated property losses associated with the extreme heat hazard are anticipated to be minimal across the area.

Extreme temperatures do however present a significant threat to life and safety for the population of the area as a whole. Heat casualties for example are typically caused by a lack of adequate air-conditioning or heat exhaustion. The most vulnerable population to heat casualties are the elderly or infirmed, who frequently live on low fixed incomes and cannot afford to run air-conditioning on a regular basis. This population is sometimes isolated, with no immediate family or friends to look out for their well-being.

Populations over 65 in the Council of Cities planning area exceeds 15% of the total population and children under the age of 5 exceed 8% or an estimated total of 12,395[4] potentially vulnerable residents in the planning area based on age (Table 8-4).

Table 8-4. Populations at Greater Risk by Jurisdiction

JURISDICTION	POPULATION 65 AND OLDER	POPULATION UNDER 5
Bayview	127	10
Indian Lake	182	87
Laguna Vista	662	235
Los Fresnos	668	418
Port Isabel	784	534
Primera	391	389
Rancho Viejo	655	142
Rio Hondo	462	156
San Benito	3156	2361
South Padre Island	913	63
TOTAL	**8000**	**4395**

Students in the Independent School Districts are also susceptible as sporting events and practices are often held outside during early fall or late spring when temperatures are at the highest. Another segment of the population at risk are those whose jobs consist of strenuous labor outdoors. Additionally, livestock and crops can become stressed, decreasing in quality or in production, during times of extreme heat.

[4] US Census Bureau 2014 data for Council of Cities Planning Area

Section 8: Extreme Heat

Extreme high temperatures can have significant secondary impacts, leading to droughts, water shortages, increased fire danger, and prompt excessive demands for energy. The possibility of rolling blackouts increases with unseasonably high temperatures in what is a normally mild month with low power demands.

Typically more than 12 hours of warning time would be given before the onset of an extreme heat event. Only minor property damage would result. The potential impact of excessive summer heat is considered "Minor" as injuries and/or illnesses do not result in permanent disability.

Impact of extreme heat experienced in the area has a substantial severity as there has been a death reported; although in terms of structures, the impact from extreme heat would be negligible. It is possible that critical facilities and infrastructure could be shut down for 24 hours if cooling units are running constantly, leading to a temporary power outage. Less than ten percent of residential and commercial property could be damaged if extreme heat events lead to structure fires.

The potential impact of extreme heat for the Council of Cities planning area can be considered "Minor," resulting in few injuries and minimal disruption to the quality of life. Based on historical records over a 65-year period, annualized losses for Cameron County are negligible.

Assessment of Impacts

The greatest risk from extreme heat is to public health and safety. Potential impacts the community may expect include:

- Vulnerable populations, particularly the elderly and infants, can face serious or life-threatening health problems from exposure to extreme heat including hyperthermia; heat cramps; heat exhaustion; and heat stroke (or sunstroke).
- Response personnel including utility workers, public works personnel, and any other professions where individuals are required to work outside, are more subject to extreme heat related illnesses since their exposure would typically be greater.
- High energy demand periods can outpace the supply of energy, potentially creating the need for rolling brownouts which would elevate the risk of illness to vulnerable residents.
- Highways and roads may be damaged by excessive heat causing asphalt roads to soften and concrete roads to shift or buckle.
- Vehicles engines and cooling systems typically run harder during extreme heat events resulting in increases in mechanical failures.
- Extreme heat events during times of drought can exacerbate the environmental impacts associated with drought, decreasing water and air quality and further degrading wildlife habitat.
- Extreme heat increases ground-level ozone (smog), increasing the risk of respiratory illnesses.
- Tourism and recreational activities may be negatively impacted during extreme heat events, reducing seasonal revenue.
- Food suppliers can anticipate an increase in food costs due to increases in production costs and crop and livestock losses.

- Fisheries may be negatively impacted by extreme heat, suffering damage to fish habitats (either natural or man-made) and a loss of fish and/or other aquatic organisms due to decreased water flows or availability.
- Negatively impacted water suppliers may face increased costs resulting from the transport water or develop supplemental water resources.

The economic and financial impacts of extreme heat on the community will depend on the duration of the event, demand for energy, drought associated with extreme heat, and many other factors. The level of preparedness and the amount of planning done by the jurisdiction, local businesses and citizens will impact the overall economic and financial conditions before, during, and after an extreme heat event.

Section 9: Drought

Hazard Description

Drought is a period of time without substantial rainfall that persists from one year to the next. Drought is a normal part of virtually all climatic regions, including areas with high and low average rainfall. Drought is the consequence of anticipated natural precipitation reduction over an extended period of time, usually a season or more in length. Droughts can be classified as meteorological, hydrologic, agricultural, and socioeconomic. Table 9-1 presents definitions for these different types of drought.

Droughts are one of the most complex of all natural hazards as it is difficult to determine their precise beginning or end. In addition, droughts can lead to other hazards such as extreme heat and wildfires. Their impact on wildlife and area farming is enormous, often killing crops, grazing land, edible plants, and even in severe cases, trees. A secondary hazard to drought is wildfire because dying vegetation serves as a prime ignition source. Therefore, a heat wave combined with a drought is a very dangerous situation.

Table 9-1. Drought Classification Definitions[1]

METEOROLOGICAL DROUGHT	The degree of dryness or departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
HYDROLOGIC DROUGHT	The effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
AGRICULTURAL DROUGHT	Soil moisture deficiencies relative to water demands of plant life, usually crops.
SOCIOECONOMIC DROUGHT	The effect of demands for water exceeding the supply as a result of a weather-related supply shortfall.

Location

Droughts occur regularly throughout Texas and Cameron County, and are a normal condition. However, they can vary greatly in their intensity and duration. The Drought Monitor shows the study region to currently be in an area with low drought condition. There is no distinct geographic boundary to drought; therefore, it can occur throughout the Council of Cities areas equally.

Extent

The Palmer Drought Index is used to measure the extent of drought by measuring the duration and intensity of long-term drought-inducing circulation patterns. Long-term drought is cumulative, with the intensity of drought during the current month dependent upon the current weather patterns plus the cumulative patterns of previous months. The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop. Table 9-2 provides classification descriptions for the Palmer Drought Severity Index, and Table 9-3 depicts the magnitude of drought according to the Index.

Table 9-2. Palmer Drought Category Descriptions[2]

CATEGORY	DESCRIPTION	POSSIBLE IMPACTS	PALMER DROUGHT INDEX
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.	-1.0 to -1.9

[1] *Source: Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy, FEMA*

[2] *Source: National Drought Mitigation Center*

CATEGORY	DESCRIPTION	POSSIBLE IMPACTS	PALMER DROUGHT INDEX
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.	-2.0 to -2.9
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.	-3.0 to -3.9
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions.	-4.0 to -4.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies.	-5.0 or less

Table 9-3. Palmer Drought Index

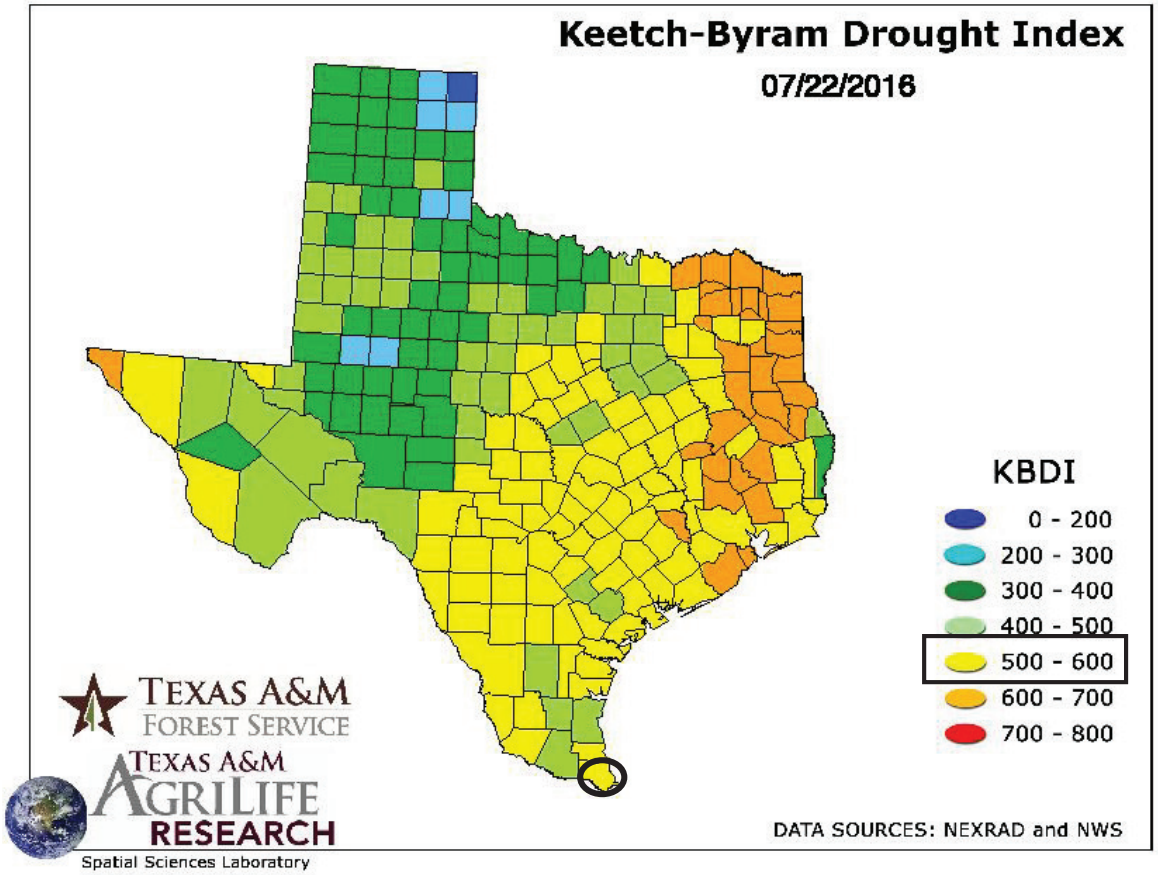
DROUGHT INDEX	DROUGHT CONDITION CLASSIFICATIONS						
	Extreme	Severe	Moderate	Normal	Moderately Moist	Very Moist	Extremely Moist
Z Index	-2.75 and below	-2.00 to -2.74	-1.25 to -1.99	-1.24 to +.99	+1.00 to +2.49	+2.50 to +3.49	n/a
Meteorological	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.99	+3.00 to +3.99	+4.00 and above
Hydrological	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.99	+3.00 to +3.99	+4.00 and above

Drought is monitored nationwide by the National Drought Mitigation Center (NDMC). Indicators are used to describe broad scale drought conditions across the U.S. Indicators correspond to the intensity of drought.

Based on historical occurrences for drought and the location of the Council of Cities planning area, the area can anticipate a range of drought from moderate drought to exceptional drought or D1 to D4 based on the Palmer Drought Category.

The Texas Forest Service uses the Keetch-Byram Drought Index to determine the fire potential (based on daily water balance 0 precipitation and soil moisture), which uses a rating classification that is color coded with a scale of 0 to 800 (Low risk to high risk). The Council of Cities planning area can experience a range of low risk to high risk. Although the planning area can experience moderate to severe drought conditions in the summer.

Figure 9-1. Keetch-Byram Drought Index



Historical Occurrences

Cameron County may typically experience a severe drought. Tables 9-4 and 9-5 lists historical events that have occurred in Cameron County as reported in the National Climatic Data Center (NCDC). Historical drought information, as provided by the NCDC, shows drought activity across a multi-county forecast area for each event, the appropriate percentage of the total property and crop damage reported for the entire forecast area has been allocated to each county impacted by the event. Historical drought data for all participating jurisdictions in the Council of Cities planning area are provided on a County-wide basis per the NCDC database.

Only drought events that have been reported have been factored into this Risk Assessment. It is likely that additional drought occurrences have gone unreported before and during this recording period. Tables 9-4 and 9-5 show historical incident information for the Council of Cities planning area which resulted in crop damage from January 1996 to 2015.

Table 9-4. Historical Drought Years, 1996-2015

DROUGHT YEAR
1996
2000
2000
2001
2002
2003
2009
2011
2014
9 unique events

Table 9-5. Historical Drought Events, 1996-2015[3]

JURISDICTION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Cameron County	1/1/2001	0	0	$0	$13,274,402
Cameron County	8/18/2009	0	0	$0	$22,958,564
Cameron County	6/1/2011	0	0	$0	$1,935,811
Cameron County	8/23/2011	0	0	$0	$4,918,864
Totals		**0**	**0**	**$0**	**$43,087,641**

Significant Past Events

January 2001

The United States Department of Agriculture-Farm Service Agency, received a Presidential Disaster Declaration in December of 2000. This declaration was issued for the persistent drought which included 6 counties of south Texas, specifically, Brooks, Jim Hogg, Cameron, Hidalgo, Willacy, and Kenedy counties. Both Zapata and Starr counties received declarations in August of 2000.

[3] *Only recorded events with fatalities, injuries, and/or damages are listed.*

The Farm Service Agency estimated approximately 25 million dollars combined in damages in Cameron, Hidalgo, Starr, and Willacy counties. This value does not include Brooks or Jim Hogg counties and does not reflect actual losses or other estimates that any other USDA Agencies may have compiled.

Monthly rainfall departures averaged about a half to an inch below normal in January 2001, the first month of the year. Lack of beneficial rainfall continued to keep much of south Texas in a moderate to severe drought. Storage at Falcon reservoir was 46 feet below conservation level, and 37 feet below conservation at Lake Amistad.

August 2009
Record to near record heat, windy conditions, low humidity, and lack of rainfall allowed the 2009 Drought to peak before the end of August, ensuring massive dryland crop, pastureland, and livestock loss. The Exceptional (D4) drought spread across Cameron County in the middle of the month. The long duration of extreme to exceptional drought, which prevailed for most of July and August, resulted in massive dryland crop and pastureland losses for the entire event. The USDA Farm Service Agency in San Benito reported at the end of August, prior to the September 1 plowing date, was more than $20 million in damage to cotton, corn, sorghum, sugar cane, and pastureland, county-wide. The pattern, featuring a persistent high pressure ridge above the surface from the southwest U.S. through the central Gulf of Mexico, would begin to break at month's end, but the rains were far too little and too late to save much of the crop yield.

Probability of Future Events

Based on available records of historic events, there have been 79 recorded events over 9 extended time periods within a 19 year reporting period. This does not mean that there were 79 separate events. This frequency supports a highly likely probability of future events. The Council of Cities planning area can experience 3 to 4 months of drought per year. All participating jurisdictions events are included under the County.

Vulnerability and Impact

Loss estimates were based on 19 years of statistical data from the NCDC. A drought event frequency-impact was then developed to determine an impact profile on agriculture products and estimate potential losses due to drought in the area. Table 9-6 shows annualized exposure.

Table 9-6. Drought Event Damage Totals, 1996-2015

JURISDICTION	PROPERTY & CROP LOSS	ANNUALIZED LOSS ESTIMATES
Cameron County	$43,087,641	$2,154,382
Council of Cities[4]	$1,641,639	$82,082

Drought impacts large areas and crosses jurisdictional boundaries. All existing and future buildings, facilities, and populations are exposed to this hazard and could potentially be impacted. However, drought impacts are mostly experienced in water shortages and crop/livestock losses on agricultural lands and typically have no impact on buildings.

In terms of vulnerability, population, agriculture, property, and environment are all vulnerable to drought. The average person will survive only a few days without water, and this timeframe can be drastically shortened for those people with more fragile health – typically children, the elderly, and the ill. Populations over 65 in the Council of Cities planning area exceeds 15% of the total population and children under the age of 5 exceed 8% or an estimated total of 12,395[5] potentially vulnerable residents in the planning area based on age (Table 9-7).

Table 9-7. Populations at Greater Risk by Jurisdiction

JURISDICTION	POPULATION 65 AND OLDER	POPULATION UNDER 5
Bayview	127	10
Indian Lake	182	87
Laguna Vista	662	235
Los Fresnos	668	418
Port Isabel	784	534
Primera	391	389
Rancho Viejo	655	142
Rio Hondo	462	156
San Benito	3156	2361
South Padre Island	913	63

[4] *Calculated as a percentage (3.81) of the county*

[5] US Census Bureau 2014 data for Council of Cities Planning Area

JURISDICTION	POPULATION 65 AND OLDER	POPULATION UNDER 5
TOTAL	8000	4395

The population is also vulnerable to food shortages when drought conditions exist and potable water is in short supply. Potable water is used for drinking, sanitation, patient care, sterilization, equipment, heating and cooling systems, and many other essential functions in medical facilities.

The economic impact of droughts can be significant as they produce a complex web of impacts that spans many sectors of the economy and reach well beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services. If droughts extend over a number of years, the direct and indirect economic impact can be significant. Based on the reported previous occurrences and potential exposure for the hazard, the potential severity of impact of droughts is "Limited," with less than 10 percent of property destroyed or with major damage, a shutdown of facilities and services for 24 hours or less, and injuries and/or illnesses are treatable with first aid.

Habitat damage is a vulnerability of the environment during periods of drought, for both aquatic and terrestrial species. The environment also becomes vulnerable during periods of extreme or prolonged drought due to severe erosion and land degradation.

Impact of droughts experienced in the Council of Cities planning area has resulted in no injuries and fatalities supporting a limited severity of impact meaning injuries and/or illnesses are treatable with first aid, shutdown of facilities and services for 24 hours or less, and less than 10% of property is destroyed or with major damage. Annualized loss over the 20-year reporting period in Cameron County is $2,154,382 annually.

Assessment of Impacts

The drought Impact Reporter was developed in 2005 by the University of Nebraska-Lincoln to provide a national database of drought impacts. Droughts can have an impact on: the agriculture; business and industry; energy; fire; plants and wildlife; relief, response, and restrictions; society and public health; tourism and recreation; and water supply and quality. Table 9-8 lists the drought impacts to Cameron County from 2005 to 2015, based on reports received by the Drought Impact Reporter.

Table 9-8. Drought Impacts, 2005-2015

DROUGHT IMPACTS 2005-2015	
Agriculture	281
Business & Industry	29
Energy	10

Section 9: Drought

DROUGHT IMPACTS 2005-2015	
Agriculture	281
Fire	131
Plants & Wildlife	87
Relief, Response & Restrictions	141
Society & Public Health	84
Tourism & Recreation	7
Water Supply & Quality	84

Drought is frequently associated with a variety of impacts. The planning area may suffer long term economic losses during extended periods of drought. Impacts to the community include:

- The number of health-related low-flow issues (e.g., diminished sewage flows, increased pollution concentrations, reduced firefighting capacity, and cross-connection contamination) will increase as the drought intensifies.
- Public safety from forest/range/wildfires will increase as water availability and/or pressure decreases.
- Respiratory ailments may increase as the air quality decreases.
- There may be an increase in disease due to wildlife concentrations (e.g., rabies, Rocky Mountain spotted fever, Lyme disease).
- Jurisdictions and residents may disagree over water use/water rights, creating conflict.
- Political conflicts may increase between municipalities, counties, states, and regions.
- Water management conflicts may arise between competing interests.
- Increased law enforcement activities may be required to enforce water restrictions.
- Severe water shortages could result in inadequate supply for human needs as well as lower quality of water for consumption.
- Firefighters may have limited water resources to aid in firefighting and suppression activities, increasing risk to lives and property.
- During drought there is an increased risk for wildfires and dust storms.
- The community may need increased operational costs to enforce water restriction or rationing.
- Prolonged drought can lead to increases in illness and disease related to drought.
- Utility providers can see decreases in revenue as water supplies diminish.
- Utilities providers may cut back energy generation and service to their customers to prioritize critical service needs.
- Hydroelectric power generation facilities and infrastructure would have significantly diminished generation capability. Dams simply cannot produce as much electricity from low water levels as they can from high water levels.
- Fish and wildlife food and habitat will be reduced or degraded over time during a drought and disease will increase, especially for aquatic life.

- Wildlife will more to more sustainable locations creating higher concentrations of wildlife in smaller areas, increasing vulnerability and further depleting limited natural resources.
- Severe and prolonged drought can result in the reduction of a species, or cause the extinction of a species altogether.
- Plant life will suffer from long-term drought. Wind and erosion will also pose a threat to plant life as soil quality will decline.
- Dry and dead vegetation will increase the risk of wildfire.
- Land subsidence threat increases as groundwater is depleted.
- Recreational activities that rely on water may be curtailed, such as hunting and fishing, resulting in fewer tourists and lower revenue.
- Drought poses a significant risk to annual and perennial crop production and overall crop quality leading to higher food costs.
- Drought related declines in production may lead to an increase in unemployment.
- Drought may limit livestock grazing resulting in decreased livestock weight, potential increased livestock mortality, and increased cost for feed.
- Negatively impacted water suppliers may face increased costs resulting from the transport water or develop supplemental water resources.
- Long term drought may negatively impact future economic development.

The overall extent of damages caused by periods of drought is dependent on its extent and duration. The level of preparedness and pre-event planning done by government, businesses and citizens will contribute to the overall economic and financial conditions throughout a drought.

Section 10: Tornado

Hazard Description

Tornadoes are among the most violent storms on the planet. A tornado is a rapidly rotating column of air extending between, and in contact with, a cloud and the surface of the earth. The most violent tornadoes are capable of tremendous destruction, with wind speeds of 250 miles per hour or more. In extreme cases, winds may approach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long.

The most powerful tornadoes are produced by "Supercell Thunderstorms." Supercell Thunderstorms are created when horizontal wind shears (winds moving in different directions at different altitudes) begin to rotate the storm. This horizontal rotation can be tilted vertically by violent updrafts, and the rotation radius can shrink, forming a vertical column of very quickly swirling air. This rotating air can eventually reach the ground, forming a tornado.

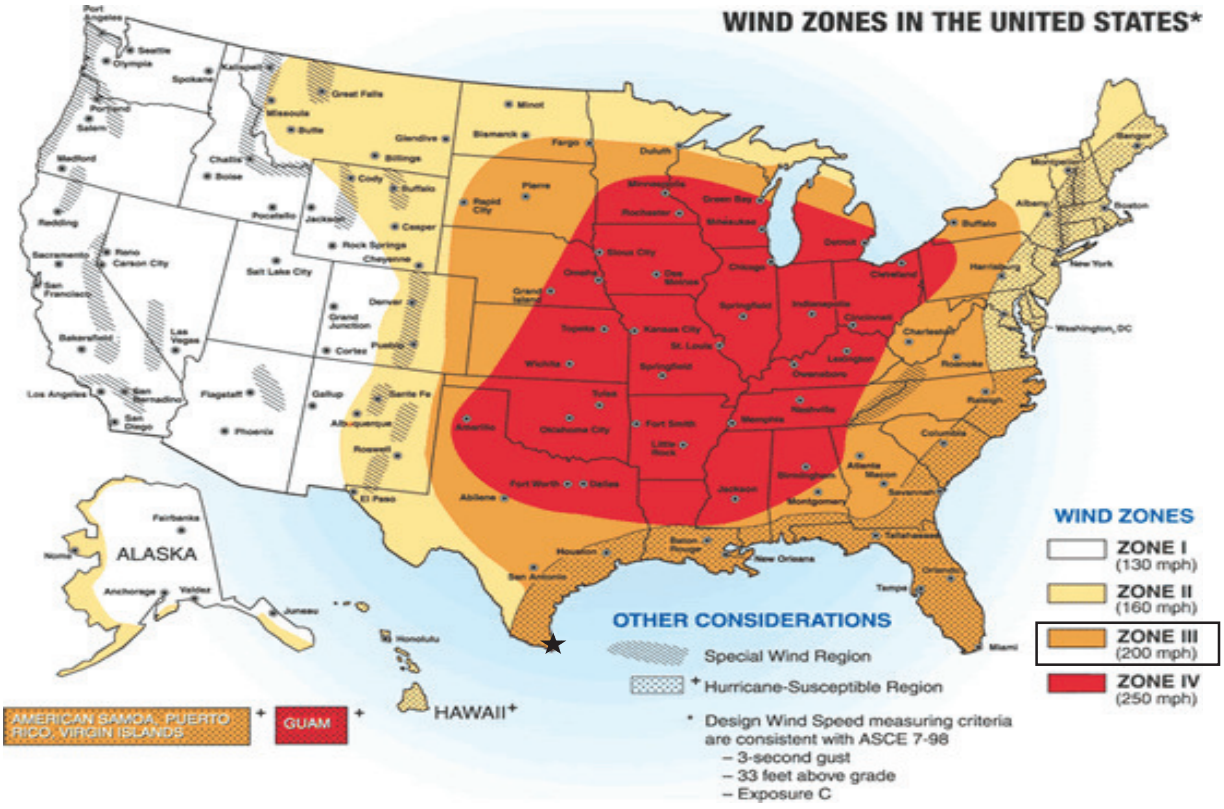
Table 10-1. Variations among Tornadoes

WEAK TORNADOES	STRONG TORNADOES	VIOLENT TORNADOES
• 69% of all tornadoes • Less than 5% of tornado deaths • Lifetime 1-10+ minutes • Winds less than 110 mph	• 29% of all tornadoes • Nearly 30% of all tornado deaths • May last 20 minutes or longer • Winds 110 – 205 mph	• 2% of all tornadoes • 70% of all tornado deaths • Lifetime can exceed one hour • Winds greater than 205 mph

Location

Tornadoes do not have any specific geographic boundary and can occur throughout the planning area uniformly. It is assumed that the Council of Cities planning area is uniformly exposed to tornado activity. Cameron County is located in Wind Zone III (Figure 10-1), where tornado winds can be as high as 200 mph.

Figure 10-1. FEMA Wind Zones in the United States[1]



[1] *Council of Cities planning area is indicated by the star.*

Extent

The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, such as residential homes (particularly mobile homes).

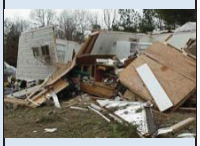
Table 10-2. The Fujita Tornado Scale[2]

F-SCALE NUMBER	INTENSITY	WIND SPEED (MPH)	TYPE OF DAMAGE DONE	PERCENT OF APPRAISED STRUCTURE VALUE LOST DUE TO DAMAGE
F0	Gale Tornado	40 – 72	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.	None Estimated
F1	Moderate Tornado	73 – 112	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads; attached garages may be destroyed.	0% – 20%
F2	Significant Tornado	113 – 157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.	50% – 100%
F3	Severe Tornado	158 – 206	Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.	100%
F4	Devastating Tornado	207 – 260	Well-constructed homes leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.	100%
F5	Incredible Tornado	261 – 318	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles flying through the air in excess of 330 yards; trees debarked; steel reinforced concrete badly damaged.	100%

[2] *Source: http://www.tornadoproject.com/fscale/fscale.htm*

Tornado magnitudes prior to 2005 were determined using the traditional version of the Fujita Scale (Table 10-2). Since February 2007, the Fujita Scale has been replaced by the Enhanced Fujita Scale (Table 10-3), which retains the same basic design and six strength categories as the previous scale. The newer scale reflects more refined assessments of tornado damage surveys, standardization, and damage consideration to a wider range of structures.

Table 10-3. Enhanced Fujita Scale for Tornadoes

STORM CATEGORY	DAMAGE LEVEL	3 SECOND GUST (MPH)	DESCRIPTION OF DAMAGES	PHOTO EXAMPLE
EF0	Gale	65 – 85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.	
EF1	Weak	86 – 110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads; attached garages may be destroyed.	
EF2	Strong	111 – 135	Considerable damage; roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.	
EF3	Severe	136 – 165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.	
EF4	Devastating	166 – 200	Well-constructed homes leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.	
EF5	Incredible	200+	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles flying through the air in excess of 330 yards; trees debarked; steel reinforced concrete badly damaged.	

Both the Fujita Scale and Enhanced Fujita Scale should be referenced in reviewing previous occurrences since tornado events prior to 2007 will follow the original Fujita Scale. The largest magnitude reported within the planning area is F3 on the Fujita Scale, a "Severe Tornado." Based on the planning areas location in wind zone III, the planning area could experience anywhere from an EF0 to an EF5 depending on the wind speed.

The events in Cameron County have been between EF0 to an EF3 (Table 10-4). Therefore, the range of intensity that the Council of Cities planning area would be expected to mitigate is a tornado event that would be a low to significant risk, an EF0 to EF3.

Historical Occurrences

Only reported tornadoes were factored into the Risk Assessment. It is likely that a high number of occurrences have gone unreported over the past 55 years.

Figure 10-2 identifies the locations of previous occurrences in the Council of Cities planning area from 1950 to November 2015. A total of 58 events have been recorded by the Storm Prediction Center (NOAA) and NCDC databases for Cameron County. The most significant event reported occurred in Cameron County near Primera on September 16, 1988. The F1 tornado and associated storm system caused more than 2.5 million dollars in property damages.

Figure 10-2. Spatial Historical Tornado Events, 1950-2015[3]

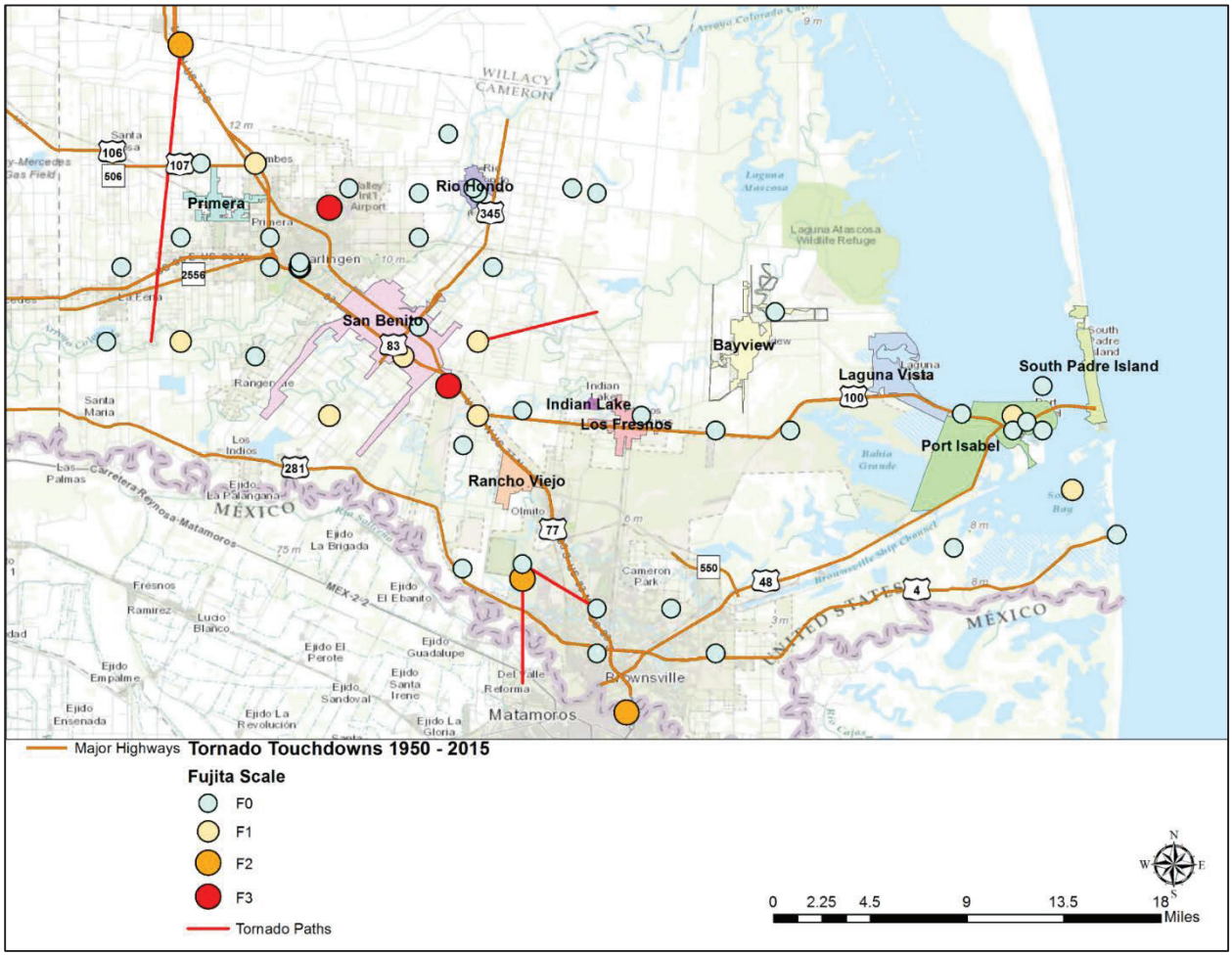


Table 10-4. Historical Tornado Events, 1950-2015[4]

JURISDICTION	DATE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Cameron County	7/15/1953	F1	0	0	$2,216	$0
Cameron County	2/16/1957	F0	0	0	$2,109	$0
Cameron County	5/12/1969	F3	0	0	$161,456	$0
Cameron County	5/12/1969	F2	0	0	$161,456	$0

[3] *Source: NOAA Records*

[4] *Only recorded events with fatalities, injuries, and/or damages are listed.*

JURISDICTION	DATE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Cameron County	5/12/1969	F3	0	0	$161,456	$0
Cameron County	5/13/1969	F1	0	0	$1,615	$0
Cameron County	5/24/1970	F2	0	0	$15,272	$0
Cameron County	8/24/1976	F0	0	0	$10,414	$0
Cameron County	4/16/1977	F1	0	0	$97,779	$0
Cameron County	4/21/1977	F1	0	0	$977,793	$0
Cameron County	8/9/1980	F2	0	0	$7,191,050	$0
Cameron County	11/6/1983	F0	0	0	$59,492	$0
Cameron County	11/6/1983	F0	0	3	$59,492	$0
Cameron County	9/16/1988	F0	0	0	$500,881	$0
Cameron County	9/16/1988	F0	0	0	$500,881	$0
Cameron County	9/16/1988	F1	0	0	$5,008,812	$0
Cameron County	11/17/1989	F0	0	0	$47,786	$0
Cameron County	4/29/1991	F0	0	0	$4,351	$0
Cameron County	4/4/1997	F1	0	0	$66,453	$0
Los Fresnos	11/4/1998	F0	0	0	$29,082	$0
Cameron County	4/26/1999	F0	0	0	$0	$2,845
Cameron County	5/29/2002	F0	0	0	$13,175	$0
Cameron County	7/20/2005	F0	0	0	$36,408	$0
Cameron County	11/7/2008	F0	0	0	$1,101	$0
Cameron County	6/30/2010	F0	0	0	$4,348	$0
Cameron County	6/30/2010	F0	0	0	$10,870	$0
Cameron County	5/11/2012	F0	0	0	$15,485	$0
Totals			**0**	**0**	**$15,141,233**	**$2,845**

Table 10-5. Summary of Historical Tornado Events, 1950-2015

JURISDICTION	NUMBER OF EVENTS	MAGNITUDE	INJURIES	FATALITIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Bayview	1	F0	0	0	$0	$0
Indian Lake	0	N/A	0	0	$0	$0
Laguna Vista	0	N/A	0	0	$0	$0
Los Fresnos	3	F0	0	0	$29,121	$0
Port Isabel	5	F1	0	0	$5,970	$0
Primera	1	F0	0	0	$0	$0
Rancho Viejo	1	F0	0	0	$0	$0
Rio Hondo	5	F0	0	0	$49,650	$0
San Benito	5	F3	0	0	$1,156,288	$0
South Padre Island	0	N/A	0	0	$0	$0
County	37	F3	0	0	$14,058,214	$2,849
Total Losses	**58**	**(Max Extent)**	**0**	**0**	**$15,302,092**	

Significant Past Events

May 12, 1969 – Port Isabel

A strong F3 tornado touched down briefly near the Colley's Fishing Service House then moved slowly from north to south with a "spinning top" like sound. The tornado was visible in the dark due to frequent lightning. Several windows were broken or blown out, signs were damaged or downed, and a rope which held a boat to a dock was snapped.

September 16, 1988 – Cameron County

A tornado touched down in the southeast portion of Harlingen and moved west-southwest across the southern section of the city about one half mail south, parallel to the Arroyo Colorado. The tornado moved across both the business and freeway sections of Highway 77. The tornado collapsed one wall and the roof of a doctor's office. Windows were blown out of a nearby hospital and residences. There was roof damage to some homes and apartment complexes. Twenty to thirty cars lost windshields in the area.

May 11, 2012 – Cameron County

A mini-supercell thunderstorms dropped a very brief tornado, containing estimated 80 mph winds (high end EF0 on the Fujita Scale) on top of a single family home, causing considerable damage to the hardy

structure. Damage included: four sections of cyclone fence bent in different directions around the home; a boat and trailer flipped over, numerous snapped tree limbs in different directions, and other limbs that came from an undetermined tree, barrel-tile roof shingles lifted off, one broken window, and a damaged carport.

Probability of Future Events

Tornadic storms can occur at any time of year and at any time of day, but they are typically more common in the spring months during the late afternoon and evening hours. A smaller, high frequency period can emerge in the fall during the brief transition between the warm and cold seasons. According to historical records, Cameron County experiences one to two tornado events each year. This frequency supports a highly likely probability of future events for the entire planning area.

Statistical probability by jurisdiction, as indicated in Table 10-7 below, indicate a significantly lower probability. However, the analysis of occurrences is based on the most reliable data available as reported by the NCDC. This data is typically reported as a county-wide event with limited data reported at the city/town level. As a result, the Team assumed a similar risk throughout the entire county and subsequent planning area since the hazard has no geographical boundaries resulting in a highly likely probability of future tornado events for all participating jurisdictions.

Vulnerability and Impact

Because tornadoes often cross-jurisdictional boundaries, all existing and future buildings, facilities and populations in the planning area are considered to be exposed to this hazard and could potentially be impacted. The damage caused by a tornado is typically a result of high wind velocity, wind-blown debris, lightning, and large hail.

The following critical facilities would be vulnerable to tornado events in each participating jurisdiction, respectively.

Table 10-6. Critical Facilities by Jurisdiction

Jurisdiction	Critical Facilities
Bayview	Town Hall, Fire Station, 2 Bridges (north and south side)
Indian Lake	Town Hall, Police Station, Community Center, 2 Water Utility Facilities, Main Water Meter, Henderson Road Bridge, Resaca Shores Bridge
Laguna Vista	City Hall/Police Station, Fire Station, Library
Los Fresnos	City Hall, Water Plant, Sewer Plant, Raw Water Meter Station, 20 Lift Stations
Port Isabel	14 Lift Stations, AEP Electrical Substations, Texas Gas Service, EOC, City Hall, Police Department, Fire Department, Port Isabel EMS, Port

Jurisdiction	Critical Facilities
	Isabel Health Clinic, Port Isabel Medical Clinic, H.E.B., Wal Mart, Harbor-Pampano Park, 3 Main Harbor Entrances
Primera	City Hall
Rancho Viejo	Town Hall, Fire Station, Valley Municipal Utilities Department
Rio Hondo	Rio Hondo Bridge, Water Plant, Reservoir Dam, Sewer Plant, Fertilizer Plant, Police Station
San Benito	2 Water Plants, 2 Water Towers, Waste Water Treatment Plant, Waste Water Wetlands, City Hall, Municipal Building, Public Works, School administration, School Campuses, AT&T Hub Location, Police Station, 2 Fire Stations, Cameron County Annex, 2 Power substations
South Padre Island	City Hall, Water Tower, AT&T Hub, Fire Station, 2 Water Towers, 2 Power substation, US Coast Guard Station, Queen Isabella Causeway

The average tornado moves from southwest to northeast, but tornadoes have been known to move in any direction. Consequently, vulnerability of humans and property is difficult to evaluate since tornadoes form at different strengths, in random locations, and create relatively narrow paths of destruction. Although tornadoes strike at random, making all buildings vulnerable, three types of structures are more likely to suffer damage:

- Manufactured Homes;
- Homes on crawlspaces (more susceptible to lift); and
- Buildings with large spans, such as shopping malls, gymnasiums, and factories.

Utility systems on roofs at school districts and hospitals would be vulnerable and could be damaged by debris and high winds. Tornadoes can possibly cause a significant threat to people as they could be struck by flying debris, falling trees/branches, utility lines, and poles. First responders could also not be able to respond to calls due to blocked roads. Tornadoes commonly cause power outages which could cause health and safety risks to faculty and students at schools, as well as to patients in hospitals or other vulnerable populations that rely on power for medical necessities.

The US Census data indicates a total of 2,519 manufactured homes located in the Council of Cities planning area including all participating jurisdictions (Table 10-7). In addition, approximately 10,175 of the residential structures in the planning area were built before 1980. These structures would typically be built to lower or less stringent construction standards than newer construction and may be more suseptible to damages during significant tornado events.

Table 10-7. Structures at Greater risk by Jurisdiction

JURISDICTION	MANUFACTURED HOMES	SFR STRUCTURES BUILT BEFORE 1980
Bayview	5	86

JURISDICTION	MANUFACTURED HOMES	SFR STRUCTURES BUILT BEFORE 1980
Indian Lake	440	178
Laguna Vista	24	338
Los Fresnos	58	592
Port Isabel	455	821
Primera	125	352
Rancho Viejo	13	512
Rio Hondo	119	481
San Benito	1255	5002
South Padre Island	25	1813
COUNCIL TOTAL	2519	10,175

The average loss estimate of property and crop is $15,302,092 (in 2015 dollars). The approximate annual loss estimate is summarized in Table 10-8 for each jurisdiction.

Table 10-8. Historical Tornado Events Summary, 1950-2015[5]

JURISDICTION	FREQUENCY	PROBABILITY OF FUTURE EVENTS	AVERAGE ANNUALIZED LOSSES
Bayview	0.02	Unlikely	$0
Indian Lake	0.00	Unlikely	$0
Laguna Vista	0.00	Unlikely	$0
Los Fresnos	0.05	Unlikely	$530
Port Isabel	0.09	Unlikely	$109
Primera	0.02	Unlikely	$0
Rancho Viejo	0.02	Unlikely	$0
Rio Hondo	0.09	Unlikely	$903
San Benito	0.09	Unlikely	$21,023

[5] *Even though the jurisdictions may have experienced more tornado events, NCDC data only records events reported and they are generally reported on a County level. The data in this chart is based on events only recorded in the respective jurisdiction. As a result, the overall probability for the Council of Cities planning area is determined using County level data as it more accurately reflects risk for each participating jurisdiction.*

JURISDICTION	FREQUENCY	PROBABILITY OF FUTURE EVENTS	AVERAGE ANNUALIZED LOSSES
South Padre Island	0.00	Unlikely	$0
County	0.67	Highly Likely	$255,656

Based on historic loss and damages, the impact of tornadoes experienced in the Council of Cities has resulted in 0 injuries and 0 fatalities supporting a limited severity of impact meaning injuries and/or illnesses are treatable with first aid, shutdown of facilities lasts for 24 hours or less, and less than 10% of property is destroyed.

Assessment of Impacts

Tornadoes have the potential to pose a significant risk to the population and can create dangerous situations. Often providing and preserving public health and safety is difficult. Impacts to the planning area can include:

- Individuals exposed to the storm can be struck by flying debris, falling limbs, or downed trees causing serious injury or death.
- Structures can be damaged or crushed by falling trees, which can result in physical harm to the occupants.
- Significant debris and downed trees can result in emergency response vehicles being unable to access areas of the community.
- Downed power lines may result in roadways being unsafe for use, which may prevent first responders from answering calls for assistance or rescue.
- Tornadoes often result in widespread power outages increasing the risk to more vulnerable portions of the population who rely on power for health and/or life safety.
- Extended power outage can result in an increase in structure fires and/or carbon monoxide poisoning, as individuals attempt to cook or heat their home with alternate, unsafe cooking or heating devices, such as grills.
- Tornadoes can destroy or make residential structures uninhabitable, requiring shelter or relocation of residents in the aftermath of the event.
- First responders are exposed to downed power lines, unstable and unusual debris, hazardous materials, and generally unsafe conditions, elevating the risk of injury to first responders and potentially diminishing emergency response capabilities.
- Emergency operations and services may be significantly impacted due to damaged facilities, loss of communications, damaged emergency vehicles and equipment.
- Critical staff may be personally injured or otherwise impacted by a tornado and unable to report for duty, limiting response capabilities.
- City or county departments may be damaged or destroyed, delaying response and recovery efforts for the entire community.

- Private sector entities that the City and its residents rely on, such as utility providers, financial institutions, and medical care providers may not be fully operational and may require assistance from neighboring communities until full services can be restored.
- Economic disruption negatively impacts the programs and services provided by the community due to short and long term loss in revenue.
- Damage to infrastructure may slow economic recovery since repairs may be extensive and lengthy.
- Some businesses not directly damaged by the tornado may be negatively impacted while roads and utilities are being restored, further slowing economic recovery.
- When the community is affected by significant property damage it is anticipated that funding would be required for infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, as well as normal day-to-day operating expenses.
- Displaced residents may not be able to immediately return to work, further slowing economic recovery.
- Residential structures destroyed by a tornado may not be rebuilt for years, reducing the tax base for the community
- Large or intense tornadoes may result in a dramatic population fluctuation, as people are unable to return to their homes or jobs and must seek shelter and/or work outside of the affected area.
- Businesses that are uninsured or underinsured may have difficulty reopening, which results in a net loss of jobs for the community and a potential increase in the unemployment rate.
- Recreation activities may be unavailable and tourism can be unappealing for years following a large tornado, devastating directly related local businesses.

The economic and financial impacts of a tornado event on the community will depend on the scale of the event, what is damaged, costs of repair or replacement, lost business days in impacted areas, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by government, businesses and citizens will contribute to the overall economic and financial conditions in the aftermath of a tornado event.

Section 11: Hail

Hazard Description

Hailstorm events are a potentially damaging outgrowth of severe thunderstorms. During the developmental stages of a hailstorm, ice crystals form within a low pressure front due to the rapid rising of warm air into the upper atmosphere, and the subsequent cooling of the air mass. Frozen droplets gradually accumulate into ice crystals until they fall as precipitation that is round or irregularly shaped masses of ice greater than 0.75 inches in diameter. The size of hailstones is a direct result of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a by-product of heating on the Earth's surface. Higher temperature gradients above Earth's surface result in increased suspension time and hailstone size.

Location

Hailstorms are an extension of severe thunderstorms that could potentially cause severe damage. As a result, they are not confined to any specific geographic location, and can vary greatly in size, location, intensity and duration. Therefore, the Council of Cities planning area is equally at risk to the hazard of hail.

Extent

The National Weather Service (NWS) classifies a storm as "severe," if there is hail three-quarters of an inch in diameter (approximately the size of a penny) or greater, based on radar intensity or as seen by

observers. The intensity category of a hailstorm depends on hail size and the potential damage it could cause, as depicted in the National Climatic Data Center (NCDC) Intensity Scale in Table 11-1.

Table 11-1. Hail Intensity and Magnitude[1]

SIZE CODE	INTENSITY CATEGORY	SIZE (DIAMETER INCHES)	DESCRIPTIVE TERM	TYPICAL DAMAGE
H0	Hard Hail	Up to 0.33	Pea	No damage
H1	Potentially Damaging	0.33 – 0.60	Marble	Slight damage to plants and crops
H2	Potentially Damaging	0.60 – 0.80	Dime	Significant damage to plants and crops
H3	Severe	0.80 – 1.20	Nickel	Severe damage to plants and crops
H4	Severe	1.2 – 1.6	Quarter	Widespread glass and auto damage
H5	Destructive	1.6 – 2.0	Half Dollar	Widespread destruction of glass, roofs, and risk of injuries
H6	Destructive	2.0 – 2.4	Ping Pong Ball	Aircraft bodywork dented and brick walls pitted
H7	Very Destructive	2.4 – 3.0	Golf Ball	Severe roof damage and risk of serious injuries
H8	Very Destructive	3.0 – 3.5	Hen Egg	Severe damage to all structures
H9	Super Hailstorms	3.5 – 4.0	Tennis Ball	Extensive structural damage, could cause fatal injuries
H10	Super Hailstorms	4.0 +	Baseball	Extensive structural damage, could cause fatal injuries

The intensity scale in Table 11-1 ranges from H0 to H10, with increments of intensity or damage potential in relation to hail size (distribution and maximum), texture, fall speed, speed of storm translation, and strength of the accompanying wind. Based on available data regarding the previous occurrences for the area, the Council of Cities planning area may experience hailstorms ranging from an H0 to an H10. The planning area can mitigate a storm from low risk or hard hail to a severe, super hailstorm with tennis ball size hail that leads to extensive structural damage and could cause fatal injuries.

Historical Occurrences

Historical evidence shown in Figure 11-1 shows that the planning area is vulnerable to hail events overall, which typically result from severe thunderstorm activity. A total of 73 reported historical hail events impacted Cameron County between 1955 and 2015 (Summary Table 11-2). These events were reported

[1] *NCDC Intensity Scale, based on the TORRO Hailstorm Intensity Scale.*

to NCDC and NOAA databases, and may not represent all hail events to have occurred during the past 60 years. Only those events for Cameron County with latitude and longitude available were plotted (Figure 11-1).

Figure 11-1. Spatial Historical Hail Events, 1955-2015

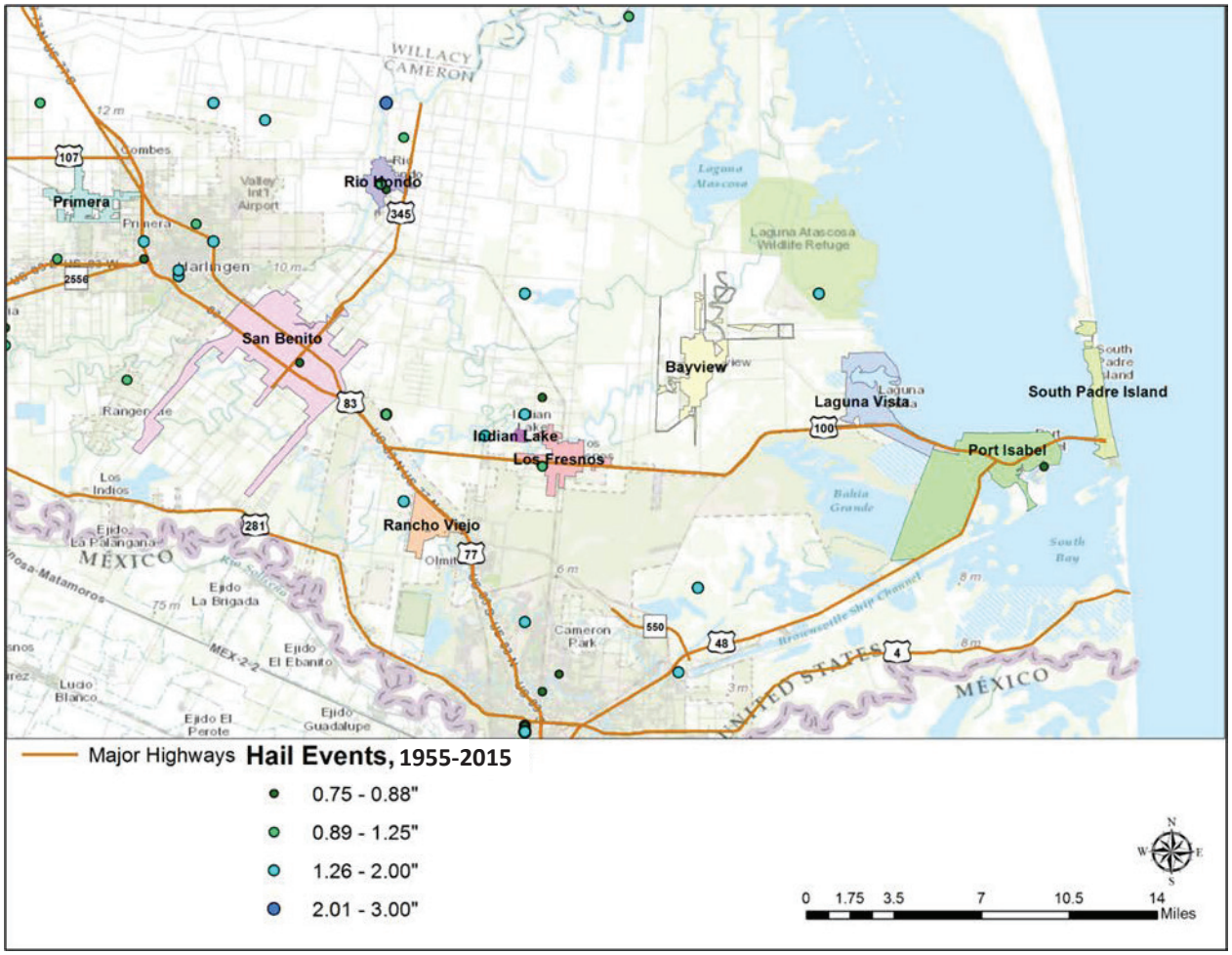


Table 11-2. Historical Hail Events Impact, 1955-2015

JURISDICTION	NUMBER OF EVENTS	MAGNITUDE	INJURIES	FATALITIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Bayview	0	N/A	0	0	$0	$0
Indian Lake	0	N/A	0	0	$0	$0
Laguna Vista	0	N/A	0	0	$0	$0
Los Fresnos	4	1.75 Inches	0	0	$0	$0

JURISDICTION	NUMBER OF EVENTS	MAGNITUDE	INJURIES	FATALITIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Port Isabel	3	1.75 Inches	0	0	$0	$0
Primera	1	1.0 inches	0	0	$0	$0
Rancho Viejo	0	N/A	0	0	$0	$0
Rio Hondo	6	2.75 Inches	0	0	$0	$0
San Benito	5	1.75 Inches	0	0	$0	$0
South Padre Island	0	N/A	0	0	$0	$0
County	54	4.00 Inches	0	0	$64,487,271	$7,997
Total Losses	**73**	**(Max Extent)**		**2.75**	**$64,495,268**	
Council of Cities[2]					**$2,457,270**	

Significant Past Events

May 11, 1971

Large hail damaged property and crops in the Lower Rio Grande Valley with the heaviest losses from Weslaco eastward. In Brownsville, hailstones four inches in diameter and chunks of ice 5 x 7 inches across and weighing twelve ounces, smashed car windshields, greenhouses, windows and damaged roofs. The average size of hailstones was approximately ¾ inch in diameter. Property damages was estimated at $2,800,000 or $16,519,437 in 2015 dollars. Automobiles suffered body damage as well as windshield damage. Manufactured home roofs were punctured. One large tract of 80 acres of honeydew melons was reported to be an entire loss.

March 9, 1994

A severe thunderstorm formed along the Rio Grande River as a cold front was moving through South Texas. The storm produced hail up to one-inch in diameter and very strong wind gusts near Weslaco. As the storm moved eastward, it continued to produce hail in eastern Hidalgo and western Cameron County. Hail up to golf ball-size fell in the west side of Harlingen. Marble-size hail was reported between Weslaco and Harlingen in the towns of La Feria and Los Fresnos.

[2] *Calculated as a percentage (3.81) of the county.*

Probability of Future Events

Based on available records of historic events, 73 events in a 60 year reporting period for Cameron County provides a frequency of occurrence of 1 to 2 events every year. This frequency supports a highly likely probability of future events for all participating future events. The numbers listed for the jurisdictions within the County are historical events that are known to have specifically impacted those jurisdictions. It should be noted that the analysis of occurrences is based on the most reliable data available as reported by the NCDC. This data is typically reported as a county-wide event with limited data reported at the city/town level. As a result, the most pragmatic analysis assumes a similar risk throughout the entire county and subsequent planning area when the hazard has no geographical boundaries.

Vulnerability and Impact

Damage from hail approaches $1 billion in the U.S. each year. 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 most commonly damaged by hail.

Utility systems on roofs at school districts and hospitals would be vulnerable and could be damaged. Hail could cause a significant threat to people as they could be struck by hail and falling trees and branches. First responders could not be able to respond to calls due to blocked roads. Also, hail could cause power outages which could cause health and safety risks to faculty and students at schools, as well as to patients in hospitals.

The US Census data indicates a total of 2,519 manufactured homes located in the Council of Cities planning area including all participating jurisdictions (Table 11-3). In addition, approximately 10,175 of the residential structures in the planning area were built before 1980. These structures would typically be built to lower or less stringent construction standards than newer construction and may be more suseptible to damages during significant hail events.

Table 11-3. Structures at Greater risk by Jurisdiction

JURISDICTION	MANUFACTURED HOMES	SFR STRUCTURES BUILT BEFORE 1980
Bayview	5	86
Indian Lake	440	178
Laguna Vista	24	338
Los Fresnos	58	592
Port Isabel	455	821
Primera	125	352

JURISDICTION	MANUFACTURED HOMES	SFR STRUCTURES BUILT BEFORE 1980
Rancho Viejo	13	512
Rio Hondo	119	481
San Benito	1255	5002
South Padre Island	25	1813
COUNCIL TOTAL	2519	10,175

The following critical facilities would be vulnerable to hail events in each participating jurisdiction, respectively.

Table 11-3. Critical Facilities by Jurisdiction

Jurisdiction	Critical Facilities
Bayview	Town Hall, Fire Station, 2 Bridges (north and south side)
Indian Lake	Town Hall, Police Station, Community Center, 2 Water Utility Facilities, Main Water Meter, Henderson Road Bridge, Resaca Shores Bridge
Laguna Vista	City Hall/Police Station, Fire Station, Library
Los Fresnos	City Hall, Water Plant, Sewer Plant, Raw Water Meter Station, 20 Lift Stations
Port Isabel	14 Lift Stations, AEP Electrical Substations, Texas Gas Service, EOC, City Hall, Police Department, Fire Department, Port Isabel EMS, Port Isabel Health Clinic, Port Isabel Medical Clinic, H.E.B., Walmart, Harbor-Pampano Park, 3 Main Harbor Entrances
Primera	City Hall
Rancho Viejo	Town Hall, Fire Station, Valley Municipal Utilities Department
Rio Hondo	Rio Hondo Bridge, Water Plant, Reservoir Dam, Sewer Plant, Fertilizer Plant, Police Station
San Benito	2 Water Plants, 2 Water Towers, Waste Water Treatment Plant, Waste Water Wetlands, City Hall, Municipal Building, Public Works, School administration, School Campuses, AT&T Hub Location, Police Station, 2 Fire Stations, Cameron County Annex, 2 Power substations
South Padre Island	City Hall, Water Tower, AT&T Hub, Fire Station, 2 Water Towers, 2 Power substation, US Coast Guard Station, Queen Isabella Causeway

Hail has been known to cause injury to humans, and occasionally has been fatal. Overall, the average loss estimate of property and crop (in 2015 dollars) is $2,457,270, having an approximate annual loss estimate of $40,955. Based on historic loss and damages, the impact of hail damages on the Council of Cities planning area can be considered limited severity of impact meaning injuries and/or illnesses are treatable

with first aid, shutdown of facilities and services for 24 hours or less, and less than 10% of property is destroyed or with major damage.

Assessment of Impacts

Hail events have the potential to pose a significant risk to people, and can create dangerous situations. Impacts to the planning area can include:

- Hail may create hazardous road conditions during and immediately following an event, delaying first responders from providing for or preserving public health and safety.
- Individuals and first responders who are exposed to the storm may be struck by hail, falling branches, or downed trees resulting in injuries or possible fatalities.
- Residential structures can be damaged by falling trees, which can result in physical harm to occupants.
- Large hail events will likely cause extensive roof damage to residential structures along with siding damage and broken windows, creating a spike in insurance claims and a rise in premiums.
- Automobile damage may be extensive depending on the size of the hail and length of the storm.
- Hail events can result in power outages over widespread areas increasing the risk to more vulnerable portions of the population who rely on power for health and/or life safety.
- Extended power outage can result in an increase in structure fires and/or carbon monoxide poisoning, as individuals attempt to cook or heat their home with alternate, unsafe cooking or heating devices, such as grills.
- First responders are exposed to downed power lines, damaged structures, hazardous spills, and debris that often accompany hail events, elevating the risk of injury to first responders and potentially diminishing emergency response capabilities.
- Downed power lines and large debris, such as downed trees, can result in the inability of emergency response vehicles to access areas of the community.
- Hazardous road conditions may prevent critical staff from reporting for duty, limiting response capabilities.
- Economic disruption negatively impacts the programs and services provided by the community due to short and long term loss in revenue.
- Some businesses not directly damaged by the hail event may be negatively impacted while roads are cleared and utilities are being restored, further slowing economic recovery.
- Businesses that are more reliant on utility infrastructure than others may suffer greater damages without a backup power source.
- Hazardous road conditions will likely lead to increases in automobile accidents, further straining emergency response capabilities.
- Depending on the severity and scale of damage caused by large hail events, damage to power transmission and distribution infrastructure can require days or weeks to repair.
- A significant hail event could significantly damage agricultural crops, resulting in extensive economic losses for the community and surrounding area.
- Hail events may injure or kill livestock and wildlife.

Section 11: Hail

The economic and financial impacts of hail will depend entirely on the scale of the event, what is damaged, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning conducted by the community, local businesses and citizens will contribute to the overall economic and financial conditions in the aftermath of any hail event.

Section 12: Wildfire

Hazard Description

A wildfire event can rapidly spread out of control and occurs most often in the summer, when the brush is dry and flames can move unchecked through a highly vegetative area. Wildfires can start as a slow burning fire along the forest floor, killing and damaging trees. The fires often spread more rapidly as they reach the tops of trees, with wind carrying the flames from tree to tree. Usually, dense smoke is the first indication of a wildfire.

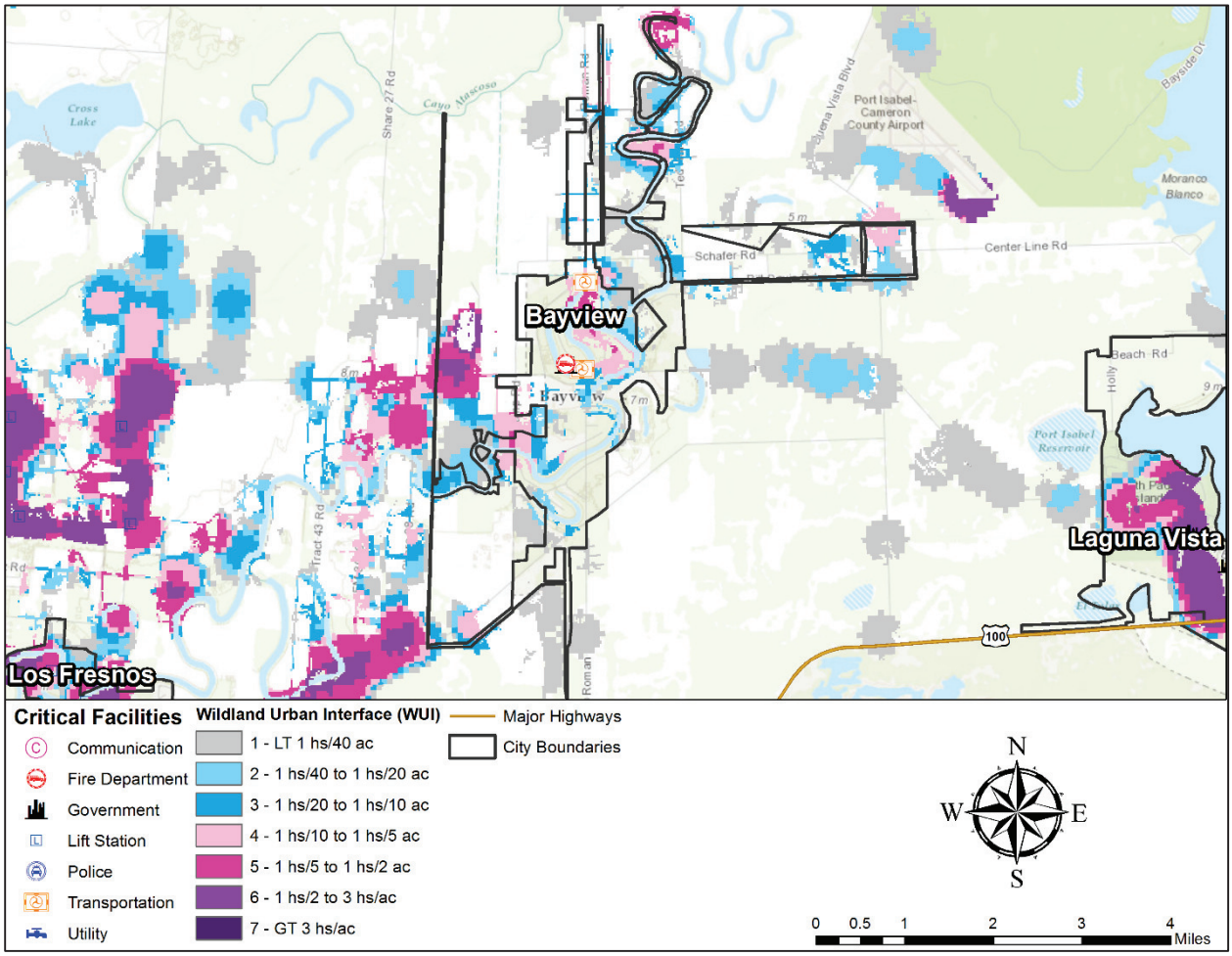
A wildfire event often begins unnoticed and spreads quickly, lighting brush, trees and homes on fire. For example, a wildfire may be started by a campfire that was not doused properly, tossed cigarette, burning debris, or arson.

Texas has seen a significant increase in the number of wildfires in the past 30 years, which included wildland, interface or intermix fires. Wildland fires are fueled almost exclusively by natural vegetation while interface or intermix fires are urban/wildland fires in which vegetation and the built-environment provide the fuel.

Location

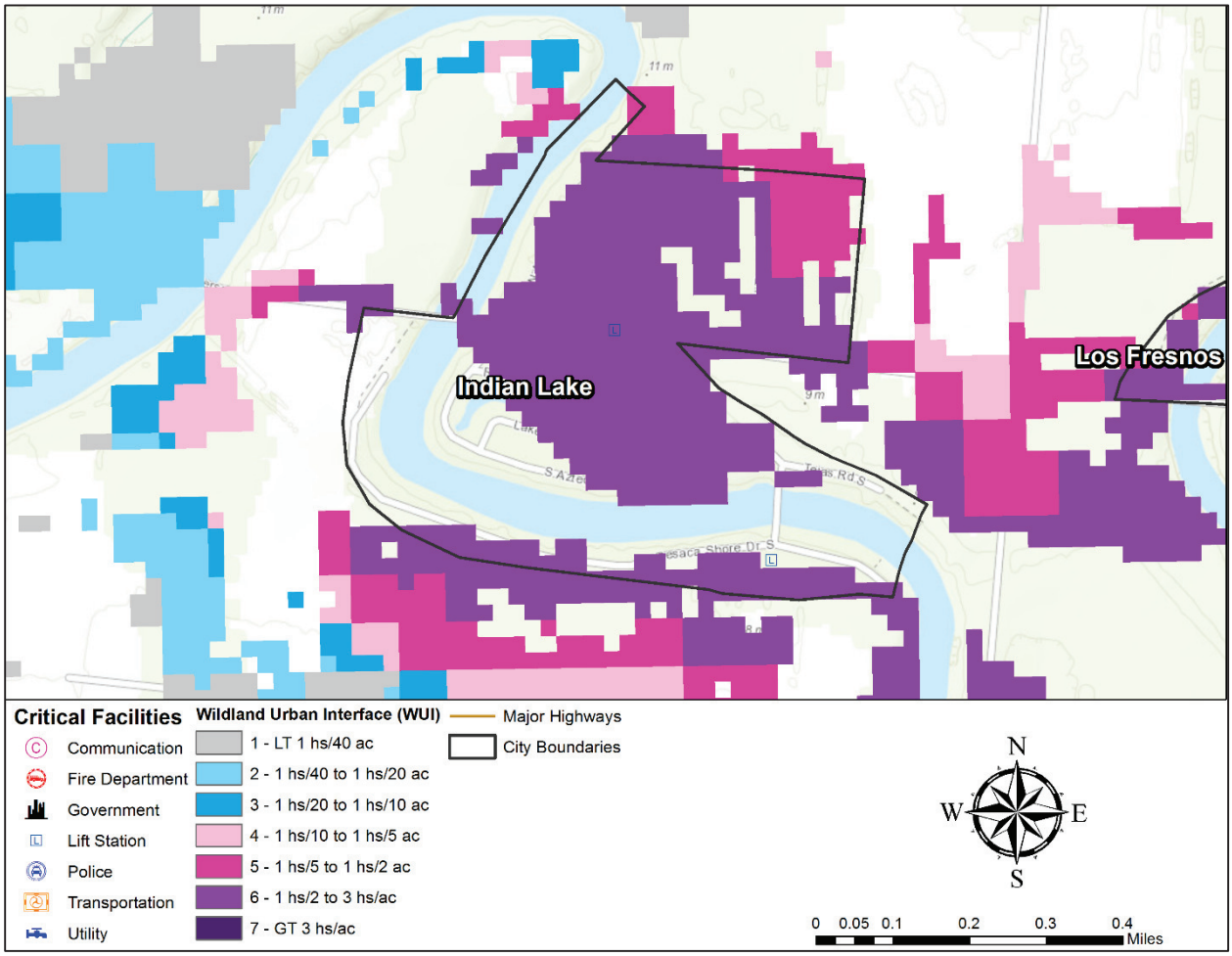
A wildfire event can be a potentially damaging consequence of drought. Wildfires can vary greatly in terms of size, location, intensity and duration. While wildfires are not confined to any specific geographic location, they are most likely to occur in open grasslands. The threat to people and property from a wildfire event is greater in the fringe areas where developed areas meet open grass lands, such as the WUI (Figures 12-1 through 12-10). It is estimated that 36 percent of the total population in Cameron County live within the WUI. However, the entire Council of Cities planning area is at risk for wildfires.

Figure 12-1. Wildland Urban Interface Map – Bayview



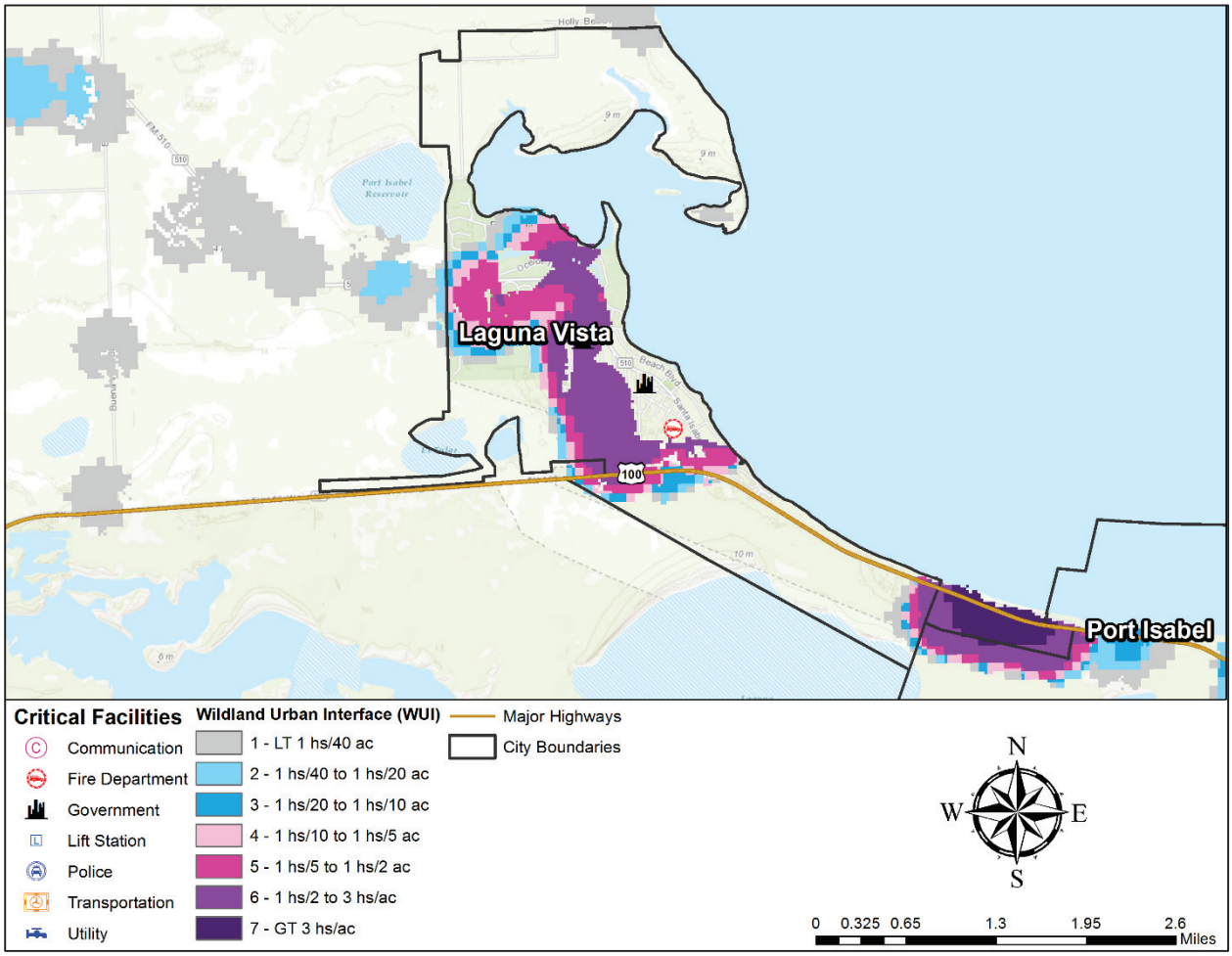
It is estimated that 55 percent of the total population in Bayview live within the WUI. However, the entire Town of Bayview is at risk for wildfires.

Figure 12-2. Wildland Urban Interface Map – Indian Lake



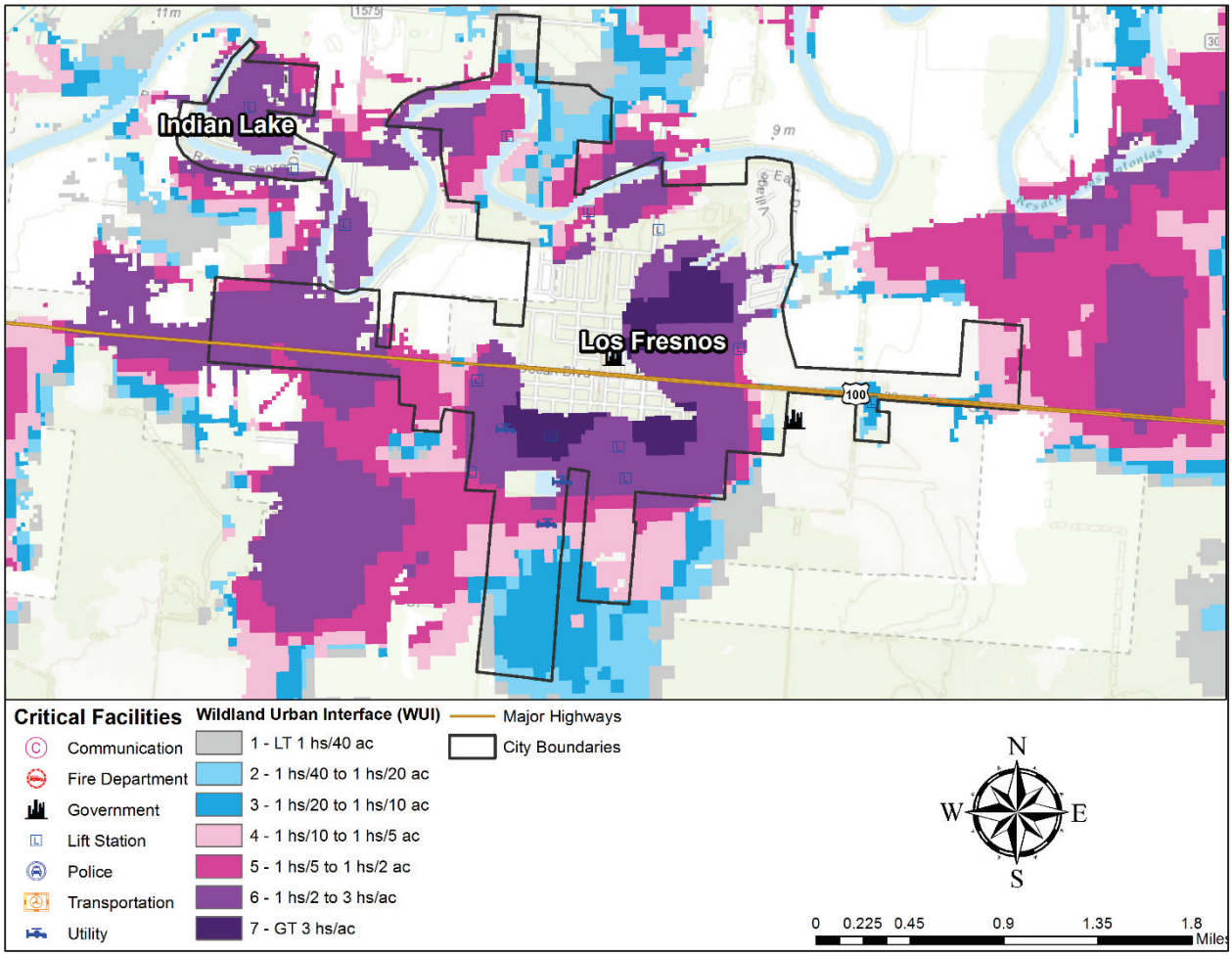
It is estimated that 61 percent of the total population in Indian Lake live within the WUI. However, the entire Town of Indian Lake is at risk for wildfires.

Figure 12-3. Wildland Urban Interface Map – Laguna Vista



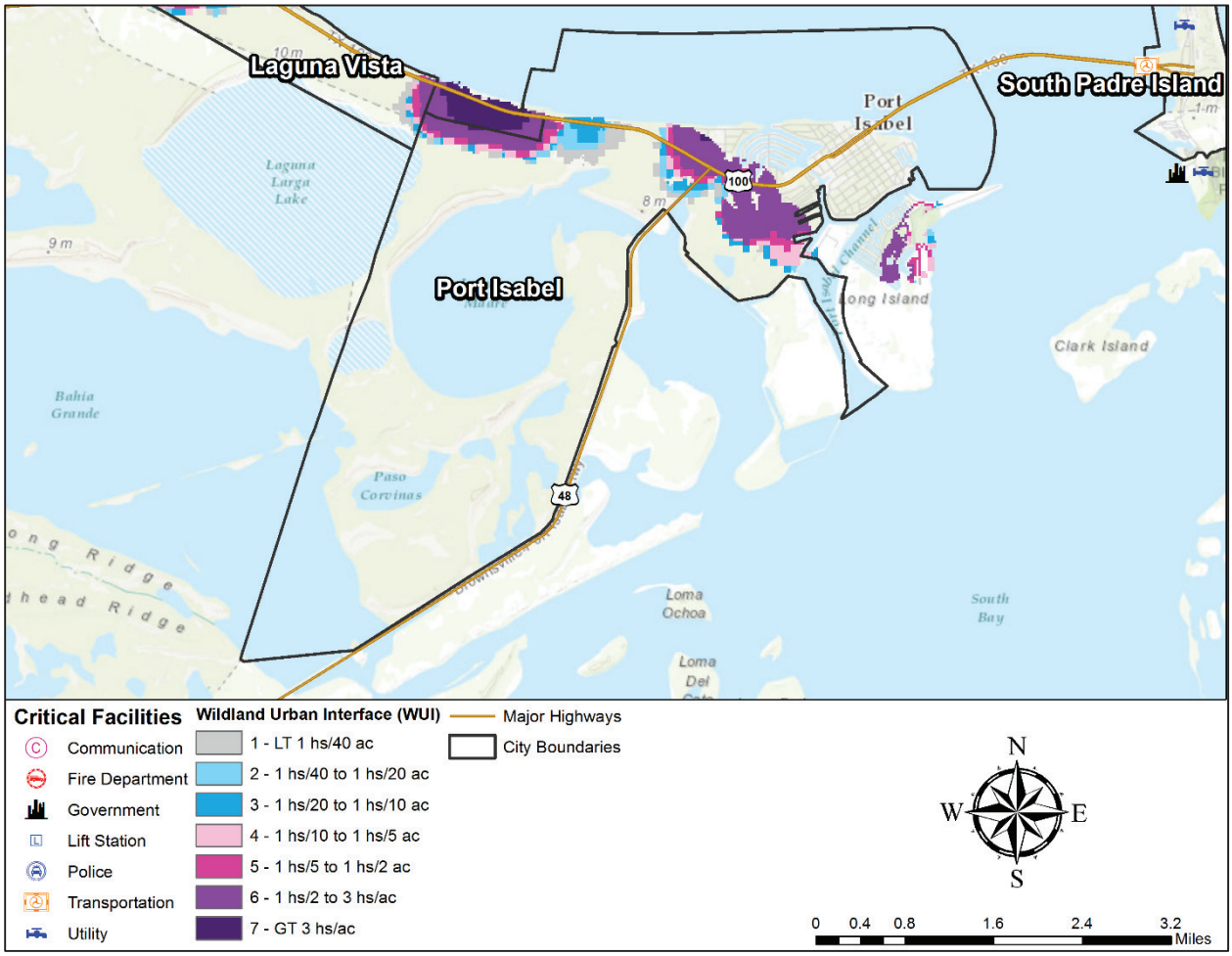
It is estimated that 59 percent of the total population in Laguna Vista live within the WUI. However, the entire Town of Laguna Vista is at risk for wildfires.

Figure 12-4. Wildland Urban Interface Map – Los Fresnos



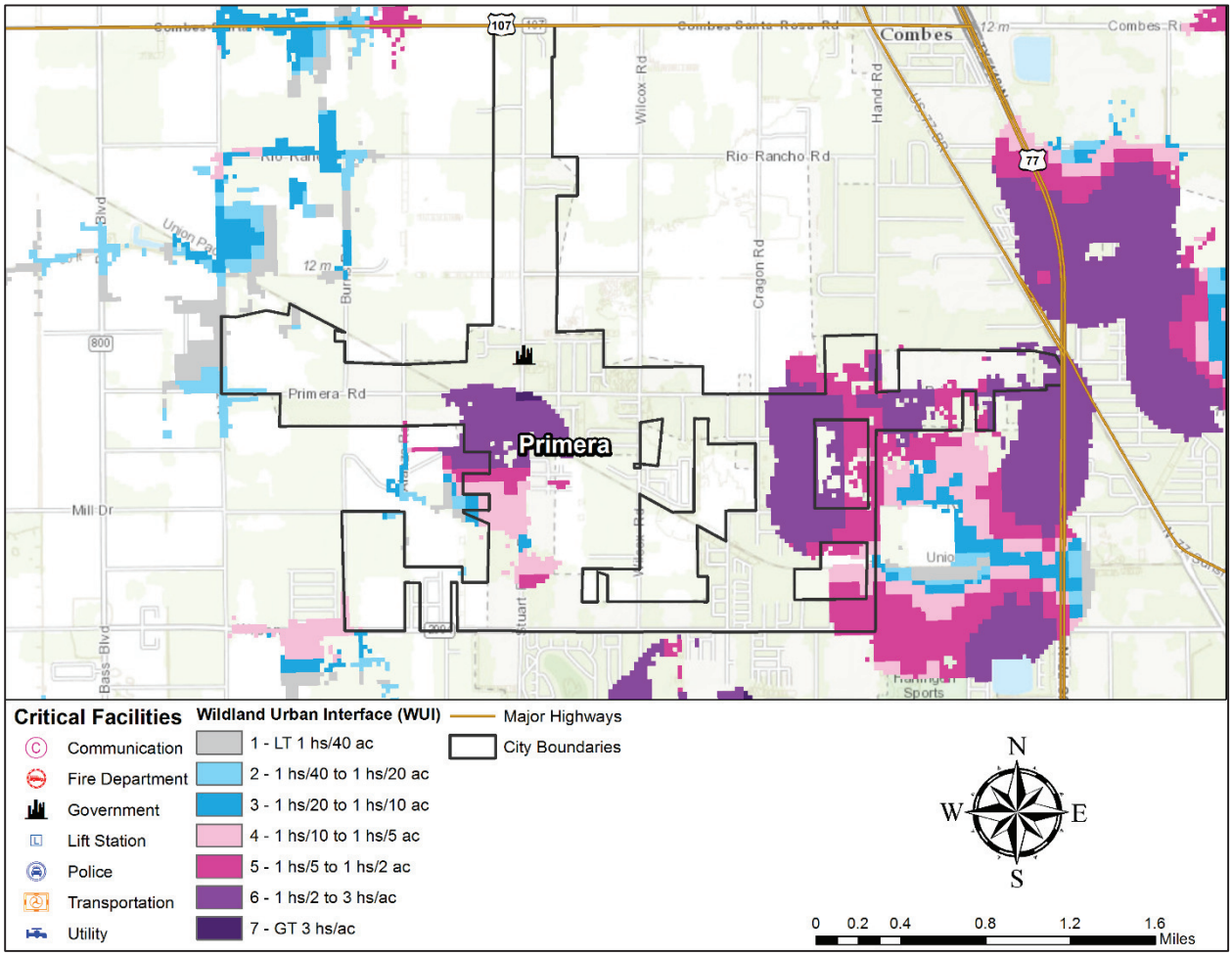
It is estimated that 67 percent of the total population in Los Fresnos live within the WUI. However, the entire City of Los Fresnos is at risk for wildfires.

Figure 12-5. Wildland Urban Interface Map – Port Isabel



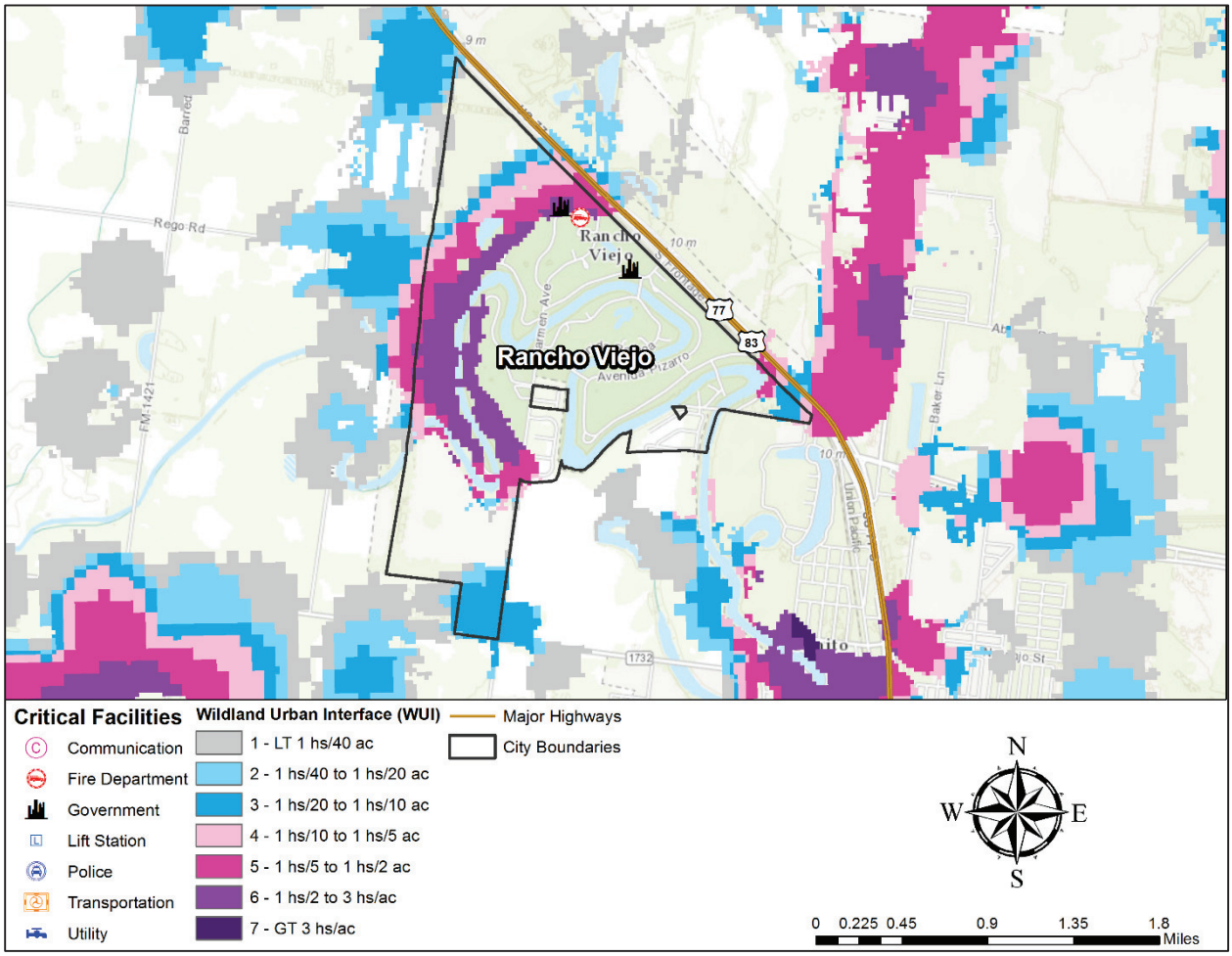
It is estimated that 18 percent of the total population in Port Isabel live within the WUI. However, the entire City of Port Isabel is at risk for wildfires.

Figure 12-6. Wildland Urban Interface Map – Primera



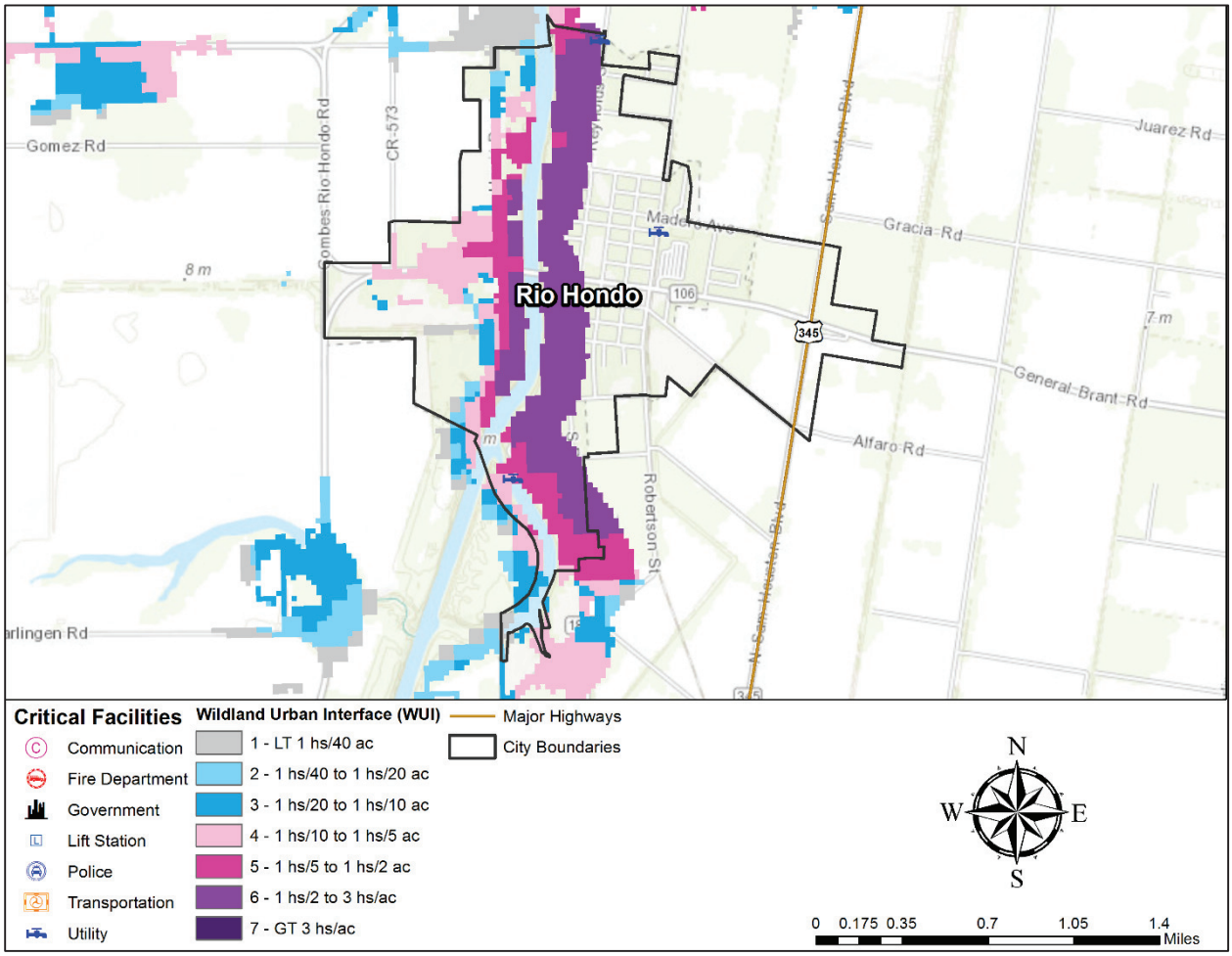
It is estimated that 28 percent of the total population in Primera live within the WUI. However, the entire Town of Primera is at risk for wildfires.

Figure 12-7. Wildland Urban Interface Map – Rancho Viejo



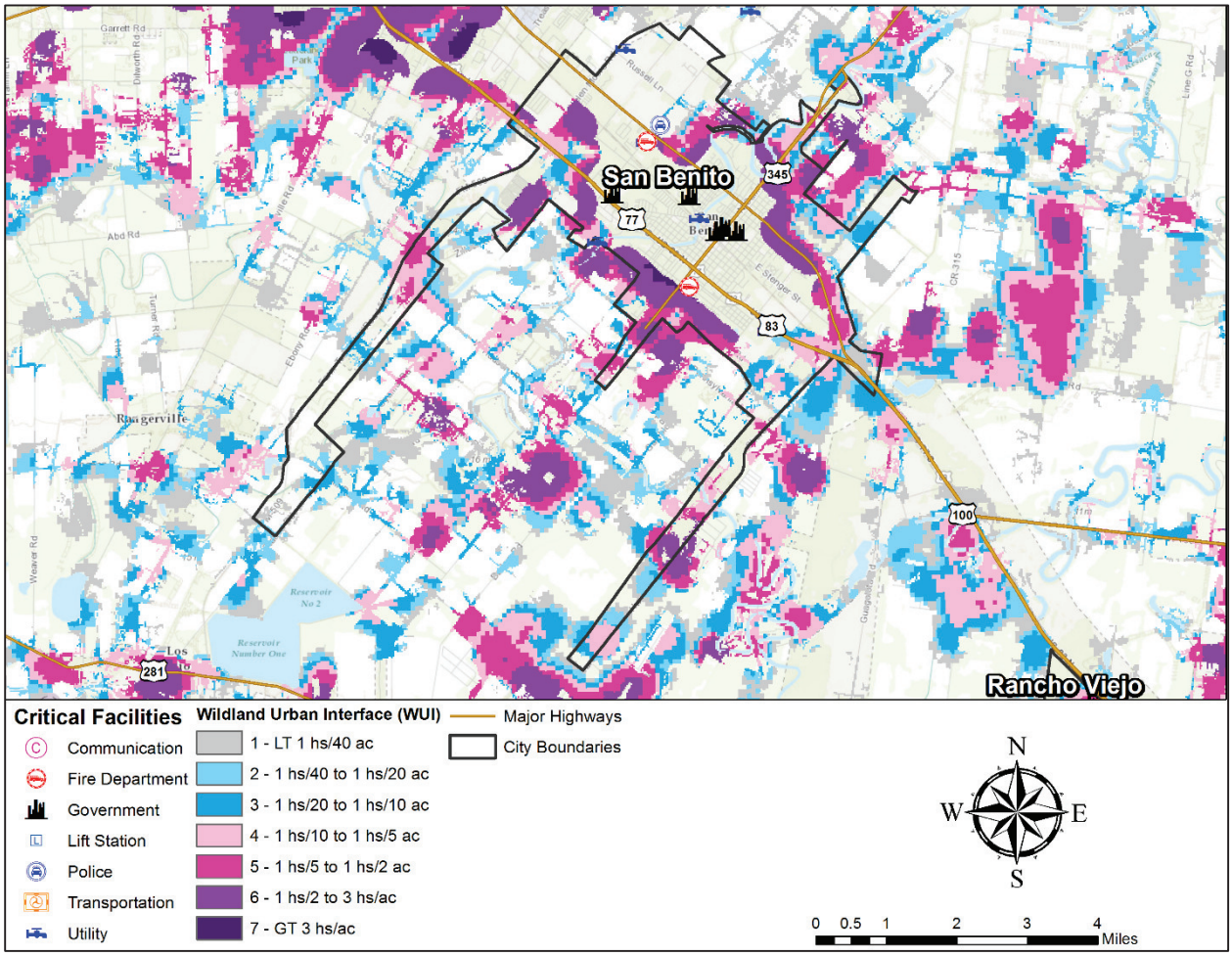
It is estimated that 19 percent of the total population in Rancho Viejo live within the WUI. However, the entire City of Rancho Viejo is at risk for wildfires.

Figure 12-8. Wildland Urban Interface Map – Rio Hondo



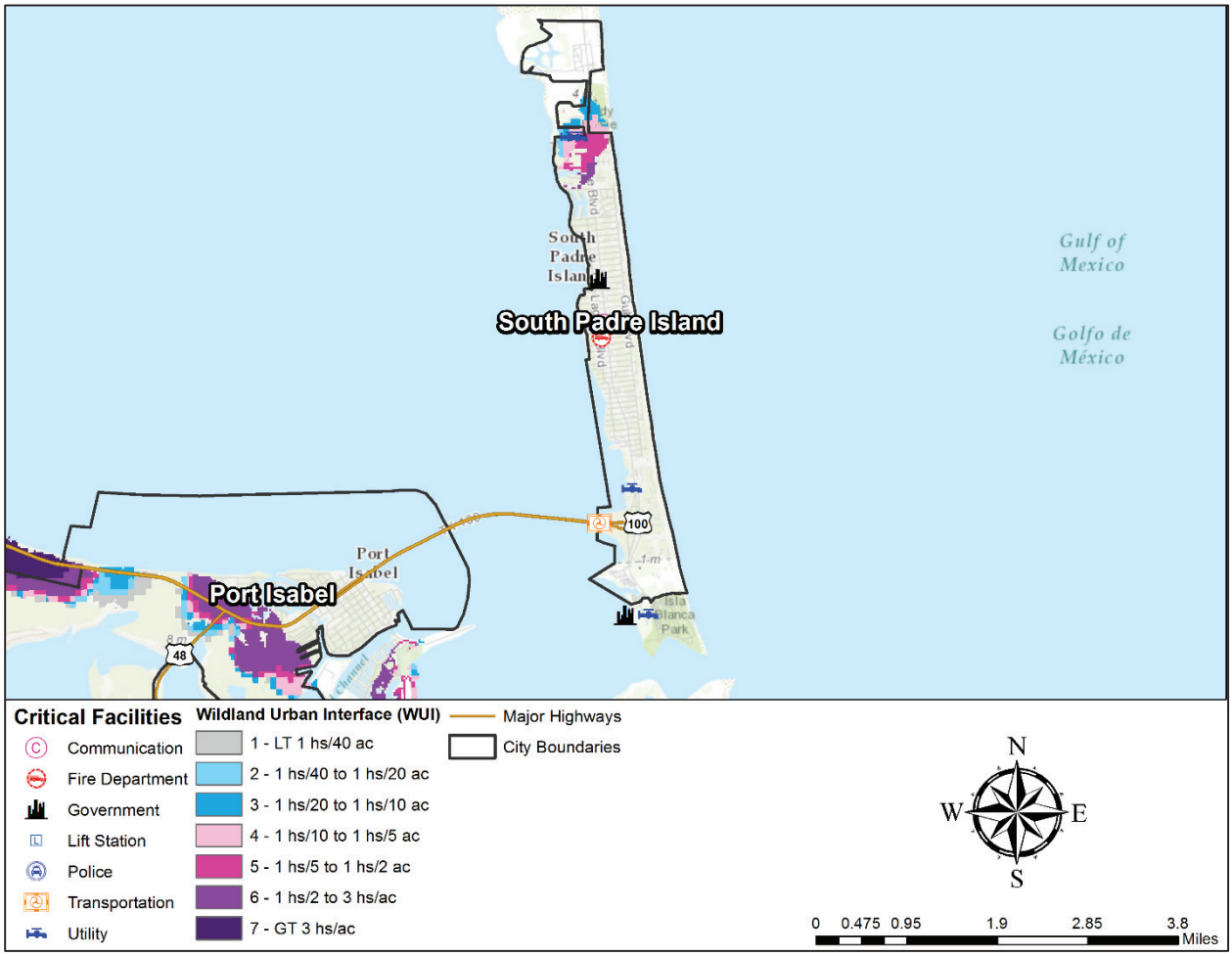
It is estimated that 30 percent of the total population in Rio Hondo live within the WUI. However, the entire City of Rio Hondo is at risk for wildfires.

Figure 12-9. Wildland Urban Interface Map – San Benito



It is estimated that 36 percent of the total population in San Benito live within the WUI. However, the entire City of San Benito is at risk for wildfires.

Figure 12-10. Wildland Urban Interface Map – South Padre Island



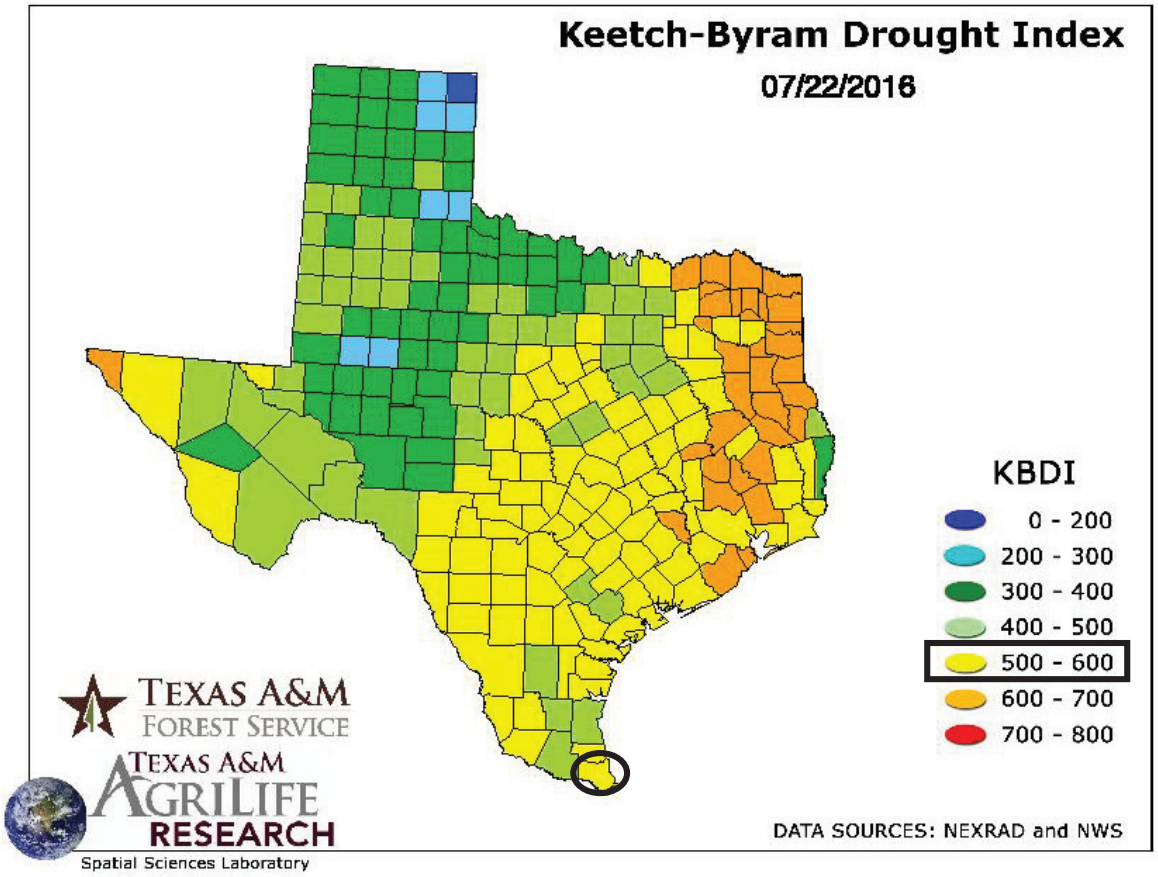
It is estimated that 2 percent of the total population in South Padre Island live within the WUI. However, the entire Town of South Padre Island is at risk for wildfires.

Extent

Risk for a wildfire event is measured in terms of magnitude and intensity using the Keetch Byram Drought Index (KBDI), a mathematical system for relating current and recent weather conditions to potential or expected fire behavior. The KBDI determines forest fire potential based on a daily water balance, derived by balancing a drought factor with precipitation and soil moisture (assumed to have a maximum storage capacity of eight inches), and is expressed in hundredths of an inch of soil moisture depletion.

Each color in Figure 12-11 represents the drought index at that location. The drought index ranges from 0 to 800. A drought index of 0 represents no moisture depletion, and a drought index of 800 represents absolutely dry conditions.

Figure 12-11. Keetch-Byram Drought Index (KBDI) for the State of Texas, 2016[1]



Fire behavior can be categorized at four distinct levels on the KBDI:

- **0 -200:** Soil and fuel moisture are high. Most fuels will not readily ignite or burn. However, with sufficient sunlight and wind, cured grasses and some light surface fuels will burn in spots and patches.
- **200 -400:** Fires more readily burn and will carry across an area with no gaps. Heavier fuels will not readily ignite and burn. Expect smoldering and the resulting smoke to carry into and possibly through the night.
- **400 -600:** Fires intensity begins to significantly increase. Fires will readily burn in all directions exposing mineral soils in some locations. Larger fuels may burn or smolder for several days creating possible smoke and control problems.

[1] *Council of Cities planning area is located within the black circle.*

- **600 -800:** Fires will burn to mineral soil. Stumps will burn to the end of underground roots and spotting will be a major problem. Fires will burn through the night and heavier fuels will actively burn and contribute to fire intensity.

The KBDI is a good measure of the readiness of fuels for a wildfire event. The KBDI should be referenced as the area experiences changes in precipitation and soil moisture, and caution exercised in dryer, hotter conditions.

The range of intensity for the Council of Cities planning area in a wildfire event is within 500 to 600. The average extent to be mitigated for the Council of Cities planning area is a KBDI of 502. At this level fires intensity begins to significantly increase and fires readily burn in all directions, exposing mineral soils in some locations.

The Texas Forest Service's Fire Intensity Scale identifies areas where significant fuel hazards and associated dangerous fire behavior potential exist based on weighted average of four percentile weather categories. The Council of Cities is between a potential low to high wildfire intensities. Figures 12-12 through 12-22 identifies the wildfire intensity for the Council of Cities planning area.