SECTION 4. RISK ASSESSMENT

4.3 Hazard Profiles

4.3.5 Geologic Hazards

The following section provides the hazard profile and vulnerability assessment for geologic hazards in Fort Bend County.

Hazard Profile

Hazard Description

For the 2023 Hazard Mitigation Plan (HMP) update, the geologic hazards profile includes erosion and expansive soils.

Erosion

Erosion is the process of the wearing-away or removal of soil by large storms, flooding, strong wave action, sea level rise, fluvial (riverine) currents, and human activities. In the State of Texas, there are two types of erosion: coastal erosion and inland erosion. Fort Bend County can be impacted by inland erosion.

Soil erosion on cropland is of particular interest because of its on-site impacts on soil quality and crop productivity and its off-site impacts on water quantity and quality, air quality, and biological activity. Erosion is measured as a rate of change in the position or displacement of a river or stream bank over a period of time or the amount of soil removal. Short-term erosion results from periodic flooding and wind. Long-term erosion is a result of repetitive events of this type and of prolonged drought (State of Texas Hazard Mitigation Plan 2018).

Erosion caused by water is the primary concern for the County. Water erosion is the detachment and removal of soil by water. The process can occur naturally or be accelerated by human activity. The rate of erosion can be a slow process that continues relatively unnoticed or can occur very rapidly. The rate is dependent on the type of soil, the local landscape, and weather conditions (Ritter 2018, USDA 2000).

Three types of water erosion can occur: sheet, rill, and gully. Sheet erosion is the most difficult to see as it is a uniform soil layer being removed from an area over the surface. Rill erosion starts as water flowing over the soil surface concentrates into small streams, creating channels of water flow. Gully erosion is when rill erosion is not kept under control and creates gullies (deeper and wider cuts) (Soil Science Society of America n.d.).

Erosion can be most severe where urbanization, development, recreational activities, logging, and agricultural practices take place. Extreme rainfall events, lack of vegetative cover, fragile soils, and steep slopes combine to accelerate erosion (Ritter 2018).

Expansive Soils

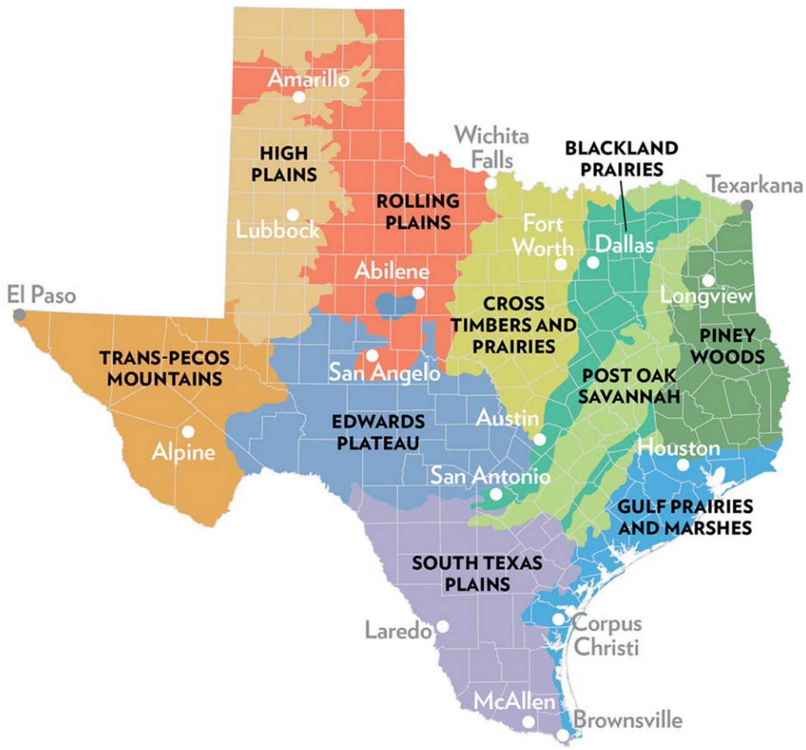
Expansive soils are soils that expand when water is added and shrink when they dry out. This continuous change in soil volume can cause structures to move unevenly and crack and roads and sidewalks to buckle. Soils with a high clay content exhibit high expansive properties. Slab-on-grade construction is the most susceptible to damage from expansive clays.

Location

Erosion

In the State of Texas, inland erosion is more prominent in the High Plains, Rolling Plains, and Coastal Sand Plains. Although Fort Bend County is located in the Gulf Coast Prairies & Marshes ecoregion, inland erosion is a more common hazard and a more significant concern than coastal erosion (Figure 4.3.5-1).

Figure 4.3.5-1. Ecoregions in the State of Texas



Source: Texas Highways 2020

Fort Bend County is located in three major water basins, including the San Jacinto-Brazos Coastal Basin, the Brazos River Basin, and the Brazos-Colorado River Basin. Erosion along the Brazos River has been an ongoing concern in Fort Bend County for years, with the County regularly participating in the Brazos River Authority's Lower Brazos Floodplain Protection Planning Study.

A measure of soil erodibility is the K-factor, which represents both susceptibility of soil to erosion and the rate of runoff. Soils high in clay have low K values, about 0.05 to 0.15, because they are resistant to detachment. Coarse textured soils, such as sandy soils, have low K values, about 0.05 to 0.2, because of low runoff even though these soils are easily detached. Medium textured soils, such as the silt loam soils, have a moderate K values, about 0.25 to 0.4, because they are moderately susceptible to detachment and they produce moderate runoff. Soils having a high silt content are most erodible of all soils and have K values greater than 0.4. They are easily detached, tend to crust, and produce high rates of runoff (Michigan State University 2002).

For this HMP, the inland erosion hazard area includes areas with K values of 0.49 or higher. Much of Fort Bend County lies within the inland erosion hazard area. Figure 4.3.5-2 below shows the inland erosion hazard within the County, shown in purple. To view the inland erosion hazard area for individual jurisdictions, refer to Section 9, Jurisdictional Annexes.

Expansive Soils

Most of Fort Bend County lies within the expansive soils hazard area. As seen in Figure 4.3.5-3 below, areas with swelling potential are located throughout the County. These areas have a higher potential for expansive soil incidents; however, based on history of occurrence, probability of occurrence is rare for the entire planning area. To view the expansive soils hazard area for individual jurisdictions, refer to Section 9, Jurisdictional Annexes. Fort Bend County is located within the Gulf Coast Prairie region of Texas and is composed of mainly Lake Charles-Bernard-Edna soils. Lake Charles soils are well-developed, clayey soils with high shrink-swell properties, while the Bernard and Edna soils have loamy surface textures and loamy and clayey subsoil horizons; these soil types differ primarily on drainage class and mineralogy (NRCS 2008).

Damage to buildings and critical infrastructure due to expansive soils can occur throughout Fort Bend County. The hazard is most prevalent in areas with clay or sandy soil which are prone to expanding and contracting in periods of heavy precipitation followed by periods of drought.

While all infrastructures in the higher-risk areas are vulnerable, slab-on-grade structures are most likely to suffer damages from expansive soils. In addition, older structures built to less stringent building codes may be more susceptible to damages than new construction. Bridges, highways, streets, and parking lots are especially vulnerable if they are constructed when clays are dry, such as during a drought, and then subsequent soaking rains swell the clay (Texas Division of Emergency Management 2018, State of Texas Hazard Mitigation Plan 2018, State of Texas Hazard Mitigation Plan 2018).

Figure 4.3.5-2. Location of the Inland Erosion Hazard Area in Fort Bend County

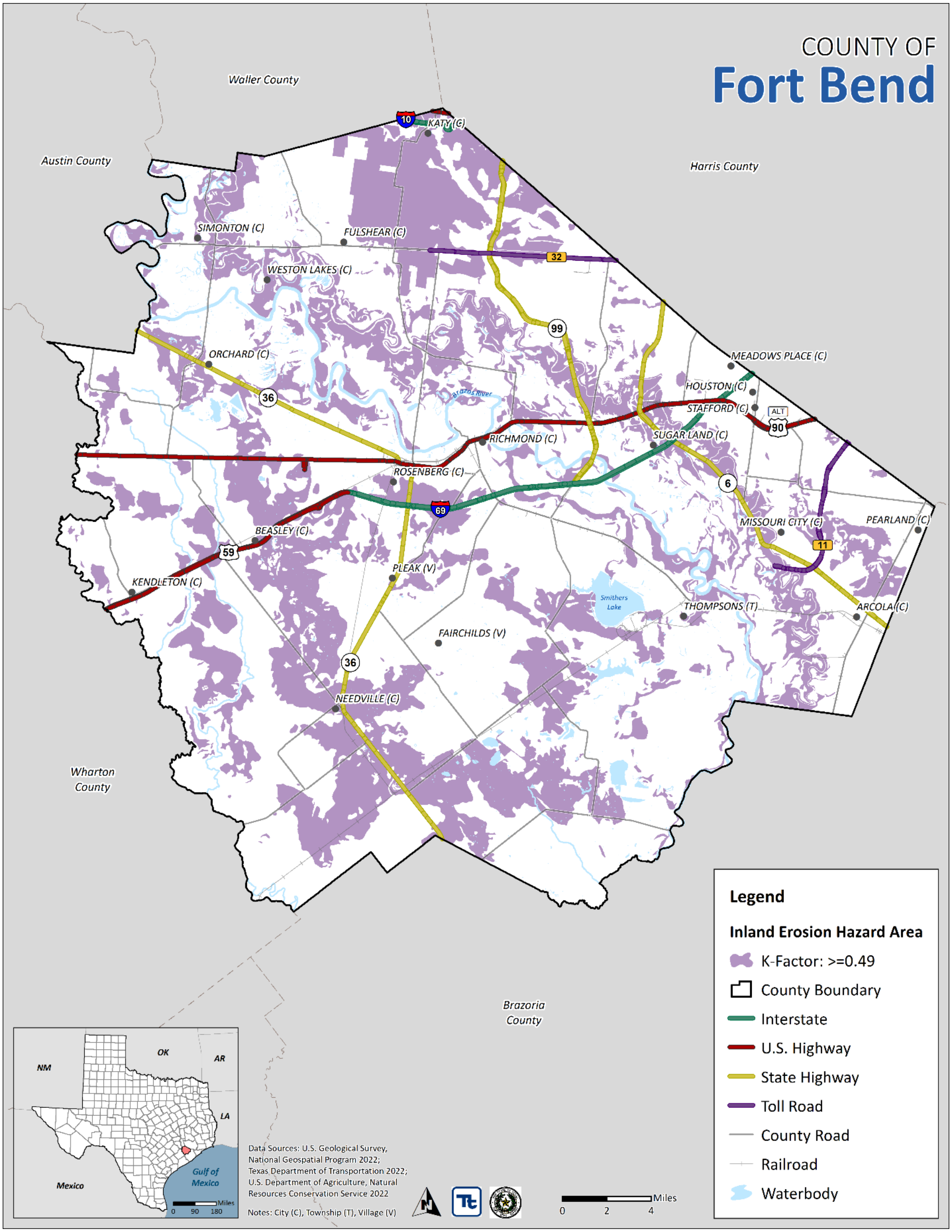
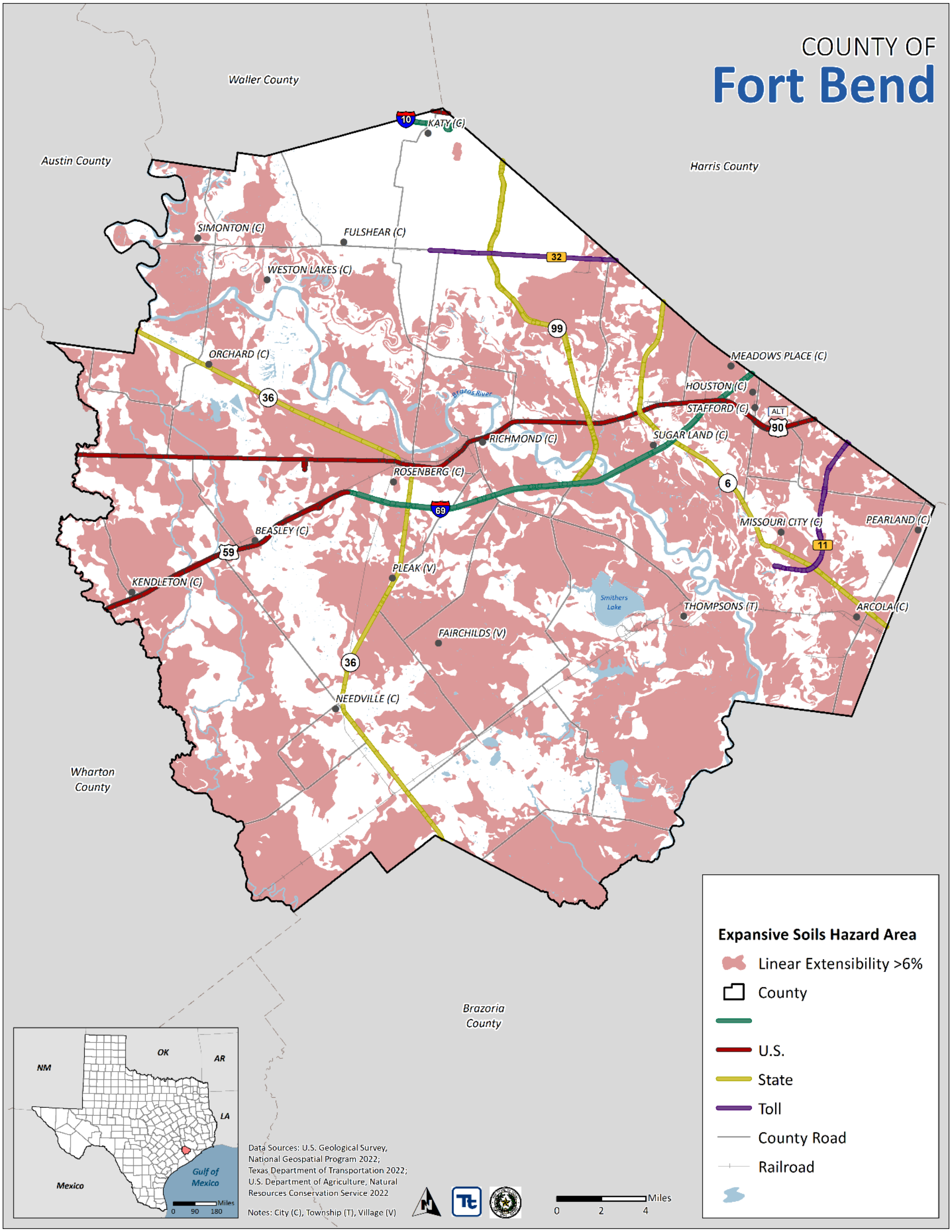


Figure 4.3.5-3. Location of the Expansive Soils Hazard Area in Fort Bend County



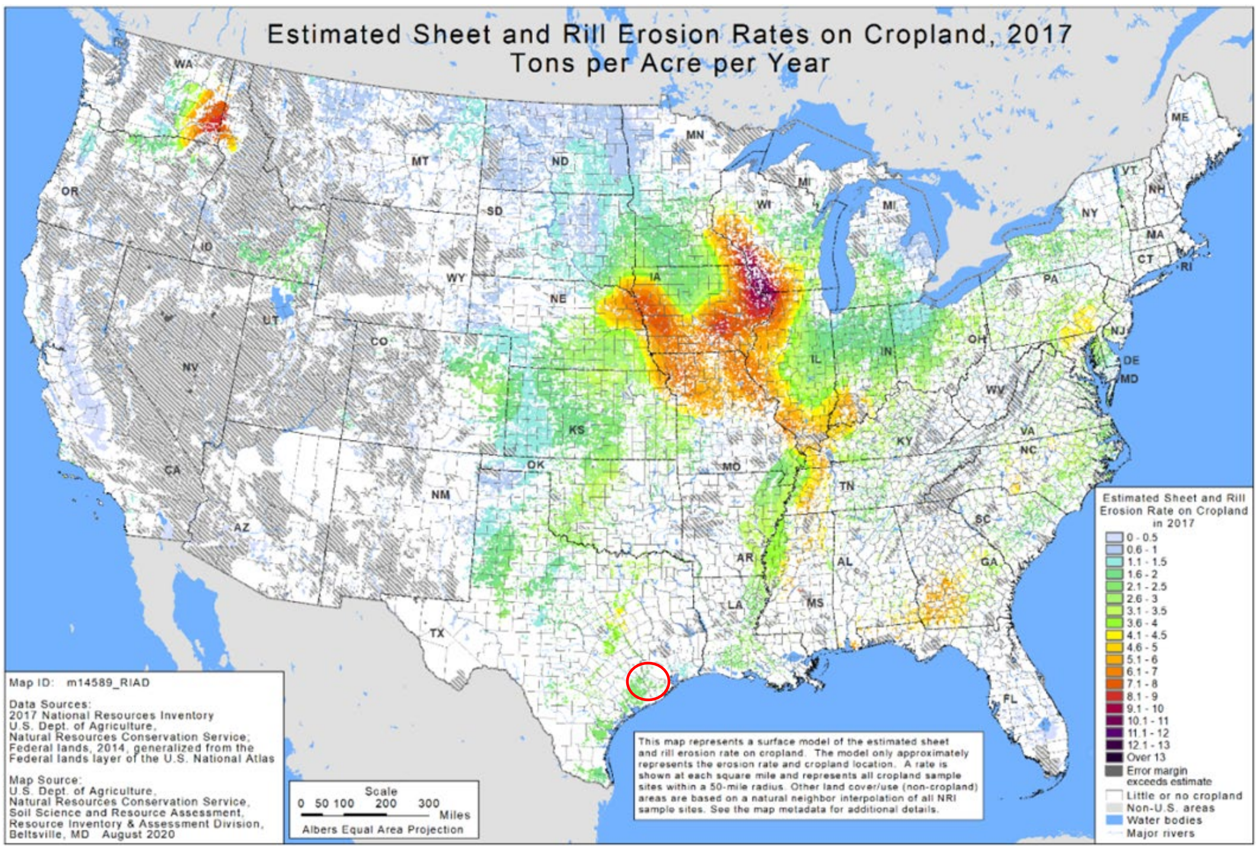
Extent

Erosion

It is difficult to directly measure erosion and the risk of erosion. There are other properties, however, that can be used to measure erosion: soil surface stability, aggregate stability, infiltration, compaction, and content of organic matter. Measuring these properties can help with understanding the susceptibility of erosion at a specific location. Comparing visual observations along with quantitative measurements can help provide information about soil surface stability, sedimentation, and soil loss (USDA 2001).

Figure 4.3.5-4 illustrates the location and rate of sheet and rill (water) erosion on croplands across the United States. According to this figure, the rates of erosion on croplands due to sheet and rill (water) in Fort Bend County ranged from 2.1 to 2.5 tons per acre each year.

Figure 4.3.5-4. Estimated Sheet and Rill Erosion Rates (Tons per Acre per Year) on Cropland, 2017



Source: *USDA 2020*

Note: *The red circle represents the approximate location of Fort Bend County.*

Expansive Soils

The extent to which soil expansion is present in an area or site can be measured using the Soil Expansion Potential standard (ASTM D-4829). The expansion index (EI) provides an indication of swelling potential of a compacted soil. The EI test is not used to duplicate any particular field conditions such as soil density, water content, loading, in-place soil structure, or soil water chemistry. Based on the expansion potential rating, mitigation may be required for building construction or repairs. The Uniform Building Code (UBC) mandates that special foundation design consideration be employed if the EI is 20 or greater (ASTM 2021).

Table 4.3.5-1. Soil Expansion Index

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High

Source: ASTM 2021

Worst-Case Scenario

Erosion

Any storm that produces significant amounts of rain in a short period of time could lead to a worst-case scenario for an erosion incident along the riverbanks of Fort Bend County. Rainfall events can create flood stages and high flow rates, which cause water to move at higher speeds through the County, leading to erosion along the banks of rivers and tributaries. Impacts from such events include road closures, damage to infrastructure and buildings, and inaccessible areas that can disrupt emergency response.

Expansive Soils

A season of flooding with rapid drying conditions, such as in a drought, would present a worst-case scenario for the expansive soils hazard. Underground utility pipes, foundations, roadways, and sidewalks would be vulnerable to cracking or buckling, causing damage to the built environment.

Previous Occurrences and Losses

FEMA Disaster Declarations

Between 1954 and 2022, Fort Bend County was not included in any disaster (DR) or emergency (EM) declarations for geologic hazard-related events. Generally, these disasters cover a wide region of the state; therefore, they can impact many counties. However, not all counties were included in the disaster declarations as determined by FEMA (FEMA 2022). Detailed information about the declared disasters since 1954 is provided in Section 3 (County Profile).

U.S. Department of Agriculture Disaster Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2017 and 2022, Fort Bend County was not included in any geologic hazard-related agricultural disaster declarations.

Previous Events

For this plan update, there was limited information regarding inland erosion in Fort Bend County. Statistical data for individual erosion events is not readily available.

Probability of Future Occurrences

It is anticipated that geologic hazards will continue to occur in Fort Bend County. As the frequency of storms and drought occur due to climate change, the probability for future events will likely increase as well. In Section 4.4, the identified hazards of concern for Fort Bend County were ranked (Table 4.4-2). The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for geologic hazards in the County is considered “rare”.

Climate Change Projections

The climate of Texas is changing. Most of the state has warmed between .5°F and 1°F in the past century. In the eastern two-thirds of the state, rainstorms are more intense, and floods are becoming more severe. In the coming decades, storms are likely to become more severe in Texas (EPA 2016). Periods of extreme precipitation increase the risk of flood (Centers for Climate and Energy Solutions n.d.). High frequency flood events (e.g., 10-year floods) in particular will likely increase with a changing climate. Scientists project greater storm intensity, resulting in more direct runoff and flooding. This is likely to result in higher rates of erosion and more frequent erosion events.

Climate change is likely to have significant impacts on the performance of buildings constructed on expansive soils. Precipitation and temperature are the primary weather parameters used for determining ground movement (Sun, Li and Zhou 2017).

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the erosion hazard, all of Fort Bend County has been identified as the hazard area. Therefore, all assets in the County (population, structures, critical facilities, and lifelines), as described in the County Profile (Section 3), are vulnerable to geologic hazards.

Impact on Life, Health, and Safety

A geologic hazard would likely be associated with another hazard, such as flooding, drought, or a hurricane; the conditions felt from these events would impact the populations within the immediate area of the incident. In addition to causing damages to residential buildings and potentially displacing residents, geologic hazards can block off or damage major roadways and inhibit travel for emergency responders or populations trying to evacuate the area.

To estimate population exposure to the inland erosion hazard area, information from the United States Department of Agriculture and the United States Census Bureau was used. Based on the analysis, there are an estimated 228,162 residents living in the hazard area, or 28 percent of the County’s total population. The Unincorporated Areas of Fort Bend have the greatest number of residents living in the hazard area with approximately 333,360 residents, followed by the City of Pearland (122,609). Table 4.3.5-2 summarizes the population exposed to the inland erosion hazard by jurisdiction.

Table 4.3.5-2. Estimated Number of Persons in Fort Bend County Living in the Inland Erosion Hazard Area

Jurisdiction	Total Population (American Community Survey 2021)	Estimated Population Located in the Inland Erosion (K-Factor: >= 0.49) Hazard Area	
		Number of Persons	Percent of Total
Arcola (C)	2,593	22	0.9%
Beasley (C)	957	87	9.1%
Fairchilds (V)	755	0	0.0%
Fulshear (C)	17,259	12,940	75.0%
Houston (C)	41,279	2,966	7.2%
Katy (C)	21,926	21,061	96.1%
Kendleton (C)	341	3	1.0%
Meadows Place (C)	4,755	0	0.0%
Missouri City (C)	73,682	16,542	22.5%
Needville (C)	3,059	2,270	74.2%
Orchard (C)	219	21	9.8%
Pearland (C)	122,609	0	0.0%
Pleak (V)	1,756	623	35.5%
Richmond (C)	11,768	44	0.4%
Rosenberg (C)	37,871	7,806	20.6%
Simonton (C)	838	279	33.3%
Stafford (C)	17,170	0	0.0%
Sugarland (C)	110,272	31,716	28.8%
Thompsons (T)	265	143	53.8%
Weston Lakes (C)	3,763	2,579	68.5%
Unincorporated Area	333,360	129,058	38.7%
Fort Bend County (Total)	**806,497**	**228,162**	**28.3%**

Source: U.S. Census Bureau 2021; U.S. Department of Agriculture, Natural Resources Conservation Service 2022

To estimate population exposure to the expansive soils hazard area, information from the United States Department of Agriculture and the United States Census Bureau was used. Based on the analysis, there are an estimated 462,717 residents living in the hazard area, or 57 percent of the County's total population. The Unincorporated Areas of Fort Bend have the greatest number of residents living in the hazard area with approximately 148,560 residents, followed by the City of Pearland (92,013). Table 4.3.5-2 summarizes the population exposed to the expansive soils hazard by jurisdiction.

Table 4.3.5-3. Estimated Number of Persons in Fort Bend County Living in the Expansive Soils Hazard Area

Jurisdiction	Total Population (American Community Survey 2021)	Estimated Population Located in the Expansive Soils (Linear Extensibility >6%) Hazard Area	
		Number of Persons	Percent of Total
Arcola (C)	2,593	2,338	90.2%
Beasley (C)	957	795	83.1%
Fairchilds (V)	755	755	100.0%
Fulshear (C)	17,259	1,322	7.7%
Houston (C)	41,279	32,078	77.7%
Katy (C)	21,926	0	0.0%
Kendleton (C)	341	235	69.0%
Meadows Place (C)	4,755	4,703	98.9%
Missouri City (C)	73,682	47,509	64.5%
Needville (C)	3,059	582	19.0%
Orchard (C)	219	57	26.2%
Pearland (C)	122,609	92,013	75.0%
Pleak (V)	1,756	974	55.4%
Richmond (C)	11,768	9,795	83.2%
Rosenberg (C)	37,871	25,523	67.4%
Simonton (C)	838	559	66.7%
Stafford (C)	17,170	15,570	90.7%
Sugarland (C)	110,272	78,061	70.8%
Thompsons (T)	265	120	45.3%
Weston Lakes (C)	3,763	1,170	31.1%
Unincorporated Area	333,360	148,560	44.6%
Fort Bend County (Total)	**806,497**	**462,717**	**57.4%**

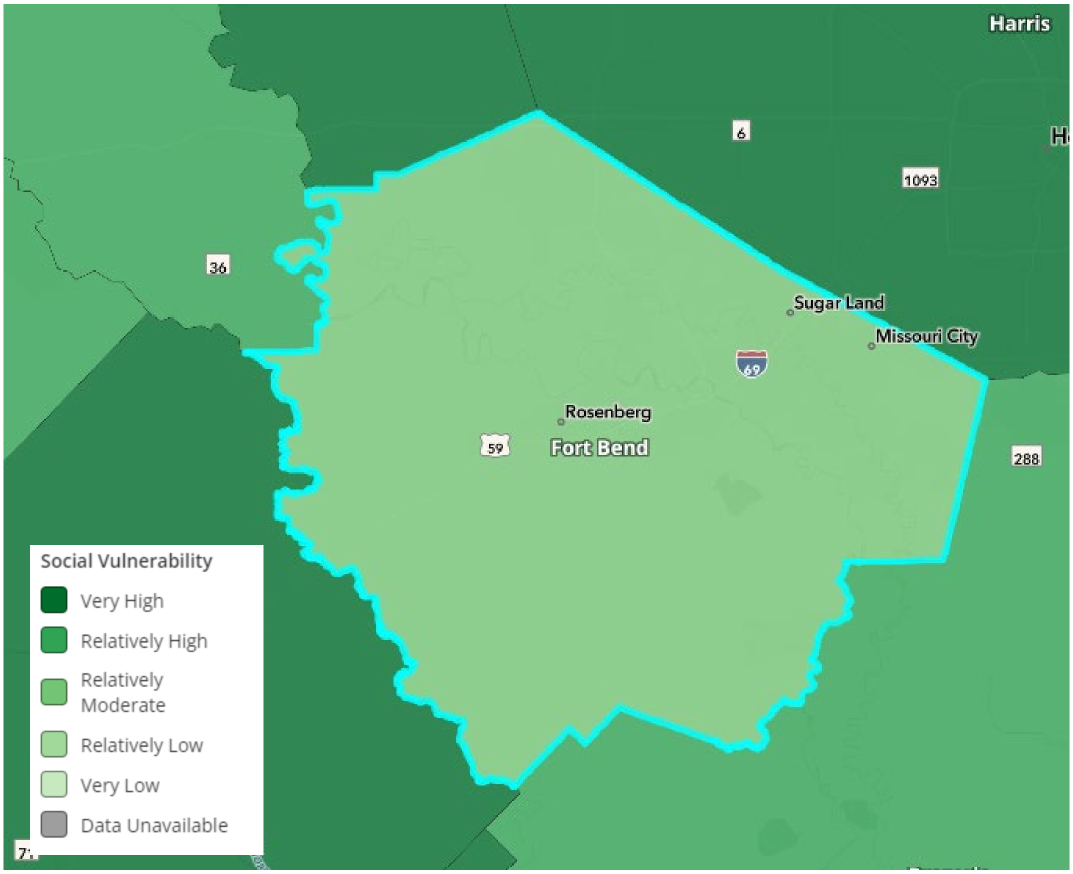
Source: U.S. Census Bureau 2021; U.S. Department of Agriculture, Natural Resources Conservation Service 2022

Socially Vulnerable Populations

Social vulnerability is defined as the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. Social vulnerability considers the social, economic, demographic, and housing characteristics of a community that influence its ability to prepare for, respond to, cope with, recover from, and adapt to environmental hazards.

Geologic hazards threaten socially vulnerable populations who may live in other hazard areas. As previously mentioned, geologic hazards, such as erosion, occurs primarily when dirt is left exposed to strong winds, hard rains, and flowing water. Populations in the floodplain of Fort Bend County are subject to higher rates of erosion from the hurricane and flood hazards. The heavy rain associated with these events transports soil out of the ocean and/or riverbed and inland; in some cases, the soil which a structure is on may be transported, causing the structure to collapse. Inland populations may face more wind erosion; in extreme cases, wind erosion can become a dust storm, which could increase in frequency as temperatures continue to rise and times of drought increase (NRDC 2021). The combination of dry, arid conditions followed by heavy rainfall, which saturates the soil, causes the expansion of soils. Nearly the entirety of Fort Bend County is vulnerable to the expansive soil hazard, including socially vulnerable populations. Refer to the figure below for the social vulnerability index for natural hazards.

Figure 4.3.5-5. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA NRI

Impact on General Building Stock

The erosion hazard has the potential to destabilize the foundation of structures, which may result in monetary losses to businesses and residents. These events can expose the underlying bedrock adjacent to structures, which can erode and threaten the structural integrity and safety of the structure above.

Table 4.3.5-4 summarizes the number of structures located in the erosion hazard area by jurisdiction. In summary, there are 94,987 buildings located in the hazard area, with an estimated $73 billion of replacement cost value (i.e., building and content replacement costs). In total, this represents approximately 33 percent of the County's total general building stock inventory.

Table 4.3.5-4. Estimated General Building Stock Located in the Inland Erosion Hazard Area

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Number and Total Replacement Cost Value of Structures Located in the Inland Erosion (K-Factor: >= 0.49) Hazard Area			
			Number of Buildings	Percent of Total	Total Replacement Cost Value of Buildings	Percent of Total
Arcola (C)	676	$1,374,107,673	5	0.7%	$1,917,616	0.1%
Beasley (C)	367	$467,087,536	37	10.1%	$116,406,289	24.9%
Fairchilds (V)	190	$58,400,161	0	0.0%	$0	0.0%
Fulshear (C)	7,869	$6,124,915,172	5,854	74.4%	$4,425,178,070	72.2%

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Number and Total Replacement Cost Value of Structures Located in the Inland Erosion (K-Factor: >= 0.49) Hazard Area			
			Number of Buildings	Percent of Total	Total Replacement Cost Value of Buildings	Percent of Total
Houston (C)	11,589	$5,814,576,859	843	7.3%	$618,284,118	10.6%
Katy (C)	2,206	$4,980,024,025	2,105	95.4%	$4,573,298,559	91.8%
Kendleton (C)	329	$241,970,568	3	0.9%	$802,101	0.3%
Meadows Place (C)	1,676	$1,270,821,734	0	0.0%	$0	0.0%
Missouri City (C)	27,170	$23,213,328,025	6,232	22.9%	$7,065,601,763	30.4%
Needville (C)	1,346	$1,362,324,702	1,025	76.2%	$1,160,149,511	85.2%
Orchard (C)	180	$170,795,761	18	10.0%	$30,595,278	17.9%
Pearland (C)	2,171	$1,063,851,539	0	0.0%	$0	0.0%
Pleak (V)	436	$672,927,271	149	34.2%	$193,692,484	28.8%
Richmond (C)	3,296	$4,128,822,403	32	1.0%	$420,331,439	10.2%
Rosenberg (C)	11,894	$22,921,973,230	2,426	20.4%	$3,152,534,225	13.8%
Simonton (C)	395	$372,092,732	148	37.5%	$233,135,597	62.7%
Stafford (C)	4,222	$10,638,345,589	1	0.0%	$15,739,005	0.1%
Sugarland (C)	37,506	$36,732,455,899	10,862	29.0%	$10,762,097,536	29.3%
Thompsons (T)	143	$404,590,514	86	60.1%	$310,211,305	76.7%
Weston Lakes (C)	1,589	$1,145,826,270	1,090	68.6%	$800,005,792	69.8%
Unincorporated Area	166,035	$103,633,654,804	64,071	38.6%	$39,360,030,238	38.0%
Fort Bend County (Total)	**281,285**	**$226,792,892,466**	**94,987**	**33.8%**	**$73,240,010,927**	**32.3%**

Source: Fort Bend County 2016, 2022; RS Means 2022; U.S. Department of Agriculture, Natural Resources Conservation Service 2022

Table 4.3.5-5 summarizes the number of structures located in the expansive soils hazard area by jurisdiction. In summary, there are 148,120 buildings located in the hazard area, with an estimated $125 billion in replacement cost value (i.e., building and content replacement costs). In total, this represents approximately 53 percent of the County's total general building stock inventory.

Table 4.3.5-5. Estimated General Building Stock Located in the Expansive Soils Hazard Area

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Number and Total Replacement Cost Value of Structures Located in the Expansive Soils (Linear Extensibility >6%) Hazard Area			
			Number of Buildings	Percent of Total	Total Replacement Cost Value of Buildings	Percent of Total
Arcola (C)	676	$1,374,107,673	615	91.0%	$1,353,953,941	98.5%
Beasley (C)	367	$467,087,536	302	82.3%	$342,428,037	73.3%
Fairchilds (V)	190	$58,400,161	190	100.0%	$58,400,161	100.0%
Fulshear (C)	7,869	$6,124,915,172	593	7.5%	$273,681,675	4.5%
Houston (C)	11,589	$5,814,576,859	9,004	77.7%	$4,452,834,950	76.6%
Katy (C)	2,206	$4,980,024,025	0	0.0%	$0	0.0%
Kendleton (C)	329	$241,970,568	227	69.0%	$189,452,177	78.3%
Meadows Place (C)	1,676	$1,270,821,734	1,650	98.4%	$985,874,377	77.6%
Missouri City (C)	27,170	$23,213,328,025	17,442	64.2%	$14,205,389,317	61.2%
Needville (C)	1,346	$1,362,324,702	234	17.4%	$148,362,088	10.9%
Orchard (C)	180	$170,795,761	46	25.6%	$39,348,457	23.0%
Pearland (C)	2,171	$1,063,851,539	1,629	75.0%	$811,904,923	76.3%
Pleak (V)	436	$672,927,271	244	56.0%	$387,984,065	57.7%

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Number and Total Replacement Cost Value of Structures Located in the Expansive Soils (Linear Extensibility >6%) Hazard Area			
			Number of Buildings	Percent of Total	Total Replacement Cost Value of Buildings	Percent of Total
Richmond (C)	3,296	$4,128,822,403	2,602	78.9%	$2,188,170,998	53.0%
Rosenberg (C)	11,894	$22,921,973,230	8,094	68.1%	$17,697,117,553	77.2%
Simonton (C)	395	$372,092,732	247	62.5%	$138,957,135	37.3%
Stafford (C)	4,222	$10,638,345,589	3,751	88.8%	$8,486,948,055	79.8%
Sugarland (C)	37,506	$36,732,455,899	26,457	70.5%	$25,404,128,002	69.2%
Thompsons (T)	143	$404,590,514	55	38.5%	$68,360,081	16.9%
Weston Lakes (C)	1,589	$1,145,826,270	493	31.0%	$341,910,070	29.8%
Unincorporated Area	166,035	$103,633,654,804	74,245	44.7%	$47,521,558,886	45.9%
Fort Bend County (Total)	**281,285**	**$226,792,892,466**	**148,120**	**52.7%**	**$125,096,764,947**	**55.2%**

Source: Fort Bend County 2016, 2022; RS Means 2022; U.S. Department of Agriculture, Natural Resources Conservation Service 2022

Impact on Critical Facilities

Critical facility exposure to the erosion hazard was examined. Table 4.3.5-6 lists the critical facilities and number of lifelines within the inland erosion hazard area. Of the 1,009 critical facilities located in the hazard area, the greatest number are food, water, and shelter facilities. A majority of the critical facilities located in the inland erosion hazard area are in the Unincorporated Areas of Fort Bend County (548), followed by the City of Sugarland (202), shown in Table 4.3.5-7.

Table 4.3.5-6. Critical Facilities and Lifelines Located in the Inland Erosion Hazard Area

FEMA Lifeline Category	Number of Lifelines	Number of Lifelines Located in the Inland Erosion (K-Factor: >= 0.49) Hazard Area
Communications	44	13
Energy	584	190
Food, Water, Shelter	1,480	449
Hazardous Material	13	1
Health and Medical	335	126
Safety and Security	282	86
Transportation	660	144
Fort Bend County (Total)	**3,398**	**1,009**

Source: Fort Bend County 2022; U.S. Department of Agriculture, Natural Resources Conservation Service 2022

Table 4.3.5-7. Critical Facilities and Lifeline Facilities Located in the Inland Erosion Hazard Area by Jurisdiction

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Located in the Inland Erosion (K-Factor: >= 0.49) Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Arcola (C)	22	21	1	4.5%	1	4.8%
Beasley (C)	18	14	5	27.8%	5	35.7%
Fairchilds (V)	3	3	0	0.0%	0	0.0%
Fulshear (C)	43	40	13	30.2%	12	30.0%
Houston (C)	105	84	10	9.5%	10	11.9%
Katy (C)	53	51	35	66.0%	33	64.7%
Kendleton (C)	21	19	1	4.8%	1	5.3%
Meadows Place (C)	17	16	0	0.0%	0	0.0%
Missouri City (C)	339	297	117	34.5%	103	34.7%
Needville (C)	42	33	39	92.9%	31	93.9%
Orchard (C)	7	7	0	0.0%	0	0.0%
Pearland (C)	1	1	0	0.0%	0	0.0%
Pleak (V)	15	15	1	6.7%	1	6.7%
Richmond (C)	123	103	8	6.5%	8	7.8%
Rosenberg (C)	340	295	94	27.6%	91	30.8%
Simonton (C)	17	17	9	52.9%	9	52.9%
Stafford (C)	164	137	0	0.0%	0	0.0%
Sugarland (C)	631	575	202	32.0%	187	32.5%
Thompsons (T)	10	9	4	40.0%	4	44.4%
Weston Lakes (C)	7	7	2	28.6%	2	28.6%
Unincorporated Fort Bend County	1,756	1,654	548	31.2%	511	30.9%
Fort Bend County (Total)	**3,734**	**3,398**	**1,089**	**29.2%**	**1,009**	**29.7%**

Source: Fort Bend County 2022; U.S. Department of Agriculture, Natural Resources Conservation Service 2022

Critical facility exposure to the expansive soils hazard was examined. Table 4.3.5-8 lists the number of lifelines within the inland erosion hazard area. Of the 1,847 critical facilities located in the hazard area, the greatest number are food, water, and shelter facilities. A majority of the critical facilities located in the inland erosion hazard area are in the Unincorporated Areas of Fort Bend County (865), followed by the City of Sugarland (401), shown in Table 4.3.5-9.

Table 4.3.5-8. Lifelines Located in the Expansive Soils Hazard Area

FEMA Lifeline Category	Number of Lifelines	Number of Lifelines Located in the Expansive Soils (Linear Extensibility >6%) Hazard Area
Communications	44	29
Energy	584	319
Food, Water, Shelter	1,480	801
Hazardous Material	13	9
Health and Medical	335	168
Safety and Security	282	147
Transportation	660	374

FEMA Lifeline Category	Number of Lifelines	Number of Lifelines Located in the Expansive Soils (Linear Extensibility >6%) Hazard Area
Fort Bend County (Total)	**3,398**	**1,847**

Source: Fort Bend County 2022; U.S. Department of Agriculture, Natural Resources Conservation Service 2022

Table 4.3.5-9. Critical Facilities and Lifeline Facilities Located in the Expansive Soils Hazard Area by Jurisdiction

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Located in the Expansive Soils (Linear Extensibility >6%) Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Arcola (C)	22	21	21	95.5%	20	95.2%
Beasley (C)	18	14	12	66.7%	8	57.1%
Fairchilds (V)	3	3	3	100.0%	3	100.0%
Fulshear (C)	43	40	3	7.0%	3	7.5%
Houston (C)	105	84	75	71.4%	57	67.9%
Katy (C)	53	51	0	0.0%	0	0.0%
Kendleton (C)	21	19	14	66.7%	12	63.2%
Meadows Place (C)	17	16	17	100.0%	16	100.0%
Missouri City (C)	339	297	181	53.4%	154	51.9%
Needville (C)	42	33	2	4.8%	2	6.1%
Orchard (C)	7	7	2	28.6%	2	28.6%
Pearland (C)	1	1	1	100.0%	1	100.0%
Pleak (V)	15	15	14	93.3%	14	93.3%
Richmond (C)	123	103	72	58.5%	63	61.2%
Rosenberg (C)	340	295	225	66.2%	186	63.1%
Simonton (C)	17	17	8	47.1%	8	47.1%
Stafford (C)	164	137	125	76.2%	106	77.4%
Sugarland (C)	631	575	401	63.5%	360	62.6%
Thompsons (T)	10	9	6	60.0%	5	55.6%
Weston Lakes (C)	7	7	5	71.4%	5	71.4%
Unincorporated Fort Bend County	1,756	1,654	865	49.3%	822	49.7%
Fort Bend County (Total)	**3,734**	**3,398**	**2,052**	**55.0%**	**1,847**	**54.4%**

Source: Fort Bend County 2022; U.S. Department of Agriculture, Natural Resources Conservation Service 2022

In addition to critical facilities, a significant amount of infrastructure can be exposed to geologic hazards:

- **Roads** – Access to major roads is crucial to life-safety after a disaster event and to response and recovery operations. Egress and ingress can be blocked on roads, causing isolation for neighborhoods, traffic problems, and delays for public and private transportation. This can result in economic losses for businesses.
- **Bridges** – Geologic hazards can significantly impact road bridges. Movements can knock out bridge abutments or significantly weaken the soil supporting them, making them hazardous for use.
- **Power Lines** – While power lines are generally elevated, the towers supporting them can be subject to geologic hazards. Soil underneath a tower could become unstable, causing it to collapse and ripping down the lines. Power and communication failures due to erosion can create problems for vulnerable populations and businesses.
- **Rail Lines** – Similar to roads, rail lines are important for response and recovery operations after a disaster. Geologic hazards can block travel along the rail lines, which would become especially troublesome because it would not be as easy to detour a rail line as it is on a local road or highway.

Several other types of infrastructure may also be exposed to geologic hazards, including water and sewer infrastructure. In some cases, water infrastructure may even be the cause of a hazard's formation due to the lines leaking.

Impact on Economy

The impact of geologic hazards on the economy and estimated dollar losses is difficult to measure. As stated earlier, these hazards can impose direct and indirect impacts on society. Direct costs include the actual damage sustained by buildings, property, and infrastructure. Indirect costs, such as clean-up costs, business interruption, loss of tax revenues, reduced property values, and loss of productivity are difficult to measure. Additionally, geologic hazards threaten transportation corridors, fuel and energy conduits, and communication lines (USGS 2000).

Direct building losses are the estimated costs to repair or replace the damage caused to the building. Geologic hazards can cause several types of secondary effects, such as blocking access to roads, which can isolate residents and businesses and delay commercial, public, and private transportation.

Impact on Environment

Geologic hazards can potentially alter rivers or streams, potentially harming water quality, fisheries, and spawning habitat; they can also create new depressions that can fill with water, creating new aquatic habitat. Table 4.3.5-10 lists the number of acres exposed to the inland erosion hazard area; Table 4.3.5-11 lists the number of acres exposed to the expansive soils hazard area.

Table 4.3.5-10. Land Acreage in Fort Bend County Located in the Inland Erosion Hazard Areas

Jurisdiction	Total Acres of Land Area	Total Acres of Land Area (Excluding Waterbodies) Located in the Inland Erosion (K-Factor: >= 0.49) Hazard Area	Percent of Total
Arcola (C)	1,664	15	0.9%
Beasley (C)	673	229	34.1%
Fairchilds (V)	831	0	0.0%
Fulshear (C)	7,962	3,743	47.0%
Houston (C)	7,440	745	10.0%
Katy (C)	2,843	2,348	82.6%
Kendleton (C)	850	24	2.8%
Meadows Place (C)	586	0	0.0%
Missouri City (C)	20,841	5,228	25.1%
Needville (C)	1,264	1,024	81.0%
Orchard (C)	250	26	10.3%
Pearland (C)	839	0	0.0%
Pleak (V)	1,193	354	29.7%
Richmond (C)	2,752	255	9.3%
Rosenberg (C)	23,442	6,845	29.2%
Simonton (C)	1,487	800	53.8%
Stafford (C)	4,467	3	0.1%
Sugarland (C)	27,073	7,294	26.9%
Thompsons (T)	995	391	39.3%
Weston Lakes (C)	1,623	1,031	63.5%
Unincorporated Area	449,862	136,055	30.2%
Fort Bend County (Total)	**558,937**	**166,410**	**29.8%**

Source: Fort Bend County 2022; U.S. Department of Agriculture, Natural Resources Conservation Service 2022

Table 4.3.5-11. Land Acreage in Fort Bend County Located in the Expansive Soils Hazard Areas

Jurisdiction	Total Acres of Land Area	Total Acres of Land Area (Excluding Waterbodies) Located in the Expansive Soils (Linear Extensibility >6%) Hazard Area	Percent of Total
Arcola (C)	1,664	1,493	89.7%
Beasley (C)	673	408	60.6%
Fairchilds (V)	831	831	100.0%
Fulshear (C)	7,962	1,363	17.1%
Houston (C)	7,440	4,498	60.5%
Katy (C)	2,843	6	0.2%
Kendleton (C)	850	704	82.9%
Meadows Place (C)	586	554	94.6%
Missouri City (C)	20,841	12,438	59.7%
Needville (C)	1,264	190	15.0%
Orchard (C)	250	77	30.9%
Pearland (C)	839	618	73.7%
Pleak (V)	1,193	722	60.5%
Richmond (C)	2,752	1,758	63.9%
Rosenberg (C)	23,442	14,267	60.9%
Simonton (C)	1,487	686	46.1%
Stafford (C)	4,467	3,633	81.3%
Sugarland (C)	27,073	16,996	62.8%
Thompsons (T)	995	594	59.7%
Weston Lakes (C)	1,623	555	34.2%
Unincorporated Area	449,862	246,608	54.8%
Fort Bend County (Total)	**558,937**	**308,998**	**55.3%**

Source: Fort Bend County 2022; U.S. Department of Agriculture, Natural Resources Conservation Service 2022

Future Changes That May Impact Vulnerability

Understanding future changes that affect vulnerability in Fort Bend County can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. The County considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Projected Development

As discussed and illustrated in Section 3 (County Profile), areas targeted for future growth and development have been identified across the County. New development that has occurred in the last five years within the County and potential future development in the next five years as identified by the County and each municipality is included in the jurisdictional annexes in Section 9, along with an indication of proximity to known hazard zones. Refer to Section 3, and Volume II Section 9 for more information about the potential new development in Fort Bend County.

Projected Changes in Population

According to the U.S. Census Bureau, the population of the County has increased by approximately 40.4 percent since 2010. Increased population trends will change the County's overall risk to geologic hazards. Refer to Section 3 (County Profile), which includes a discussion on population trends for the County.

Climate Change

The climate of Texas is changing. Most of the state has warmed between.5°F and 1°F in the past century. In the eastern two-thirds of the state, rainstorms are more intense, and floods are becoming more severe. In the coming decades, storms are likely to become more severe in Texas (EPA 2016). Periods of extreme precipitation increase the risk of flood (Centers for Climate and Energy Solutions n.d.). High frequency flood events (e.g., 10-year floods) in particular will likely increase with a changing climate. Scientists project greater storm intensity, resulting in more direct runoff and flooding. This is likely to result in higher rates of erosion and more frequent erosion events.

Climate change is likely to have significant impacts on the performance of buildings constructed on expansive soils. Precipitation and temperature are the primary weather parameters used for determining ground movement (Sun, Li and Zhou 2017).

Change in Vulnerability Since 2018 HMP

Fort Bend County continues to be vulnerable to geologic hazards. Updated population and building stock statistics were used in the current risk assessment. Further, exposure for both the population and critical facilities was analyzed. These updated datasets provide a more accurate exposure analysis to geologic hazards.