CHAPTER 3: AFFECTED ENVIRONMENT
TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 3
AFFECTED ENVIRONMENT

The proposed project (Grand Parkway Segments H and I-1) is located on the northeast side of the greater Houston metropolitan area from United States Highway (US) 59 North (N)/Interstate Highway (I) 69 to I-10 (E) generally between Farm-to-Market Road (FM) 2100 and State Highway (SH) 146 (**Exhibit 2-5**). The total distance of Segments H and I-1 is approximately 37 miles (mi). Segment H extends from US 59 (N)/I-69 (near Community Drive) to US 90. Segment I-1 continues south from US 90 to I-10 (E). Due to the similarities between Segment H and Segment I-1, it was agreed upon by the Federal Highway Administration (FHWA) and the Texas Department of Transportation (TxDOT) that these segments could be studied as one project for the purposes of evaluating environmental impacts. Segments H and I-1 collectively constitute the proposed project evaluated in this Final Environmental Impact Statement (FEIS).

The proposed project traverses through Montgomery, Harris, Liberty, and Chambers counties. Cities within the study area include Mont Belvieu, Dayton, Plum Grove, Patton Village, Roman Forest, and Woodbranch. The unincorporated community of New Caney is also located within the study area. The study area includes the northeastern portion of Lake Houston, Caney and Peach Creeks, the East Fork of the San Jacinto River, Luce Bayou, Cedar Bayou, and several drainage and irrigation canals.

3.1 LAND USE

The Segments H and I-1 study area is mostly in agricultural usage or is undeveloped (78 percent) with about 15 percent residential development, 1 percent industrial, 1 percent commercial development, and 5 percent other (**Table 3-1**). Most of the developed land is within and adjacent to the northern portion of the study area along US 59 (N)/I-69 and FM 1485 and along the southern portion in Mont Belvieu. The 4,990-acre (ac) Lake Houston Wilderness Park, operated by the City of Houston Parks and Recreation Department, is a major constraint within the study area. **Exhibit 3-1** outlines the boundaries of the study area used to examine land use. Refer to **Exhibit 2-6** for the location of parks and cities within the study area. Other land uses within the study area include the following:

- Dempsey Henley State Prison is located north of Dayton on the eastern edge of the study area.
- Two salt domes, the Esperson Dome northwest of Dayton and the Barbers Hill Dome near Mont Belvieu.
- Several oil fields are located throughout the study area, including in the area of Splendora, Dayton, and Mont Belvieu.

- There is one state Superfund site in the study area, the Cox Road Dump (also known as Liberty Waste Disposal Landfill), which is located 1 mi north of FM 1413 on the west side of County Road (CR) 491 (Cox Road) in Dayton (Liberty County).
- A number of primarily residential developments stretch between the east shore of Lake Houston and FM 2100. The largest of these is The Commons of Lake Houston, a large lot subdivision.
- Large expanses of agricultural land are located throughout the study area.

The bulk of the proposed project would be constructed in Liberty County. While a substantial portion of the county is devoted to agriculture, it is a part of the Houston metropolitan statistical area (MSA) and is experiencing the advancement of urban development outward from Harris County. Between 1997 and 2002, Liberty County experienced a reduction of 2,209 ac of farmland. During this five-year period, the number of farms actually increased, resulting in a reduction in the average size of farms from 270 ac in 1997 to 191 ac in 2002. More than 53 percent of the principal farm operators have a non-farming principal occupation and more than 44 percent of the principal farm operators worked more than 200 days out of the year off the farm.

Land use designations and geographic information system (GIS) data were obtained from the Houston-Galveston Area Council (H-GAC), as well as recent aerial photography (2009 & 2010), and field reconnaissance of the study area. Refer to **Exhibit 3-1** for the general land use types within the study area and **Appendix D** for photographs of the study area. The H-GAC land use designations described below are limited to commercial, residential, industrial, other, and open space (agricultural and undeveloped).

Commercial

The commercial category includes businesses, restaurants, retail centers, entertainment-oriented businesses, convenience stores, and other similar structures or uses.

Residential

The residential category includes single and multi-family dwellings including both permanent and non-fixed structures.

Industrial

The industrial category includes large refineries, warehouses, distribution centers, and oil and gas production facilities.

Other

The other category includes land devoted to recreational and outdoor leisure activities such as sports facilities, public parks, nature centers, etc.

Open Space (Agricultural and Undeveloped)

The open space category includes land with few or no permanent structures present, evidence of cultivated crops, rangeland, orchards, plant production, or timber production. This category includes land that would be considered undeveloped or agricultural.

Table 3-1: General Land Use Within the Study Area

Land Use	Acreage Within the Study Area	% of Study Area
Commercial	2,278	1
Industrial	1,203	1
Other	10,721	5
Residential	34,905	15
Open Space (Agricultural and Undeveloped)	175,734	78

Source: H-GAC, 2009 & 2010

Historical aerial photography and GIS data obtained from the H-GAC show that within the study area from 1970 to 2010, residential growth, as represented by households, has occurred primarily in unincorporated Harris County, Liberty County, and Montgomery County. Growth in Chambers County represented less than 1 percent of the metropolitan growth in households, while Liberty County accounted for 1.3 percent of the household growth during the 1970s, 1.0 percent in the 1980s and 1.6 percent during the 1990s.

3.1.1 Section 4(f) Properties

The Lake Houston Wilderness Park covers approximately 4,990 ac in the northwest portion of the study area, just south of FM 1485. Ownership was transferred from the Texas Parks and Wildlife Department (TPWD) to the City of Houston in 2006, and the park is now operated by the City of Houston Parks and Recreation Department. There are no other Section 4(f) resources located within the study area. In addition, there are no areas of unique scenic beauty or other lands of national, state, or local importance.

3.1.2 Existing Utilities

A visual survey and secondary source data review was performed to identify the major utilities within the study area. Based on the visual observation, the following utilities were observed in the study area: pipelines, cable, conduit, fiber, water lines, sanitary sewer lines, cell towers, water and sewer plants, refineries, metering stations, and overhead transmission lines. Pipelines were further researched based on recorded data provided by the Texas Railroad Commission. Refer to **Table 3-2** for a listing of the major pipeline companies with line diameter sizes ranging from 2.38 inch (in.) to 40 in. within the study area.

Table 3-2: Pipelines Within the Study Area

Owner/Operator	Diameter	Commodity Description
ExxonMobil Pipeline Company	6.63”	Propylene
Gulf Coast Pipeline, L.P.	8.63”	Crude Butadiene
Mobil Vanderbilt-Beaumont P/L Co.	4.50”	Natural Gas
Mobil Pipeline Company	8.63”	Refined Products
Duke Energy Field Services, L.P.	12.75”	Natural Gas Liquids
Citgo Products Pipeline Company	12.75”	Liquefied Petroleum Gas
Houston Pipeline Company L.P.	12.75”	Natural Gas
Sunoco Pipeline L.P.	6.63”	Crude Oil
Shell Pipeline Company L.P.	20.00”	Crude Oil
Kinder Morgan Tejas Pipeline, L.P.	2.38”	Natural Gas
Kinder Morgan Tejas Pipeline, L.P.	8.63”	Natural Gas
El Paso Field Services, L.P.	8.63”	Natural Gas
Natural Gas Pipeline Co. of Amer.	30.00”	Natural Gas
Black Hills Operating Co. LLC	10.75”	Crude Oil
Dynegy NGL Pipeline Company, LLC	12.75”	Natural Gas Liquids
Colonial Pipeline Company	40.00”	Gasoline/Fuel Oil/Kerosene
Explorer Pipeline Company	28.00”	Refined Petroleum Products
Valero Logistics Operations L.P.	8.63”	Propylene
Enterprise Products Operating L.P.	14.00”	Natural Gas Liquids
Koch Pipeline Company, L.P.	12.75”	Crude Oil
TE Products Pipeline Co. L.P.	10.75”	Liquefied Petroleum Gas
Exxon Corp.	2.38”	Crude Oil
Buckeye Gulf Coast Pipelines, L.P.	8.63”	Ethylene
Equistar Chemicals, L.P.	6.63”	Butane
Buckeye Gulf Coast Pipelines, L.P.	6.63”	Propylene
Mustang Pipeline Company	6.63”	Propylene
Trunkline Gas Company, LLC	24.00”	Natural Gas
Transcontinental Gas Pipeline Corp.	30.00”	Natural Gas
Chevron Pipeline Company	8.63”	Refined Products
BP Pipelines (North America), Inc.	4.50”	Empty
Dow Pipeline Company	8.63”	Liquefied Petroleum Gas
Phillips Pipeline Company	8.63”	EP Mix/Propane
Seadrift Pipeline Corporation	12.75”	Ethane
Texas Genco, L.P.	24.00”	Natural Gas
Teppco	12.75”	Crude Oil
Phoenix Hydrocarbons Operating	4.50”	Natural Gas

Source: RRC, 2012

3.2 COMMUNITY RESOURCES

3.2.1 Social and Economic Conditions

This section discusses the social and economic conditions within the study area, focusing on population, demographic, employment, and income characteristics. Socioeconomic information was collected from the United States (U.S.) Census Bureau *2010 Census* for census blocks (CB) and census block groups (BG) that comprise the study area. If *2010 Census* data was not available, either the *2007-2011 American Community Survey* (ACS) or the *2006-2010 ACS* data was used, depending on the availability of data. It should be noted that ACS data are estimates, not actual counts. The availability of census data for median household income and Limited English Proficiency (LEP) is limited to the BG level; therefore, only race/ethnicity data are presented at both the CB and BG level.

Municipal Characteristics

The following profiles describe the existing demographic make-up of the six municipalities located within the study area, as well as general business trends and current major planned development. The community of New Caney is not included in the following profiles because it is unincorporated. However, New Caney is discussed in the following sections and community impacts are described. The (limited) data described throughout this discussion represents the best available data for the study area.

City of Dayton

According to the U.S. Census Bureau's *2010 Census*, the City of Dayton has a total population of 7,242 and a median household income of $50,625. The city encompasses approximately 11.4 square miles (mi^2). The City of Dayton is located on the very eastern edge of the central portion of the study area. Located roughly midway between Houston and Beaumont, Dayton is located at the key intersection of four important highways including US 90, SH 146, SH 321, and FM 1960. The City of Dayton is also served by an extensive freight rail transportation system, with Union Pacific Rail Road (UPRR) and Burlington Northern/Santa Fe Railroad (BNSF) operating facilities in the area.

City of Mont Belvieu

The City of Mont Belvieu has a total population of 3,835 and a median household income of $67,714, according to the *2010 Census*. The city encompasses approximately 14.5 mi^2, and is located at the southern end of the study area near I-10 (E). Located on a salt dome in Chambers County, the city's economy is deeply tied to the petroleum industry, and the salt dome storage of petroleum products. Due to

its proximity and its location at the junction of I-10 (E) and SH 146, the city is also closely tied to the Houston-Baytown area. Mont Belvieu is home to the Eagle Pointe Golf Club and Recreation Complex, one of the premier golf and recreation facilities in the Houston area.

City of Patton Village

The City of Patton Village has a total population of 1,557 and a median household income of $33,500, according to the *2010 Census*. The city encompasses approximately 2 mi^2 on the eastern side of Montgomery County. The City of Patton Village is located in the extreme northwestern corner of the study area by US 59 (N)/I-69.

City of Plum Grove

The City of Plum Grove has a total population of 600 and a median household income of $39,464, according to the *2010 Census*. The city encompasses approximately 7.3 mi^2 on the western edge of Liberty County. The City of Plum Grove is located on the far northern edge of the study area.

City of Woodbranch

The City of Woodbranch has a total population of 1,282 and a median household income of $68,750, according to the *2010 Census*. The city encompasses approximately 2 mi^2 on the eastern side of Montgomery County. The City of Woodbranch is located in the northwest corner of the study area on US 59 (N)/I-69.

City of Roman Forest

The City of Roman Forest has a total population of 1,538 and a median household income of $88,125, according to the *2010 Census*. The city encompasses approximately 1.5 mi^2 in eastern Montgomery County. The City of Roman Forest is located in the northwest corner of the study area.

Community of Huffman

The community of Huffman is an unincorporated community with a total population of 4,797 and a median household income of approximately $80,090 according to the *2010 Census*. The community of Huffman encompassed approximately 54 mi^2 in northeastern Harris County. The community of Huffman is located in the western edge of the study area near FM 2100 and FM 1960. The community of Huffman consists largely of established subdivisions, scattered farms, apartments, and small business.

Population and Demographic Characteristics

The study area includes, 1,804 CBs, of which 918 contain resident populations, 56 BGs, and 25 Census Tracts (CT). BGs either partially or wholly contained within the study area are included in this analysis and are shown on **Exhibit 3-2.** The proposed project falls within the Houston MSA, which is defined as the 10 counties of Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, San Jacinto, and Waller. The study area is located east of the City of Houston and within four counties – Montgomery, Harris, Liberty, and Chambers counties. Twenty-five CTs are all or partially located within the study area. The study area boundary for social and economic conditions was determined by examining the CTs that are all or partially located within the project limits outlined in **Exhibit 1-2**. These CTs are identified in **Exhibit 3-2**.

For statistical purposes, the BGs are used to describe the social and economic characteristics of the study area. BGs provide the appropriate level of detail for an area that is sufficiently small to characterize the area of impact. Population data at the BG level for the year 2010 from the U.S. Census Bureau has been used in this socioeconomic analysis. County data from the *2010 Census* is used throughout the population and employment projection analysis.

A more detailed profile of the study area reveals a total population of 126,709 spanning across 56 BGs. Overall, minorities account for 30 percent of the study area population. Five of the BGs in the study area have a minority population percentage greater than 50 percent (**Exhibit 3-2**). The term minority is defined by FHWA as a person who is Black, Hispanic, Asian American, American Indian/Alaskan Native, or Pacific Islander. The two largest minority groups of the study area include Hispanics (21 percent) and Blacks (6 percent). Additionally, the minority groups American Indian and Alaska Native alone; Asian alone; Native Hawaiian and Other Pacific Islander alone; Some Other Race alone; and Two or More Races make up 3 percent of the study area population. The federal government considers race and Hispanic origin to be two separate and distinct concepts. The *2010 Census* uses the Office of Management and Budget definition of Hispanic or Latino to be "a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race."

Table 3-3 contains the percent minority population for each BG within the study area. The total minority population for the study area at the BG level is 30 percent.

Table 3-3: Racial and Ethnic Composition of Population - 2010

2010 Census Geography	Total Population	Not Hispanic or Latino														Hispanic or Latino of Any Race		Total Minority	
		White		Black*		Indian*		Asian		Islander*		Other*		Two*					
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Place																			
City of Dayton	7,242	4,587	63.3	1,309	18.1	21	0.3	87	1.2	2	0	8	0.1	118	1.6	1,110	15.3	2,655	36.7
City of Mont Belvieu	3,835	3,153	82.2	101	2.6	30	0.8	22	0.6	5	0.1	0	-	46	1.2	478	12.5	682	17.8
City of Patton Village	1,557	1,171	75.2	14	0.9	14	0.9	7	0.4	1	0.1	4	0.3	23	1.5	323	20.7	386	24.8
City of Plum Grove	600	520	86.7	2	0.3	1	0.2	0	-	0	-	0	-	3	0.5	74	12.3	80	13.3
City of Roman Forest	1,538	1,314	85.4	19	1.2	6	0.4	29	1.9	0	-	0	-	12	0.8	158	10.3	224	14.6
City of Woodbranch	1,282	1,121	87.4	16	1.2	6	0.5	4	0.3	1	0.1	0	-	31	2.4	103	8	161	12.6
Study Area																			
CT 2509.00	**8,569**	**7,459**	**87**	**181**	**2.1**	**24**	**0.3**	**205**	**2.4**	**2**	**-**	**21**	**0.2**	**81**	**0.9**	**596**	**7**	**1,110**	**13.0**
BG 3	1,151	995	86.4	12	1	3	0.3	40	3.5	0	-	0	-	13	1.1	88	7.6	156	13.6
CT 2515.01	**4,807**	**3,652**	**76**	**128**	**2.7**	**19**	**0.4**	**351**	**7.3**	**4**	**0.1**	**5**	**0.1**	**88**	**1.8**	**560**	**11.6**	**1,155**	**24.0**
BG 1	4,807	3,652	76	128	2.7	19	0.4	351	7.3	4	0.1	5	0.1	88	1.8	560	11.6	1,155	24.0
CT 2516.00	**5,750**	**4,872**	**84.7**	**144**	**2.5**	**37**	**0.6**	**34**	**0.6**	**1**	**-**	**8**	**0.1**	**59**	**1**	**595**	**10.3**	**878**	**15.3**
BG 1	1,695	1,433	84.5	14	0.8	10	0.6	11	0.6	0	-	0	-	32	1.9	195	11.5	262	15.5
BG 2	4,055	3,439	84.8	130	3.2	27	0.7	23	0.6	1	-	8	0.2	27	0.7	400	9.9	616	15.2
CT 2517.00	**8,069**	**6,494**	**80.5**	**222**	**2.8**	**33**	**0.4**	**83**	**1**	**5**	**0.1**	**17**	**0.2**	**76**	**0.9**	**1,139**	**14.1**	**1,575**	**19.5**
BG 1	1,583	1,286	81.2	50	3.2	4	0.3	29	1.8	1	0.1	1	0.1	21	1.3	191	12.1	297	18.8
BG 2	3,214	2,619	81.5	43	1.3	11	0.3	36	1.1	2	0.1	0	-	35	1.1	468	14.6	595	18.5
BG 3	1,211	1,031	85.1	9	0.7	7	0.6	3	0.2	1	0.1	0	-	5	0.4	155	12.8	180	14.9
BG 4	2,061	1,558	75.6	120	5.8	11	0.5	15	0.7	1	-	16	0.8	15	0.7	325	15.8	503	24.4
CT 2518.00	**1,847**	**1,450**	**78.5**	**40**	**2.2**	**2**	**0.1**	**5**	**0.3**	**0**	**-**	**3**	**0.2**	**15**	**0.8**	**332**	**18**	**397**	**21.5**
BG 1	1,847	1,450	78.5	40	2.2	2	0.1	5	0.3	0	-	3	0.2	15	0.8	332	18	397	21.5
CT 2519.01	**9,353**	**7,237**	**77.4**	**478**	**5.1**	**45**	**0.5**	**39**	**0.4**	**1**	**-**	**17**	**0.2**	**144**	**1.5**	**1,392**	**14.9**	**2,116**	**22.6**
BG 2	759	598	78.8	5	0.7	6	0.8	9	1.2	0	-	3	0.4	6	0.8	132	17.4	161	21.2
BG 4	2,914	2,382	81.7	47	1.6	8	0.3	6	0.2	0	-	3	0.1	40	1.4	428	14.7	532	18.3

Table 3-3: Racial and Ethnic Composition of Population - 2010

2010 Census Geography	Total Population	Not Hispanic or Latino														Hispanic or Latino of Any Race		Total Minority	
		White		Black*		Indian*		Asian		Islander*		Other*		Two*					
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
CT 2527.00	**4,163**	**2,684**	**64.5**	**244**	**5.9**	**6**	**0.1**	**18**	**0.4**	**4**	**0.1**	**4**	**0.1**	**50**	**1.2**	**1,153**	**27.7**	**1,479**	**35.5**
BG 1	1,425	904	63.4	162	11.4	2	0.1	9	0.6	0	-	2	0.1	28	2	318	22.3	521	36.6
BG 2	1,704	957	56.2	44	2.6	4	0.2	7	0.4	4	0.2	0	-	17	1	671	39.4	747	43.8
BG 3	1,034	823	79.6	38	3.7	0	-	2	0.2	0	-	2	0.2	5	0.5	164	15.9	211	20.4
CT 2528.00	**5,882**	**1,748**	**29.7**	**2,623**	**44.6**	**9**	**0.2**	**12**	**0.2**	**0**	**-**	**6**	**0.1**	**60**	**1**	**1,424**	**24.2**	**4,134**	**70.3**
BG 2	2,048	1,122	54.8	122	6	0	-	6	0.3	0	-	0	-	18	0.9	780	38.1	926	45.2
CT 2531.00	**8,439**	**2,962**	**35.1**	**1,592**	**18.9**	**13**	**0.2**	**348**	**4.1**	**2**	**-**	**20**	**0.2**	**126**	**1.5**	**3,376**	**40**	**5,477**	**64.9**
BG 1	4,690	1,745	37.2	804	17.1	9	0.2	213	4.5	1	-	14	0.3	60	1.3	1,844	39.3	2,945	62.8
CT 2532.00	**9,429**	**5,141**	**54.5**	**1,355**	**14.4**	**51**	**0.5**	**99**	**1**	**3**	**-**	**15**	**0.2**	**88**	**0.9**	**2,677**	**28.4**	**4,288**	**45.5**
BG 2	2,595	1,108	42.7	593	22.9	11	0.4	47	1.8	0	-	5	0.2	28	1.1	803	30.9	1,487	57.3
BG 3	1,273	829	65.1	162	12.7	7	0.5	3	0.2	0	-	0	-	11	0.9	261	20.5	444	34.9
CT 6923.00	**15,803**	**9,014**	**57**	**764**	**4.8**	**95**	**0.6**	**350**	**2.2**	**19**	**0.1**	**33**	**0.2**	**161**	**1**	**5,367**	**34**	**6,789**	**43.0**
BG 5	5,320	3,502	65.8	251	4.7	14	0.3	158	3	11	0.2	8	0.2	54	1	1,322	24.8	1,818	34.2
CT 6924.00	**8,609**	**5,861**	**68.1**	**465**	**5.4**	**45**	**0.5**	**335**	**3.9**	**11**	**0.1**	**10**	**0.1**	**159**	**1.8**	**1,723**	**20**	**2,748**	**31.9**
BG 1	2,099	1,409	67.1	40	1.9	14	0.7	4	0.2	0	-	0	0	39	1.9	593	28.3	690	32.9
BG 2	1,353	1,075	79.5	7	0.5	8	0.6	5	0.4	3	0.2	0	-	22	1.6	233	17.2	278	20.5
CT 6925.00	**8,331**	**6,017**	**72.2**	**192**	**2.3**	**38**	**0.5**	**29**	**0.3**	**4**	**-**	**5**	**0.1**	**95**	**1.1**	**1,951**	**23.4**	**2,314**	**27.8**
BG 1	1,195	986	82.5	39	3.3	7	0.6	2	0.2	1	0.1	0	-	12	1	148	12.4	209	17.5
BG 2	1,756	1,302	74.1	55	3.1	4	0.2	10	0.6	0	-	0	-	28	1.6	357	20.3	454	25.9
BG 3	1,794	1,271	70.8	24	1.3	10	0.6	2	0.1	1	0.1	0	-	15	0.8	471	26.3	523	29.2
BG 4	3,586	2,458	68.5	74	2.1	17	0.5	15	0.4	2	0.1	5	0.1	40	1.1	975	27.2	1,128	31.5
CT 6926.02	**10,150**	**6,389**	**62.9**	**216**	**2.1**	**35**	**0.3**	**68**	**0.7**	**1**	**-**	**5**	**-**	**129**	**1.3**	**3,307**	**32.6**	**3,761**	**37.1**
BG 2	5,107	3,345	65.5	143	2.8	11	0.2	55	1.1	0	-	5	0.1	72	1.4	1,476	28.9	1,762	34.5
BG 3	2011	1181	58.7	49	2.4	19	0.9	4	0.2	0	-	0	-	27	1.3	731	36.4	830	41.3
CT 6927.00	**7,058**	**5,456**	**77.3**	**117**	**1.7**	**38**	**0.5**	**34**	**0.5**	**5**	**0.1**	**16**	**0.2**	**69**	**1**	**1,323**	**18.7**	**1,602**	**22.7**
BG 2	2,114	1,738	82.2	29	1.4	14	0.7	9	0.4	5	0.2	11	0.5	18	0.9	290	13.7	376	17.8
BG 3	2,587	1,966	76	71	2.7	11	0.4	16	0.6	0	-	5	0.2	31	1.2	487	18.8	621	24.0
CT 6928.01	**8,647**	**7,110**	**82.2**	**79**	**0.9**	**36**	**0.4**	**47**	**0.5**	**2**	**-**	**8**	**0.1**	**113**	**1.3**	**1,252**	**14.5**	**1,537**	**17.8**

Table 3-3: Racial and Ethnic Composition of Population - 2010

2010 Census Geography	Total Population	Not Hispanic or Latino														Hispanic or Latino of Any Race		Total Minority	
		White		Black*		Indian*		Asian		Islander*		Other*		Two*					
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
BG 1	2,344	2,041	87.1	24	1	7	0.3	27	1.2	2	0.1	0	-	49	2.1	194	8.3	303	12.9
BG 2	2,820	2,353	83.4	20	0.7	3	0.1	11	0.4	0	-	0	-	27	1	406	14.4	467	16.6
BG 4	1,798	1,366	76	15	0.8	15	0.8	7	0.4	0	-	7	0.4	22	1.2	366	20.4	432	24.0
CT 6928.02	**3,745**	**2,618**	**69.9**	**84**	**2.2**	**33**	**0.9**	**14**	**0.4**	**0**	**-**	**4**	**0.1**	**31**	**0.8**	**961**	**25.7**	**1,127**	**30.1**
BG 1	1,508	954	63.3	47	3.1	13	0.9	6	0.4	0	-	1	0.1	21	1.4	466	30.9	554	36.7
BG 2	1,282	879	68.6	27	2.1	12	0.9	2	0.2	0	-	3	0.2	10	0.8	349	27.2	403	31.4
BG 3	955	785	82.2	10	1	8	0.8	6	0.6	0	-	0	-	0	-	146	15.3	170	17.8
CT 7003.00	**9,514**	**6,390**	**67.2**	**478**	**5**	**40**	**0.4**	**37**	**0.4**	**1**	**-**	**13**	**0.1**	**97**	**1**	**2,458**	**25.8**	**3,124**	**32.8**
BG 4	752	707	94	4	0.5	1	0.1	0	-	0	-	0	-	11	1.5	29	3.9	45	6.0
BG 5	2,257	1,342	59.5	18	0.8	9	0.4	0	-	0	-	3	0.1	15	0.7	870	38.5	915	40.5
CT 7004.00	**6,334**	**5,953**	**94**	**31**	**0.5**	**11**	**0.2**	**8**	**0.1**	**0**	**-**	**3**	**-**	**47**	**0.7**	**281**	**4.4**	**381**	**6.0**
BG 2	1,502	1,358	90.4	11	0.7	1	0.1	2	0.1	0	-	3	0.2	5	0.3	122	8.1	144	9.6
CT 7008.00	**8,892**	**7,047**	**79.3**	**664**	**7.5**	**49**	**0.6**	**65**	**0.7**	**4**	**-**	**5**	**0.1**	**96**	**1.1**	**962**	**10.8**	**1,845**	**20.7**
BG 1	1,858	1,716	92.4	13	0.7	4	0.2	22	1.2	1	0.1	0	-	9	0.5	93	5	142	7.6
BG 2	2,688	1,717	63.9	530	19.7	7	0.3	30	1.1	0	-	1	-	40	1.5	363	13.5	971	36.1
BG 3	829	611	73.7	52	6.3	4	0.5	7	0.8	1	0.1	4	0.5	16	1.9	134	16.2	218	26.3
BG 4	1,429	1,261	88.2	32	2.2	23	1.6	3	0.2	1	0.1	0	-	8	0.6	101	7.1	168	11.8
BG 5	2,088	1,742	83.4	37	1.8	11	0.5	3	0.1	1	-	0	-	23	1.1	271	13	346	16.6
CT 7009.00	**6,059**	**2,948**	**48.7**	**1,534**	**25.3**	**13**	**0.2**	**19**	**0.3**	**0**	**-**	**17**	**0.3**	**45**	**0.7**	**1,483**	**24.5**	**3,111**	**51.3**
BG 1	765	509	66.5	49	6.4	2	0.3	0	0	0	-	2	0.3	20	2.6	183	23.9	256	33.5
BG 2	1,303	918	70.5	178	13.7	7	0.5	7	0.5	0	-	2	0.2	18	1.4	173	13.3	385	29.5
BG 3	3,991	1,521	38.1	1,307	32.7	4	0.1	12	0.3	0	-	13	0.3	7	0.2	1,127	28.2	2,470	61.9
CT 7010.00	**6,216**	**3,044**	**49**	**518**	**8.3**	**26**	**0.4**	**30**	**0.5**	**2**	**-**	**2**	**-**	**67**	**1.1**	**2,527**	**40.7**	**3,172**	**51.0**
BG 1	2,913	1,604	55.1	122	4.2	17	0.6	9	0.3	0	-	0	-	23	0.8	1,138	39.1	1,309	44.9
BG 2	810	368	45.4	280	34.6	2	0.2	15	1.9	0	-	1	0.1	21	2.6	123	15.2	442	54.6
BG 3	2,493	1,072	43	116	4.7	7	0.3	6	0.2	2	0.1	1	-	23	0.9	1,266	50.8	1,421	57.0
CT 7011	**6,954**	**5,595**	**80.5**	**400**	**5.8**	**43**	**0.6**	**19**	**0.3**	**10**	**0.1**	**5**	**0.1**	**114**	**1.6**	**768**	**11**	**1,359**	**19.5**
BG 2	2,698	2,305	85.4	55	2	12	0.4	3	0.1	7	0.3	1	-	41	1.5	274	10.2	393	14.6

Table 3-3: Racial and Ethnic Composition of Population - 2010

2010 Census Geography	Total Population	Not Hispanic or Latino														Hispanic or Latino of Any Race		Total Minority	
		White		Black*		Indian*		Asian		Islander*		Other*		Two*					
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
BG 3	874	655	74.9	39	4.5	3	0.3	5	0.6	1	0.1	1	0.1	15	1.7	155	17.7	219	25.1
CT 7101	**6,502**	**5,496**	**84.5**	**208**	**3.2**	**34**	**0.5**	**26**	**0.4**	**5**	**0.1**	**0**	**-**	**77**	**1.2**	**656**	**10.1**	**1,006**	**15.5**
BG 1	2,830	2,194	77.5	147	5.2	11	0.4	19	0.7	5	0.2	0	-	55	1.9	399	14.1	636	22.5
BG 2	1,740	1,570	90.2	11	0.6	19	1.1	3	0.2	0	-	0	-	8	0.5	129	7.4	170	9.8
CT 7102	**15,543**	**11,025**	**70.9**	**1,039**	**6.7**	**46**	**0.3**	**176**	**1.1**	**6**	**-**	**16**	**0.1**	**159**	**1**	**3,076**	**19.8**	**4,518**	**29.1**
BG 2	4,944	2,519	51	558	11.3	22	0.4	92	1.9	0	-	8	0.2	62	1.3	1,683	34	2,425	49.0
BG 3	5,276	4,289	81.3	165	3.1	12	0.2	45	0.9	0	-	3	0.1	47	0.9	715	13.6	987	18.7
BG 5	2,971	2,240	75.4	179	6	8	0.3	26	0.9	0	-	5	0.2	30	1	483	16.3	731	24.6

* The complete Census race descriptions are as follows: White alone; Black or African American alone; American Indian and Alaska Native alone; Asian alone; Native Hawaiian and Other Pacific Islander alone; Some Other Race alone; and Two or More Races

Source: 2010 Census Summary File 1—Texas [machine-readable data files]/prepared by the U.S. Census Bureau, 2011. Table P9

3.2.1.1 Environmental Justice

Executive Order (EO) 12898 *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* requires each federal agency to "make achieving Environmental Justice (EJ) part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low-income populations". The FHWA has identified three fundamental principles of environmental justice:

- To avoid, minimize, or mitigate disproportionately high and adverse human health or environmental effects, including social and economic effects, on minority populations and low-income populations;
    - To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process; and
    - To prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority populations and low-income populations.

Disproportionately high and adverse human health or environmental effects are defined by FHWA as adverse effects that:

- Are predominately borne by a minority population and/or a low-income population; or
- Will be suffered by the minority population and/or low-income population and are appreciably more severe or greater in magnitude than the adverse effects that will be suffered by the nonminority population and/or non-low-income populations.

Minority means a person who is:

- Black (having origins from any of the black racial groups of Africa);
- Hispanic/Latino (of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race);
- Asian-American (having origins from any place of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); or
- American Indian and Alaskan Native (having origins from any of the original people of North America and now maintains cultural identification through tribal affiliation or community recognition).

Minority Population means any readily identifiable group of minority persons who live in geographic proximity, and, if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by a proposed program, policy, or activity. Minority populations were identified based on the federal Council on Environmental Quality's (CEQ's)

guidance document *Environmental Justice*: *Guidance Under the National Environmental Policy Act* (CEQ 1997). Based on this guidance:

"Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis…"

Low-Income means a household income for a family of four at or below the Department of Health and Human Services (HHS) poverty guidelines (i.e. $23,550 in 2013) for a family of four.

Low-Income Population means any readily identifiable group of low-income persons who live in geographic proximity, and, if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who would be similarly affected by a proposed FHWA program, policy or activity.

Unlike the CEQ guidance (1997) on minority population, no EJ order or guidance document contains a quantitative definition of how many low-income individuals constitute low-income populations. In the absence of guidance for the analysis, one of the measures used to identify low-income populations was the median household income for the inclusive CT and/or BGs.

The primary source of demographic data was the *2010 Census* and the *2006-2010 ACS* because it is the most comprehensive, complete and detailed data source currently available. Five of the study area BGs show minority populations above 50 percent (refer to **Table 3-3**). None of the 56 BGs have a household median income below that of the HHS 2013 poverty guidelines (refer to **Table 3-8**). Percentages of minority populations in CBs containing resident populations within the study area are provided in **Appendix E**. 164 of the 918 CBs containing resident populations in the study area reflect racial or ethnic minority percentages greater than 50 percent.

Origin-Destination Analysis

Origin-destination (O&D) data secured from H-GAC may be used for further analysis of "user impacts" of the Grand Parkway Segments H and I-1 on low-income and minority populations. Studying O&D data can

determine travel patterns of traffic along a transportation facility during a typical day. Trips are defined as a one-way movement from where a person starts (origin) to where the person is going (destination).

The O&D data presented in **Chapter 4 (Environmental Consequences)** is normalized for BGs using Traffic Analysis Zones (TAZ). TAZs are small geographic units of area that are developed as a basis for estimate of travel. TAZs may vary in size, are determined by the roadway network and homogeneity of development, and directly reflect demographic data generated by the U.S. Census Bureau. Delineated by state and/or transportation officials for tabulating traffic-related data, TAZs usually consist of one or more CBs, BGs, or CTs.

3.2.1.2 Limited English Proficiency (LEP)

EO 13166, "*Improving Access to Services for Persons with Limited English Proficiency,*" requires agencies to examine the services they provide, identify the need for services, and develop and implement a system to provide those services so that LEP persons can have meaningful access to them.

An analysis was conducted to identify residents in the study area that may have LEP. The analysis was conducted at the BG level, the smallest geographic area for which LEP data is provided by the U.S. Census Bureau. The results are presented in **Table 3-4**.

LEP persons were identified within the BGs throughout the study area. According to the *2006-2010 ACS* data, Spanish is the predominate language spoken by residents within the study area who speak English "less than well," "not well," or "not at all." This data indicates that 2.7 percent of the population (5 years and older) within the study area BGs speak English "less than well," "not well," or "not at all". **Table 3-4** contains the percent LEP population for each CT and BG in the study area. **Exhibit 4-3** shows the locations of the LEP BGs. Thirty-six of the BGs contain a LEP population. These BGs are scattered throughout the study area, but are mostly concentrated in the center of the study area. Both CT 2527.00-BG 2 and CT 7010.00-BG 3 report a higher than average percent (17.6 percent for both) LEP population than the other BGs in the study area. In a windshield survey along the proposed study area, English and Spanish were observed on billboards and signs.

Table 3-4: Percentage LEP Population - 2010

Census 2010 Geography	Population 5 years & over	Total Number Who Speak English "Less than Well," "Not Well," or "Not at All""	% LEP
CT 2509.00	**14,055**	**232**	**1.7**
BG 3	1,357	0	-
CT 2515.01	**4,758**	**59**	**1.2**
BG 1	4,758	59	1.2
CT 2516.00	**4,912**	**57**	**1.2**
BG 1	1,294	21	1.6
BG 2	3,618	36	1.0
CT 2517.00	**7,473**	**26**	**0.3**
BG 1	1,827	0	-
BG 2	2,846	11	0.4
BG 3	1,226	15	1.2
BG 4	1,574	0	-
CT 2518.00	**1,672**	**31**	**1.9**
BG 1	1,672	31	1.9
CT 2519.01	**7,961**	**48**	**0.6**
BG 2	537	12	2.2
BG 4	2,438	0	-
CT 2527.00	**3,474**	**303**	**8.7**
BG 1	802	0	-
BG 2	1,719	303	17.6
BG 3	953	0	-
CT 2528.00	**4,260**	**198**	**4.6**
BG 2	1,690	137	8.1
CT 2531.00	**6,196**	**158**	**2.6**
BG 1	3,401	68	2.0
CT 2532.00	**7,676**	**532**	**6.9**
BG 2	1,943	131	6.7
BG 3	1,368	0	-
CT 6923.00	**13,869**	**1099**	**7.9**
BG 5	4,652	260	5.6
CT 6924.00	**7,232**	**219**	**3.0**
BG 1	1,871	128	6.8
BG 2	1,201	67	5.6
CT 6925.00	**6,955**	**21**	**0.3**
BG 1	1,506	0	-
BG 2	1,122	0	-
BG 3	1,269	0	-
BG 4	3,058	21	0.7

Table 3-4: Percentage LEP Population - 2010

Census 2010 Geography	Population 5 years & over	Total Number Who Speak English "Less than Well," "Not Well," or "Not at All""	% LEP
CT 6926.02	**8,142**	**454**	**5.6**
BG 2	4,477	250	5.6
BG 3	1,266	12	0.9
CT 6927.00	**6,973**	**43**	**0.6**
BG 2	2,144	0	-
BG 3	1,786	0	-
CT 6928.01	**7,136**	**138**	**1.9**
BG 1	2,239	18	0.8
BG 2	2,268	82	3.6
BG 4	1,219	21	1.7
CT 6928.02	**3,448**	**103**	**3.0**
BG 1	1,792	103	5.7
BG 2	758	0	-
BG 3	898	0	-
CT 7003.00	**8,860**	**689**	**7.8**
BG 4	652	0	-
BG 5	1,528	93	6.1
CT 7004.00	**5,433**	**0**	**-**
BG 2	1,684	0	-
CT 7008.00	**8,319**	**136**	**1.6**
BG 1	1,846	6	0.3
BG 2	1,840	36	2.0
BG 3	435	0	-
BG 4	1,542	0	-
BG 5	2,656	94	3.5
CT 7009.00	**6,141**	**86**	**1.4**
BG 1	449	36	8.0
BG 2	968	0	-
BG 3	4,724	50	1.1
CT 7010.00	**5,127**	**514**	**10.0**
BG 1	2,975	227	7.6
BG 2	627	18	2.9
BG 3	1,525	269	17.6
CT 7011.00	**5,890**	**106**	**1.8**
BG 2	3,164	77	2.4
BG 3	566	20	3.5
CT 7101.00	**6,320**	**42**	**0.7**
BG 1	2,250	4	0.2

Table 3-4: Percentage LEP Population - 2010

Census 2010 Geography	Population 5 years & over	Total Number Who Speak English "Less than Well," "Not Well," or "Not at All""	% LEP
BG 2	1,641	31	1.9
CT 7102.00	**14,055**	**232**	**1.7**
BG 2	4,633	202	4.4
BG 3	4,542	13	0.3
BG 5	26,70	0	-

Source: U.S. Census Bureau, 2006-2010 American Community Survey
ACS data are estimates; they are not counts

3.2.1.3 Community Cohesion

Using FHWA definitions as guidelines, community cohesion is defined as patterns of behavior that individuals or groups of individuals hold in common. Residential subdivisions may develop a sense of community cohesion through social interaction or participation in neighborhood organizations. For instance, if a local church or school provides a location where residents of the neighborhood or community can assemble and associate with one another, or a neighborhood association or neighborhood watch program is in place to serve the community and satisfy the residents' economic and social needs, then some sense of cohesion likely exists. Cohesion may also be based on common characteristics of interest shared by the members of the community, such a religion, ethnicity, or income level (FHWA 1996).

The northern portion of the study area contains developing communities, such as Roman Forest, Kings Colony, and Woodbranch. Roman Forest and Woodbranch are established communities that are experiencing new development. Kings Colony has been platted but is still in the early development stage. Some of these communities are densely populated, while others are in the early stages of development with only street infrastructure in place. Some large areas have been cleared in preparation of development. Other scattered areas consist of low-lying floodplain areas. Along US 59 (N)/I-69, the study area appears mostly developed with residential areas and commercial strip centers. Some undeveloped forested areas are present north of FM 1485, as well as floodplains and wetlands in and around Caney Creek and Peach Creek in the vicinity of Patton Village. Residences and businesses become increasingly sparse along FM 1485 as you travel further from US 59 (N)/I-69. The Lake Houston Wilderness Park is along the south side and adjacent to FM 1485; however, there is no entrance to the park along FM 1485. The entrance to Lake Houston Wilderness Park is off Baptist Encampment Road on the west side of the park, south of FM 1485.

The Baptist Encampment subdivision consists of a group of individuals on a large lot subdivision west of the park that are commonly associated with the Peach Creek Baptist Church. The central portion of the study area east of the Lake Houston Wilderness Park and south along FM 2100 is also forested; however, there is evidence of future development including subdivision construction and commercial strip development.

A majority of the central portion of the study area consists of wide open spaces that are maintained as farms and pastures. The topography is very level through most of the center of the study area with the exception of a salt dome near FM 686. Crops include rice, sorghum, soybeans, and hay. Railroad lines exist along FM 1960 and US 90 and are utilized daily in and out of Houston. The City of Dayton is within this area along the eastern edge of the study area and contains many old homes and buildings and a central business area. Several rail lines converge within the City of Dayton near the central area, and an old rice industrial complex is present. An area of oil and gas activity is also present in the vicinity of the Dayton landfill. Located on the western edge of the central portion of the study area is the unincorporated community of Huffman. Huffman is a small established community with a large agricultural community.

The southern portion of the study area is characterized by heavy oil and gas industrial activities immediately north of the City of Mont Belvieu. The City of Mont Belvieu is positioned on a salt dome which can be seen as a raised landform. Surrounding the salt dome is a concentration of wells and supporting industrial facilities. Oil and gas wells, storage facilities, emission stacks, and processing plants are dense in Mont Belvieu. The residential communities of Cherry Point and Country Creek are located in the area as well as churches, businesses, and schools. The new location of the City of Mont Belvieu is physically separated from the industrial area (old Mont Belvieu) by a canal. Residents and visitors in the Mont Belvieu area view roadways that are at-grade rural facilities with limited traffic. Traffic does, however, consist of a high percentage of trucks due to the industry in the area.

Community Linkages and Interaction

Although each of the individual communities within the study area form their own unique cohesive units, a number of social, economic, educational, institutional, and cultural linkages exist among these communities. In most cases, these linkages are based on the location of community facilities and the areas they serve in relation to other surrounding communities.

Education

The study area is served by 10 school districts. Barbers Hill Independent School District (ISD) (serving the Mont Belvieu area), Cleveland ISD, Crosby ISD, Dayton ISD, Goose Creek Consolidated ISD, Huffman ISD, Humble ISD, New Caney ISD, Splendora ISD, and Tarkington ISD. New Caney ISD serves the urbanized portion of the study area between US 59 (N)/I-69 and FM 2100. Schools in the Huffman ISD are located on the western edge of the study area. Schools in the Dayton ISD and Barbers Hill ISD are located on the eastern edge of the study area. The remaining school districts' boundaries enter into the Segments H and I-1 study area and include Cleveland ISD, Crosby ISD, Goose Creek Consolidated ISD, Humble ISD, Splendora ISD, and Tarkington ISD. Refer to **Exhibit 3-3** for locations of school districts within the study area.

Activities associated with the study area ISDs schools, such as athletics, school clubs, fine arts, and other school-sponsored organizations and activities involve students from all over the Gulf Coast Region and often require students to travel to various locations within and outside the study area from many University Interscholastic League activities.

Commerce

Linkages between the study area and surrounding areas are apparent with regard to shopping opportunities for study area residents. Although there are several small local grocery options within the study area communities, to access larger grocery stores, such as Wal-Mart Super Center, Kroger, or HEB, residents must travel outside the study area to the surrounding communities. Additionally, the study area does not contain a large general merchandise store within its boundaries. For this type of shopping, residents from the study area would need to travel outside the study area.

Healthcare and Public Facilities

The closest full service hospital to the study area is Liberty Dayton Regional Medical Center, located just east of the study area in Liberty, Texas. Smaller public and private clinics serve the basic healthcare needs of the study area residents. Additionally, there are several urgent care facilities and full service hospitals located in surrounding areas of Kingwood and Conroe. The Harris County, Montgomery County, and Liberty County Health Department clinics are the only publicly-funded facilities devoted to healthcare in the study area that nearby communities can use for services. Services provided by the these facilities include,

but are not limited to, indigent healthcare services, as well as immunizations and services to children with special health care needs.

Other public facilities within the study area include, but are not limited to: local public libraries; County Tax Assessor Offices; County Rural Transportation Offices; County Courthouses; local Fire Departments; and Police Departments. These facilities serve both the study area and the surrounding areas and contribute to interaction between each of the communities within the study area. However, it should be noted that many of these public service offices have multiple locations (i.e. public libraries, public healthcare clinics, courthouses, etc.) outside the study area, so residents living outside the study area are not strictly bound to traveling to the study area to benefit from these resources.

3.2.1.4 Economic Conditions

The Houston MSA's economic assets are linked to petrochemical industries, area universities and colleges, and medical complexes. The study area is a very small portion of the Houston region in terms of population and economy. Its economic growth depends on economic activity at a broader regional scale. As the area grows and develops, the study area, which is primarily rural in character, would continue to diversify with an assortment of commercial and industrial enterprises. The data provided throughout the following sections is the best available data and reflects economic conditions at a regional or county level as smaller geographic areas of economic data are currently not available. General economic impacts of the proposed project are not discussed in **Chapter 4** (**Environmental Consequences**), but are discussed in **Chapter 5** (**Indirect Impacts**). The economic impact of tolling is discussed in **Chapter 4**.

Employment Characteristics

Education, health, professional management, and manufacturing services comprise the major sectors of the Houston MSA economy. The *2010 Census* indicated that 35.6 percent of the non-agricultural employees in the Houston MSA worked in management, business, science, and arts occupations. Sales and office occupations was the second largest category of occupations, employing 24.3 percent of the Houston MSA population in 2010, with the service occupations ranking third at 16.3 percent.

Residents within the four counties associated with the study area are predominantly employed by the management, business, science, arts, service, sales and office occupations. The agricultural industry, represented by farming/fishing/forestry occupations, employs a minimal percentage of the area population.

The importance of the four-county industry contributions to the Houston MSA economy is illustrated in **Table 3-5**.

Table 3-5: Number of Persons Employed by Occupation – 2010

Occupational Category	Chambers County		Harris County		Liberty County		Montgomery County		Statewide	
	#	%	#	%	#	%	#	%	#	%
Agriculture, forestry, fishing and hunting, and mining	613	4.1	51,017	2.7	1,441	4.9	8,571	4.2	325,101	2.9
Management, business, science, and arts occupations	4,633	31.2	62,648	33.2	6,839	23.4	74,390	36.8	3,751,544	33.7
Service occupations	1,868	21.6	313,520	16.6	4,793	16.4	28,695	14.2	1,877,988	16.9
Sales and office occupations	3,092	20.8	469,587	24.90	6,817	23.3	52,542	26.0	2,8541,95	25.7
Natural resources, construction, and maintenance occupations	2,782	18.7	231,686	12.3	5,611	19.2	23,306	11.5	1,291,496	11.6
Production, transportation, and material moving occupations	2,467	16.6	247,770	13.10	5,141	17.6	23,357	11.5	1,350,393	12.1

Source: U.S. Census Bureau, 2006-2010 American Community Survey
ACS data are estimates; they are not counts

The major employers located within the study area are listed in **Table 3-6**. The Texas Workforce Commission (TWC) provides regional labor market analysis data through the SOCRATES web-based application. Major employers provide services ranging from education to retail, with a fair amount dedicated to manufacturing and distribution.

Table 3-6: Major Employers in the Study Area - 2012

Employer	Location	No. of Local Employees
Montgomery County		
East Montgomery County Fair	New Caney	100-499
Gerlands 92 Food and Drug	New Caney	100-499
Harris County		
Huffman Lodge	Huffman	100-499
Triple B Construction Service	Huffman	100-499
Liberty County		
Criminal Justice Department	Dayton	100-499
Dayton High School	Dayton	100-499
Insteel Wire Products Co.	Dayton	100-499
Sam's Distribution Center	Dayton	100-499
Tanner Construction Co.	Dayton	100-499
Chambers County		
Enterprise Products	Mont Belvieu	100-499
Pol-Tex International	Mont Belvieu	100-499

Source: SOCRATES, TWC, 2012 http://socrates.cdr.state.tx.us/index.asp

The Career Development Resources (CDR) Unit of the TWC utilizes the CDR economic diversification index which measures the degree to which a county economy is diversified relative to the Texas economy. Concentrating employment in only one or two industrial sectors makes an area less diversified and more susceptible to widespread decline should a key sector suffer a substantial loss. A statistically diverse economy does not necessarily correlate with higher growth. The study area has an economic base which is of average diversity. The H-GAC lists the existing 2011 and projected 2035 total employment estimate shown in **Table 3-7**.

Table 3-7: 2011 - County Employment

Area	Employment		
	2011	2035	% Increase
Chambers County	9,000	13,000	44
Harris County	2,296,000	3,136,000	37
Liberty County	24,000	36,000	50
Montgomery County	133,000	239,000	80
Employment Total	**2,462,000**	**3,424,000**	**39**

Source: H-GAC, 2035 Forecast Data, 2012, http://www.h-gac.com/HGAC/home/Default.htm

Median Household Income

The 2013 (most recent data available) HHS poverty guidelines for a family of four persons is $23,550. A comparison of median household income and poverty status for the study area is shown in **Table 3-8**. Median household income of BGs comprising the study area ranged from $24,038 to $166,979 in 2011.

Table 3-8: Median Household Income and Poverty Status – 2011

Census 2010 Geography	Total Households	Median Household Income ($)	Persons Below Poverty Level*	
			#	%
CT 2509.00	**3,172**	**131,563**	**14**	**0.2**
BG 3	369	166,979	-	-
CT 2515.01	**1,410**	**118,235**	**278**	**5.5**
BG 1	1,410	118,235	-	-
CT 2516.00	**1,764**	**74,821**	**324**	**5.9**
BG 1	494	52,625	-	-
BG 2	1,270	87,045	-	-
CT 2517.00	**2,858**	**59,766**	**959**	**11.9**
BG 1	615	105,903	-	-
BG 2	1,105	54,276	-	-
BG 3	450	45,909	-	-
BG 4	688	78,269	-	-
CT 2518.00	**615**	**77,936**	**55**	**3.3**
BG 1	615	77,936	-	-
CT 2519.01	**2,973**	**62,286**	**636**	**7.4**
BG 2	186	55,214	-	-
BG 4	1,037	55,017	-	-
CT 2527.00	**1,440**	**56,884**	**781**	**18.4**
BG 1	438	35,789	-	-
BG 2	593	60,375	-	-
BG 3	409	90,063	-	-
CT 2528.00	**1,766**	**40,703**	**719**	**15.1**
BG 2	640	48,232	-	-
CT 2531.00	**2,408**	**78,040**	**329**	**4.1**
BG 1	1,366	79,779	-	-
CT 2532.00	**3,034**	**57,885**	**1,736**	**20.8**
BG 2	777	27,476	-	-
BG 3	536	67,722	-	-
CT 6923.00	**4,842**	**63,261**	**1,506**	**10.2**
BG 5	1,836	74,773	-	-
CT 6924.00	**3,567**	**45,177**	**1,204**	**15.5**
BG 1	705	46,051	-	-
BG 2	428	46,731	-	-
CT 6925.00	**2,754**	**42,683**	**1,177**	**14.8**
BG 1	448	41,667	-	-
BG 2	540	63,381	-	-

Table 3-8: Median Household Income and Poverty Status – 2011

Census 2010 Geography	Total Households	Median Household Income ($)	Persons Below Poverty Level*	
			#	%
BG 3	437	30,163	-	-
BG 4	1,329	50,625	-	-
CT 6926.02	**2,992**	**38,635**	**2,157**	**23.7**
BG 2	1,742	47,321	-	-
BG 3	490	29,531	-	-
CT 6927.00	**2,520**	**58,080**	**1,157**	**16.2**
BG 2	756	61,000	-	-
BG 3	812	58,553	-	-
CT 6928.01	**2,823**	**53,890**	**1,087**	**12.8**
BG 1	811	64,375	-	-
BG 2	941	43,843	-	-
BG 4	468	54,303	-	-
CT 6928.02	**1,176**	**60,878**	**335**	**9.9**
BG 1	604	53,056	-	-
BG 2	294	65,263	-	-
BG 3	278	88,269	-	-
CT 7003.00	**3,256**	**39,912**	**1,877**	**20.0**
BG 4	300	106,917	-	-
BG 5	599	51,023	-	-
CT 7004.00	**2,142**	**53,571**	**691**	**11.4**
BG 2	736	52,121	-	-
CT 7008.00	**3,134**	**50,476**	**1,199**	**13.1**
BG 1	560	80,769	-	-
BG 2	732	24,038	-	-
BG 3	235	56,488	-	-
BG 4	637	57,188	-	-
BG 5	970	43,200	-	-
CT 7009.00	**567**	**66,250**	**227**	**13.3**
BG 1	224	67,283	-	-
BG 2	335	63,304	-	-
BG 3	8	n/a	-	-
CT 7010.00	**1,877**	**51,473**	**1,359**	**22.7**
BG 1	951	68,072	-	-
BG 2	252	40,227	-	-
BG 3	674	35,395	-	-
CT 7011.00	**2,229**	**55,792**	**444**	**7.1**

Table 3-8: Median Household Income and Poverty Status – 2011

Census 2010 Geography	Total Households	Median Household Income ($)	Persons Below Poverty Level*	
			#	%
BG 2	984	54,375	-	-
BG 3	240	80,349	-	-
CT 7101.00	**2,279**	**75,120**	**780**	**11.2**
BG 1	794	76,229	-	-
BG 2	683	84,426	-	-
CT 7102.00	**5,127**	**86,674**	**1,131**	**7.0**
BG 2	1,518	71,848	-	-
BG 3	1,657	94,718	-	-
BG 5	1,019	88,083	-	-

Source: U.S. Census Bureau, 2007-2011 American Community Survey
*Population for whom poverty status has been determined
ACS data are estimates; they are not counts. Income data is provided in 2011 inflation adjusted dollars

All BGs in the study area exhibit median household incomes greater than the poverty threshold. The percentage of the total study area population with incomes below the poverty level is 12.1 percent. Availability of poverty data for the number of households below the poverty level is limited to the CT level, and is therefore only reported to that level in **Table 3-8**. As shown in the table, the percentage of study area persons living below poverty level per CT ranges from 0.2 to 23.7 percent.

3.2.2 Pedestrian and Bicyclists

Segments H and I-1 of the Grand Parkway would accommodate access to "Proposed Shared-Use Paths/Trails" as identified in H-GAC's Regional Bikeway Plan. These include a shared-use path/trail along FM 2100. All of the existing and proposed paths and trails within the project limits were used to define the study area boundary.

3.2.3 Visual and Aesthetic Qualities

Title 23 United States Code (U.S.C.), Section 109 (h) requires that visual effects be considered as a part of the EIS process. The visual character of an area includes landforms and topography, water features, parks, vegetation and man-made features such as statues, historic features and buildings, roadways, bridges, industries, businesses, and residences. Existing visual resources in the study area may be viewed both from the driver's perspective traveling through the study area as well as from the residents, workers and visitors whose view is of the roadway. The study area overall is heavily disturbed due to previous

development, farming, ranching, and industrial use. Existing roadways are unobtrusive because they are at-grade, and there are no existing elevated structures, with the exception of bridges slightly elevated over waterways and termini at interchanges with US 59 (N)/I-69 and I-10 (E). Most of the existing roadways are two-lane rural facilities within narrow rights-of-way (ROW). The following discussion characterizes the visual resources within the study area.

The study area near US 59 (N)/I-69 and FM 1485 is mostly developed with residential and commercial areas. Traveling east along FM 1485 from US 59 (N)/I-69 also lends a view of a forested area adjacent to a narrow rural roadway. Residences and businesses become increasingly sparse along FM 1485 as you travel further east from US 59 (N)/I-69. The Lake Houston Wilderness Park is located south and adjacent to FM 1485. FM 1485 crosses Caney Creek and Peach Creek, and the view from the roadway bridges overlooks well defined creek channels at both locations.

The central portion of the study area east of the Lake Houston Wilderness Park and south along FM 2100 is also forested; however, there is evidence of anticipated development including subdivision construction and commercial strip development. The FM 2100 roadway is narrow and the view is contained primarily to the roadway ROW and adjacent development in this area. The view along FM 1960 and US 90 traveling east-west consists of expansive vistas of open rural areas. Several rail lines converge within the City of Dayton near the central area and an old rice industrial complex is prominently seen. Traveling south from Dayton a large rail yard is visible to the west near SH 146. An area of oil and gas activity is also present in the vicinity of the Dayton landfill.

The southern portion of the study area is characterized by heavy oil and gas industrial activities. Immediately north of the City of Mont Belvieu the view is open across farms and pastures. The City of Mont Belvieu is positioned on a salt dome which can be seen as a raised landform. An extensive network of pipelines and industrial plants can be seen throughout the area from the roadway. A few residential communities are located in the area as well as churches, businesses, and schools. The new location of the City of Mont Belvieu is physically separated from the industrial area (old Mont Belvieu) by a canal. Residents and visitors in the Mont Belvieu area view roadways that are at-grade, rural facilities with limited traffic.

3.3 SOILS AND FARMLANDS

The study area for these resources includes the geology, soils, and farmlands mapped as outlined in **Exhibit 3-5** and **Exhibit 3-6**.

3.3.1 Physiographic Setting

There are seven physiographic provinces in Texas. Each physiographic province has characteristic geologic structure, rock and soil types, vegetation, and climate. The study area is located in the southeast part of Texas in the Coastal Prairies of Texas as shown in **Exhibit 3-4.** This consists of a nearly level topographic setting, bisected by many rivers, creeks, bayous, and floodplains. A portion of this region to the north is part of the Big Thicket National Preserve, a forested area with a wide variety of trees including pine, oak, ash, hickory, cypress, and walnut trees. The southern section contains Gulf prairies and marshes.

3.3.2 Geology

The study area from northwest to southeast is geologically characterized as the Lissie (Ql) and Beaumont (Qb) Formations, respectively, which were deposited during the Quaternary Period, less than two million years ago. Refer to **Exhibit 3-5** for the geological formations within the study area. Over 200 million years ago, dry climatic conditions resulted in evaporation of the sea, and salt was subsequently deposited over the area. Two salt domes, the Esperson Dome northwest of Dayton and the Barbers Hill Dome near Mont Belvieu, are prominent in the study area. Several oil fields are located throughout the study area, including the areas of Splendora, Dayton, and Mont Belvieu.

Caney Creek, Peach Creek, the East Fork of the San Jacinto River and the lower portion of the Lake Houston Wilderness Park are characterized on the Beaumont Sheet of the Geologic Atlas of Texas as the Deweyville Formation (Qd) and Alluvium (Qal). The Deweyville Formation consists of sand, silt, and clay with some gravel, and includes point bars, natural levees, stream channels, and backswamps slightly above the current floodplain. The Alluvium includes clay, silt, and sand with organic matter.

The northern portion of the Lake Houston Wilderness Park and the northern part of the study area are characterized as the Lissie Formation which consists of clay, silt, sand with gravel, pebbles, and calcareous and iron manganese concretions. The remainder of the study area to the east and south is made up of the Beaumont Formation. The portion of the study area south of US 90 is found on the Geologic Site Atlas, Houston Sheet. The Beaumont Formation is characterized by mostly clay, silt and sand, and includes

mainly stream channels, point bars, natural levees, backswamps, and some coastal marsh and mud-flat deposits.

3.3.3 Soils

The soil surveys of Montgomery County, Harris County, Liberty County, and Chambers County provide data applicable to the engineering principles as they pertain to the construction of a roadway (Natural Resources Conservation Service [NRCS] (NRCS, 1972; NRCS, 1976; NRCS, 1996; NRCS, 1976)).

The characteristics mentioned include the shrink-swell capacity of soils. The shrink-swell capacity is an indication of the volume change to be expected in the soil material as the moisture content changes. Shrinkage and swelling of soils causes damage to building foundations, roads, and other structures. All of the soils in the study area have a high shrink-swell potential and poor traffic supporting capacity, which poses engineering constraints.

3.3.3.1 Soil Associations in the Grand Parkway Segments H and I-1 Study Area

Dominant soil associations included in the study area are shown in **Exhibit 3-6**. Soil associations within Montgomery County include the Splendora-Boy-Segno association and the Sorter association. The Splendora-Boy-Segno association consists of deep, nearly level to gently sloping, somewhat poorly drained to well drained, loamy and sandy soils that have loamy lower layers. The Sorter association consists of deep, level, poorly drained soils that are loamy throughout.

Dominant soil associations included in the study area within Harris County include the Lake Charles-Bernard association, the Midland-Beaumont association, the Wockley-Gessner association, the Aldine-Ozan association, and the Segno-Hockley association. The Lake Charles-Bernard association consists of somewhat poorly drained, very slowly permeable, clayey and loamy soils. The Midland-Beaumont association consists of poorly drained, very slowly permeable, loamy and clayey soils. The Wockley-Gessner association consists of somewhat poorly drained and poorly drained, very slowly permeable soils. The Aldine-Ozan association consists of somewhat poorly drained and poorly drained, very slowly permeable and slowly permeable soils. The Segno-Hockley association consists of moderate well drained, moderately slowly permeable soils.

Dominant soil associations included in the study area within Liberty County include the Beaumont-Lake Charles association, Vamont-Woodville-Aldine association, and the Kirby-Waller-Sorter association. The Beaumont-Lake Charles association consists of nearly level to gently sloping, somewhat poorly drained and poorly drained, very slowly permeable, clayey soils. The Vamont-Woodville-Aldine association consists of nearly level to moderately sloping, somewhat poorly drained, very slowly permeable, clayey and loamy soils. The Kirby-Waller-Sorter association consists of nearly level, somewhat poorly drained and poorly drained, moderately permeable and slowly permeable, loamy soils.

Dominant soil associations included in the study area within Chambers County include the Beaumont-Morey-Lake Charles association, the Anahuac-Morey-Frost association, and the Vaiden-Acadia-Calhoun association. The study area is immediately adjacent to the Wallisville Reservoir, but not within the reservoir boundary. The Beaumont-Morey-Lake Charles association is level or nearly level, consists of acid to neutral, clayey and loamy soils, and contains standing water for long periods. The Anahuac-Morey-Frost association consists of acid loamy soils in nearly level areas with few natural drainageways. The Vaiden-Acadia-Calhoun association is in nearly level or depressional areas and contains acid, clayey and loamy soils. Water stands for long periods of time after heavy rains on Vaiden-Acadia-Calhoun association soils.

3.3.3.2 Mapped Soil Series

Eighty-six different soil types are found within the Grand Parkway Segments H and I-1 study area. **Exhibit 3-6** is a map of the soil types found in the study area, shown by mapping unit. **Tables 3-9** through **3-12** list the different soil types and corresponding county hydric soil status in the study area. Hydric soils are those that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation. Hydric soils that occur in areas having positive indicators of hydrophytic vegetation and wetland hydrology are wetland soils.

Table 3-9: Soil Types Located Within the Study Area: Montgomery County

Soil Type	Description	Hydric Status (NRCS, NTCHS)
Albany fine sand (Ab)	Occupies slightly convex ridges on stream terraces. Slopes are dominantly 0-3% but range up to 6%.	Non-hydric
Angie fine sand (An)	Occupies slightly convex ridges on stream terraces. Slopes are from 0- 2%.	Non-hydric
Bibb soils, frequently flooded (Bb)	Have slopes of less than 1% and occupy the floodplain of streams draining sandy and loamy soils.	Hydric
Blanton fine sand, 0 to 5% slopes (BlC)	This soil occupies convex slopes on ridge crests.	Non-hydric
Boy fine sand (Bo)	This level to gently sloping soil occupies convex areas. Slopes are dominantly 0-5% but in places range up to 7%.	Non-hydric
Bruno loamy fine sand (Br)	Occupies the natural levees next to the channel in the floodplain of streams. It has a plane to slightly convex slope of less than 1%.	Non-hydric
Crowley fine sandy loam (Cw)	Occupies terraces and broad upland interstream divides. Slopes are generally less than 1%, but range up to 2% and are plane to slightly concave.	Hydric
Eustics loamy fine sand (Eu)	Occupies both ridge crests and foot slopes. Slopes are mainly 0-5%, but range up to 7%, and are convex on ridge crests and concave foot slopes.	Non-hydric
Fuquay loamy fine sand, terrace (Ft)	This nearly level to slightly convex soil occupies low stream terraces and has slopes less than 1%.	Non-hydric
Fuquay loamy fine sand (Fs)	This soil has mainly slightly convex slopes of 0-3%, but some slopes range to 5%.	Non-hydric
Garner clay (Ga)	This soil level is slightly convex. Slopes are dominantly between 0.5 and 1.5% but range up to 3%.	Non-hydric
Lucy loamy fine sand (Lu)	This nearly level to gently sloping soil has convex slopes that are mainly 0.5-3%, but some slopes range up to 8% on the narrow breaks to the bottom lands.	Non-hydric
Segno fine sandy loam (Se)	Occupies broad, low, convex ridges. Slopes are dominantly 0.5-2% but range up to 5% in a few places.	Non-hydric
Sorter silt loam (So)	This nearly level to slightly depressional soil has a slope of less than 1%.	Non-hydric
Splendora fine sandy loam (Sp)	This soil has a plane slope of less than 1%.	Non-hydric
Susquehanna fine sandy loam, 1-5% (SuC)	Occupies broad interstream divides. Soil areas are irregular and have slightly convex surfaces.	Non-hydric
Tuckerman loam, heavy substratum (Tk)	Occupies slightly depressional areas on low stream terraces and has a slope of less than 0.3%.	Hydric
Waller loam (Wa)	This level to slightly depressional soil has a slope of less than 0.3%. Water is removed from the surface of this soil very slowly.	Hydric
Wicksburg loamy fine sand, 5-12% slopes (WkD)	This soil has strong; convex slopes.	Non-hydric

Note: Soil series shown as having hydric inclusions are not included on the hydric soils list. However, they may contain small, unmapped soils with hydric conditions
Sources: Soil Survey of Montgomery County, NRCS 1972; NTCHS

Table 3-10: Soil Types Located Within the Study Area: Harris County

Soil Type	Description	Hydric Status (NRCS, NTCHS)
Addicks loam (Ad)	A nearly level soil in broad areas on the upland prairies. The surface is plane to slightly convex. The slope ranges from 0-1% but averages about 0.3%.	Hydric
Addicks-Urban land complex (Ak)	A nearly level complex in rural areas. The surface is plane to slightly convex. The slope ranges from 0-1% and averages about 0.3%.	Hydric
Aldine very fine sandy loam (Am)	A nearly level soil in broad, oblong and oval wooded areas. The surface is plain to slightly convex. The slope is 0 to 1%, but averages about 0.6%.	Non-hydric
Aldine-Urban land complex (An)	A nearly level to gently sloping complex in metropolitan areas and in rural areas where the population is increasing. The slope is mainly 0-2% but ranges to 3%.	Non-hydric
Atasco find sandy loam, 1-4% slopes. (AtB)	A gently sloping soil in oblong and oval areas along ridges and natural drainageways. The surface is plane to convex. The slope averages about 2.5%.	Non-hydric
Beaumont clay (Ba)	A nearly level soil on the coastal prairie. The slope ranges from 0-1% but average 0.3%.	Hydric
Bernard clay loam (Bd)	A nearly level soil in broad, irregularly shaped areas. The slope ranges from 0 to 1% but averages less than 0.5%.	Hydric
Bernard-Edna complex (Be)	This complex is in broad areas on the costal prairie. The surface is convex and is characterized by many distinctive knolls and pimple mounds. The slopes average 0.8%.	Hydric
Beaumont-Urban land complex (Bc)	A nearly level complex in broad metropolitan areas and surrounding rural areas. The slope ranges from 0-1% but averages about 0.3%.	Non-hydric
Bernard-Urban land complex (Bg)	A nearly level complex in broad metropolitan areas and rural areas where the population is increasing. The slope is 0-1% but averages 0.5%.	Non-hydric
Clodine loam- (Cd)	Nearly level soils that are generally low on the landscape. Slopes are 0-1% but average 0.5%.	Hydric
Clodine-Urban land complex (Ce)	A nearly level complex in broad, irregular areas. The slope ranges from 0-1% but averages 0.6%.	Hydric
Edna fine sandy loam (Ed)	A nearly level soil on the prairie. The slope is mainly 0-2% but average 0.8%.	Hydric
Gessner loam (Ge)	A nearly level soil in broad irregular areas in small, round depressions. It is lower than the adjacent soils. Slopes are mainly less that 0.5%, but range 0-1%. The surface is plane to slightly concave.	Hydric
Hockley fine sandy loam, 1-4% slopes. (HoB)	This is a gently sloping soil in forest areas and pastures. Slopes are slightly convex and average 2%.	Non-hydric
Lake Charles clay, 0-1% slopes (LcA)	Soils are nearly level and are in broad, irregular areas. Slopes average 0.2%. A mulch of fine, discrete, very hard aggregates is on the surface of undisturbed areas.	Non-hydric
Lake Charles-Urban land complex (Lu)	Soils are nearly level and are in broad, irregular areas. Slopes range mainly from 0-1%, but range from 0-3% in some areas leading to drainage ways.	Non-hydric
Midland silty clay loam (Md)	Soils are nearly level and are in broad, irregular areas. Slopes range from 0-1%.	Hydric
Midland-Urban land complex (Mu)	Soils are nearly level and are in broad, irregular areas. Slopes range from 0-1%. Most areas are open prairie but some are covered with native hardwood.	Non-hydric
Ozan loam (Oa)	Nearly level soil in broad areas and on the floor of enclosed depressions. Slopes are plane to slightly concave and average 0.2%.	Hydric
Ozan-Urban land complex (On)	The nearly level soils on this complex are in built up rural and urban areas. The boundaries of this complex generally coincide with those of built-up subdivisions.	Hydric
Vamont clay, 0-1% slopes (VaA)	Nearly level soil in areas with slopes that average 0.5%. The surface is undisturbed and is characterized by gilgai micro relief.	Non-hydric
Wockley fine sandy loam (Wo)	Nearly level soils in areas of prairie and woodlands. Areas are irregularly shaped. The surface is plane to slightly concave. Slopes average 0.3%.	Hydric
Wockley-Urban land complex (Wy)	Nearly level soils in areas of prairie and woodlands.	Non-hydric

Note: Soil series shown as having hydric inclusions are not included on the hydric soils list. However, they may contain small, unmapped soils with hydric conditions
Source: Soil Survey of Harris County, NRCS 1976; NTCHS

Table 3-11: Soil Types Located Within the Study Area: Liberty County

Soil Type	Description	Hydric Status (NRCS, NTCHS)
Aldine-Aris complex (Ae)	Nearly level soils are in mounded areas of the coastal prairie and flatwoods. Most areas are broad, slopes are 0-1%.	Hydric
Anahuac-Aris complex (An)	Nearly level soils are in mounded areas of the coastal prairie. Areas are irregular in shape; slopes are 0-1%.	Hydric
Aris silt loam (Ar)	Nearly level soil on broad flats along drainage ways. Areas are long and narrow or irregular in shape; slopes are 0-1%.	Hydric
Beaumont Clay (Ba)	Nearly level soils are in broad areas of the coastal prairie; slopes are 0-1%.	Hydric
Bernard clay loam (Be)	Nearly level soils are in areas of the coastal prairie. Areas are elongated or irregular in shape; slopes are 0-1%.	Hydric
Bienville loamy fine sand, 0-2% slope (BnB)	Nearly level and gently sloping soil on stream terraces. Areas are oval or elongated.	Hydric
Bienville-Kenefick complex, 1-3% slopes (BvB)	Gently undulating soils on stream terraces. Areas are oval or elongated.	Hydric
Dylan Clay, 3-6% slopes (DyC)	Gently sloping and moderately sloping soil on side slopes along major drainage ways. Areas are elongated or irregular in shape.	Non-hydric
Estes Clay, frequently flooded (Es)	Nearly level soil on the floodplain of rivers and streams. Areas are long and narrow; slopes are 0-1%.	Hydric
Guyton-Aldine Complex (Gy)	Nearly level soils are in mounded areas of the coastal prairie. Areas are broad and irregular in shape.	Hydric
Hatliff clay loam, occasionally flooded (Ha)	Nearly level soil on the floodplain of rivers and major creeks. Areas are long and narrow; slopes are 0-1%.	Hydric
Kaman clay, frequently flooded (Kf)	Nearly level soil along the floodplain of the Trinity River and other large streams. Areas are long and broad; slopes are 0-1%.	Hydric
Kemah silt loam (Kh)	Nearly level soil in broad areas on uplands of coastal prairie. Areas are elongated or irregular in shape; slopes 0-1%.	Hydric
Kemah-Aris complex (Km)	Nearly level soils are in mounded areas of the coastal prairie. Most areas are broad, slopes are 0-1%.	Hydric
Kenefick fine sandy loam (Kn)	Nearly level soil in stream terraces. Areas are irregular in shape; slopes are 0-1%.	Hydric
Kirbyville fine sandy loam (Kr)	Nearly level soil on broad upland areas, irregular in shape. Slopes are 0-1%.	Hydric
Lake Charles clay, 0-1% slopes (LaA)	Nearly level soil on broad upland areas, irregular in shape.	Hydric
Mantachie loam, frequently flooded (Ma)	Nearly level soil on the floodplain of rivers and streams. Areas are long and narrow; slopes are 0-1%.	Hydric
Mocarey-Yeaton complex (My)	Nearly level soils on broad mounded areas of the coastal prairie. Areas are generally oblong in shape; slopes are 0-1%.	Hydric
Otanya fine sandy loam, 1-3% slopes (OyB)	Gently sloping soils on broad ridges and mounds of flatwoods. Areas are irregular in shape.	Hydric
Pits (Pt)	This map unit is mainly on stream terraces along the Trinity River. Areas are rectangular or oblong.	Non-hydric
Sorter loam (Sb)	Nearly level soil in slightly depressed areas of the flatwoods. Areas are broad and irregular in shape. Slopes are plane or convex, and less than 1%.	Hydric
Sorter-Dallardsville complex (Sd)	Nearly level soil on mounds of the flatwoods. Areas are broad and irregular in shape. Slopes are 0-1%.	Hydric
Sorter-Kirbyville complex (Sk)	Nearly level soil on mounds of the flatwoods. Areas are broad and irregular in shape. Slopes are 0-1%.	Hydric
Spurger fine sandy loam, 0-2% slopes (SrB)	This map unit is nearly level and gently sloping soil on low ridges of stream terraces along the floodplains of the Trinity River and large local streams.	Hydric
Spurger-Waller complex, 0-2% slopes (SwB)	Nearly level and gently sloping soil in stream terraces. Areas are broad and irregular in shape.	Hydric
Vamont silty clay, depressional (Vd)	Nearly level soils in broad areas of the coastal prairie. Areas are irregular in shape; slopes are 0-1%.	Hydric
Verland clay loam (Ve)	Nearly level soils in plane to slightly concave areas of the coastal prairie. Areas are irregular in shape; slopes are 0-1%.	Hydric
Voss fine sand, occasionally flooded (Vo)	This map unit is nearly level soil along the floodplains of the Trinity River and large streams. Areas are generally long and narrow. Slopes are 0-1%.	Hydric
Voss fine sand, frequently flooded (Vs)	This map unit is nearly level soil along the floodplains of the Trinity River and major streams. Areas are generally long and narrow. Slopes are 0-1%.	Hydric
Waller loam (Wa)	Nearly level soils in broad areas of the flatwoods. Areas are irregular in shape; slopes are 0-1%.	Hydric

Table 3-11: Soil Types Located Within the Study Area: Liberty County

Soil Type	Description	Hydric Status (NRCS, NTCHS)
Waller loam, depressional (Wc)	Nearly level soils in depressional areas of the flatwoods. Areas are round or elongated in shape; slopes are 0-1%	Hydric
Waller-Dallardsville complex (Wd)	Nearly level soils on broad mounded areas of stream terraces and flatwoods. Areas are irregular in shape. Slopes are 0-1%.	Hydric
Waller-Kirbyville complex (Wk)	Nearly level soils on broad mounded areas of flatwoods. Areas are irregular in shape. Slopes are 0-1%.	Hydric
Waller-Splendora complex (Wn)	Nearly level soils on mounds of the flatwoods. Areas are irregular in shape. Slopes are 0-1%.	Hydric
Wockley fine sandy loam (Wo)	Nearly level soils in broad, plane to slightly concave areas of the flatwoods. Areas are irregular in shape. Slopes are 0-1%.	Hydric
Woodville fine sandy loam, 1-3% slopes (WvB)	Very gently sloping soil on broad uplands. Areas are irregular in shape.	Non-hydric
Woodville fine sandy loam, 5-8% slopes (WvD)	Moderately sloping soil on uplands along drainage ways. Areas are generally long and narrow.	Non-hydric

Note: Soil series shown as having hydric inclusions are not included on the hydric soils list. However, they may contain small, unmapped parcels of soils exhibiting hydric characteristics within the larger map unit
Source: Soil Survey of Liberty County, NRCS 1996; NTCHS

Table 3-12: Soil Types Located Within the Study Area: Chambers County

Soil Type	Description	Hydric Status (NRCS, NTCHS)
Anahuac silt loam (An)	This soil is in long, narrow, slightly elevated areas. It is deep, nearly level, loamy soils.	Hydric
Beaumont clay (Be)	Deep nearly level, clayey soils on broad flats. Where this soil is in native range or improved pasture, the upper 4 in. has granular structure. Where it is used for rice, the surface layer is massive or has coarse platy structure.	Hydric
Frost silt loam (Fo)	Deep, acid, loamy soils that are nearly level or depressional. Slopes are less than 0.5% and are convex.	Hydric
Frost-Anahuac complex, undulating (FrB)	Deep, acid, loamy soils that are nearly level or depressional. It is 50-70% Frost silt loam, 25-45% Anahuac silt Loam and 5-25% other soils.	Hydric
Frost-Morey complex, leveled (Fs)	Deep, acid, loamy soils that are nearly level or depressional. It is 45-65% Frost silt loam, 25-55% Morey silt loam, and 5-50% other soils. Water stands on the surface of these soils for long periods after rains.	Hydric
Lake Charles clay, 0-1% slopes (LaA)	Deep, nearly level or gently sloping, clayey soils. In most places, it is not affected by floodwaters from Gulf storms. Slopes are less than 1%.	Hydric
Morey silt loam, leveled (Mo)	Deep, nearly level, loam soils. Slopes are less than 1%.	Hydric
Vaiden clay, 0-1% slopes (VaA)	Deep, nearly level or gently sloping clayey soils. Slopes are less than 1%.	Hydric
Vaiden clay, 1-5% slopes (VaB)	Deep, nearly level or gently sloping clayey soils. This soil is on narrow side slopes that lead to low terraces and floodplains of natural drainage ways. Slopes are 1-5%.	Hydric

Source: Soil Survey of Chambers County, NRCS 1976; NTCHS
Note: Soil series shown as having hydric inclusions are not included on the hydric soils list. However, they may contain small, unmapped soils with hydric characteristics within the larger map unit

3.3.3.3 Prime and Statewide or Local Important Farmland Soils

The U.S. Department of Agriculture (USDA) is the agency primarily responsible for the implementation of federal policy concerning farmland. Guiding farmland policy is the Farmland Protection Policy Act of 1981 (FPPA), U.S.C., Title 7, Chapter 73, Section 4201. The general provisions of Section 4201 state that "the Nation's farmland is a unique natural resource that provides food and fiber necessary for the continued welfare of the people of the United States." Section 4201 also states that "the Department of Agriculture and other federal agencies should take steps to assure that the actions of the Federal Government do not

cause United States farmland to be irreversibly converted to nonagricultural uses in cases in which other national interests do not override the importance of the protection of farmland nor otherwise outweigh the benefits of maintaining farmland resources". Each year a large amount of the nation's farmland is irrevocably converted from actual or potential agricultural use to nonagricultural use.

Section 4201 defines prime farmland as "land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion." Prime farmland may include land that is currently being used to produce livestock or timber. Farmlands of statewide importance are generally considered to be those lands that are nearly prime farmland and that produce high yields of crops in an economic manner when treated and managed according to acceptable farming methods. Farmlands of statewide importance may also include tracts of land that have been designated for agriculture by state law. Farmlands of local importance are additional lands used for farming that are identified by local agencies. Farmlands of local importance may also include tracts of land designated for agriculture by local ordinance.

According to the NRCS, much of the region associated with the study area contains prime and statewide or locally important farmland soils. The Segments H and I-1 study area contains 113,401 ac of prime farmland and an additional 161,139 ac that would be considered prime farmland if the soil was drained. Refer to **Table 3-13** for a list of the prime farmland soils within the study area.

Table 3-13: Prime Farmland Soil Types Located Within the Study Area

County	Soil Map Units
Montgomery County	Angie fine sand (An) and Waller loam (Wa).
Harris County	Bernard clay loam (Bd), Bernard-Edna complex (Be), Hockley fine sandy loam, 1-4% slopes (HoB), Lake Charles clay, 0-1% slopes (LcA), Vamont clay, 0-1% slopes (VaA), and Wockley fine sandy loam (Wo). If drained: Beaumont Clay (Ba), Clodine loam (Cd), Gessner loam (Ge), Verland silty clay loam (Md), and Ozan loam (Oa).
Liberty County	Bernard clay loam (Be), Bienville-Kenefick complex, Kenefick fine sandy loam (Kn), Kirbyville fine sandy loam (Kr), Lake Charles clay, 0-1% slopes (LaA), Otanya fine sandy loam, 1-3% slopes (OyB), Spurger fine sandy loam, 0-2% slopes (SrB), Vamont silty clay, 0-1% slopes (VaA), and Wockley fine sandy loam (Wo). If drained: Aldine-Aris complex (Ae), Anahuac-Aris complex (An), Mocarey-Yeaton complex (My), Sorter loam (Sb), Sorter-Dallardsville complex (Sd), Sorter-Kirbyville complex (Sk), Spurger-Waller complex, 0-2% slopes (SwB), Vamont silty clay, depressional (Vd), Waller loam (Wa), Waller-Dallardsville complex (Wd), Waller-Kirbyville complex (Wk), and Waller-Splendora complex (Wn).
Chambers County	Anahuac silt loam (An), Lake Charles clay, 0-1% slopes (LaA), and Vaiden clay, 0-1% slopes (VaA). If drained: Beaumont clay (Be), Frost silt loam (Fo), Frost-Anahuac complex, undulating (FrB), Frost-Morey complex, leveled (Fs), Morey silt loam, leveled (Mo).

Source: NRCS, 1976,1972,1976,1996

3.4 AIR QUALITY

Air pollution may contribute to adverse human health effects and ecosystem degradation. Motor vehicles, industries, construction equipment, and some commercial operations are among the sources of air pollution in the Houston area. The main air pollutants emitted from motor vehicles are volatile organic compounds (VOCs), nitrogen oxides (NO_X), carbon monoxide (CO), particulate matter (PM) and a class of compounds called mobile source air toxics (MSAT).

3.4.1 Criteria Pollutants

As reported by the Environmental Protection Agency (EPA) in 2012, the National Ambient Air Quality Standards (NAAQS) pollutants include ozone, lead, carbon monoxide, sulfur dioxide, nitrogen dioxide, and particulate matter. These pollutants are discussed below.

3.4.1.1 Ozone (O_3)

Ozone is not emitted directly into the air, but is formed through chemical reactions between precursor emissions of volatile organic compounds and nitrogen oxides in the presence of sunlight. Both volatile organic compounds and nitrogen oxides are emitted by transportation and industrial sources. Volatile organic compounds are emitted from sources such as automobiles, chemical manufacturing, dry cleaners, paint shops, and other sources using solvents.

3.4.1.2 Lead (Pb)

Historically, the main sources of lead emissions were lead gasoline additives. Emissions of lead from on-road vehicles decreased 99 percent between 1970 and 1995 due primarily to the use of unleaded gasoline. Additional reductions of lead emissions are anticipated as a result of the EPA's Multimedia Lead Strategy issued in February 1991.

3.4.1.3 Carbon Monoxide (CO)

The largest source of carbon monoxide emissions comes from motor vehicle exhaust. In some cities as much as 95 percent of all carbon monoxide emissions emanate from automobile exhaust.

3.4.1.4 Sulfur Dioxide (SO_2)

Sources of sulfur dioxide result largely from stationary sources such as coal and oil combustion, steel mills, refineries, pulp and paper mills and from non-ferrous smelters.

3.4.1.5 Nitrogen Dioxide (NO_2)

The two major emission sources of nitrogen dioxide are transportation and stationary fuel combustion sources such as electric utility and industrial boilers.

3.4.1.6 Particulate Matter (10 and 2.5 Microns)

Particulate matter (i.e., dust, dirt, soot, smoke, and liquid droplets) are directly emitted into the air by sources such as factories, power plants, cars, construction activities, fires, and natural windblown dust.

3.4.2 Regional Compliance

The EPA designates the status of an area's ambient air with respect to compliance to the NAAQS. The designations are as follows:

Designation	Definition
Attainment	Meets or is better than requirements
Nonattainment	Did not meet requirements
Unclassifiable	Cannot be classified

EPA has determined that Harris County and the seven other counties (including Montgomery, Liberty, and Chambers Counties) that comprise the Houston-Galveston–Brazoria area are in attainment for all of the NAAQS pollutants except ozone, for which it is in marginal nonattainment for the 2008 ozone NAAQS. EPA regulations require that a nonattainment area demonstrate that its Regional Transportation Plan (RTP) and Transportation Improvement Program (TIP) conform to the intent of the State Implementation Plan (SIP) by showing that the emissions under the plan are less than the emission budget set in the SIP. Under the regulations, added capacity projects, such as the Grand Parkway, may advance to construction only if they are part of the RTP and TIP that have been determined to conform to the SIP by the Metropolitan Planning Organization (MPO) and USDOT. The proposed project is included in the area's financially constrained 2035 RTP Update, as revised, and the 2013-2016 TIP, which were found to conform to the SIP by FHWA/Federal Transit Administration (FTA) on January 25, 2011 and November 1, 2012, respectively.

3.4.3 Mobile Source Air Toxics (MSAT)

Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments (CAAA) of 1990, whereby Congress mandated that the EPA regulate 188 air toxics, also known as hazardous air pollutants. The EPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430,

February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (http://www.epa.gov/ncea/iris/index.html). In addition, EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 1999 National Air Toxics Assessment (NATA) (http://www.epa.gov/ttn/atw/nata1999/). These are acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM), formaldehyde, naphthalene, and polycyclic organic matter. While FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules.

3.5 TRAFFIC NOISE

This analysis was accomplished in accordance with TxDOT's (FHWA approved) 2011 *Guidelines for Analysis and Abatement of Roadway Traffic Noise*. This guidance describes TxDOT's implementation of requirements of FHWA Noise Standard at 23 Code of Federal Regulations (CFR) Part 772. This guidance was developed by TxDOT and reviewed and concurred with by FHWA.

The following discussion provides a brief overview of the noise concept, describes the existing land uses that are most sensitive to noise (noise sensitive areas), and presents the existing noise levels within the study area. It also identifies the major sources contributing to existing noise and the methodology for determining existing noise levels within the study area.

Sound is defined as mechanical energy produced by the movement of compressed air waves radiating spherically from a source that can be sensed by the human ear. Although sounds are perceived differently from one person to another, they can be precisely measured. The strength of sound is commonly measured on a relative scale of sound pressure levels expressed in decibels or "dB." Noise is commonly defined as "unwanted" sound. Loudness is a term used to describe the manner in which people perceive the intensity of sound, and is considered to be subjective, as it varies from person to person. In general, sound becomes unwanted when it either interferes with normal activities such as sleeping or conversation, or when it disrupts or diminishes a person's quality of life.

Sound occurs over a wide range of frequencies. However, not all frequencies are detectable by the human ear; therefore, an adjustment is made to the high and low frequencies to approximate how the average human hears traffic sounds. These average levels are known as "A-weighted noise levels," and are expressed as "dB(A)."

Existing sources of noise in the study area include area roadways and railroads as well as residential, commercial and industrial developments. The predominant noise sources in the study area are currently vehicular traffic along the existing roadways (US 59 (N)/I-69, FM 1485, FM 1960, US 90, and I-10 (E)) and railroads.

Sound from highway traffic is generated primarily from a vehicle's tires, engine, and exhaust. It is commonly measured in decibels and is expressed as "dB." Sound occurs over a wide range of frequencies; however, not all frequencies are detectable by the human ear. Because traffic sound levels are never constant due to the changing number, type and speed of vehicles, a single value is used to represent the average or equivalent sound level and is expressed as "Leq."

The traffic noise analysis typically includes the following elements:

- Identification of land use activity areas that might be impacted by traffic noise;
- Determination of existing noise levels;
- Prediction of future noise levels;
- Identification of possible noise impacts; and
- Consideration and evaluation of measures to reduce noise impacts.

FHWA has established the Noise Abatement Criteria (NAC), shown in **Table 3-14**, for various land use activity areas that are used as one of two means to determine when a traffic noise impact would occur.

Table 3-14: Noise Abatement Criteria

Activity Category	FHWA dB(A) L_{eq}	Description of Land Use Activity Areas
A	57 (exterior)	Lands on which serenity and quiet are of extra-ordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Residential.
C	67 (exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72 (exterior)	Hotels, motels, offices, restaurants/bars and other developed lands, properties, or activities not included in A–D or F.
F	------	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	------	Undeveloped lands that are not permitted.

Source: *TxDOT's Guidelines for Analysis and Abatement of Roadway Traffic Noise* (2011)

A noise impact occurs when either the absolute or relative criterion is met. These criteria are defined as follows:

Absolute criterion: the predicted noise level at a receiver approaches, equals, or exceeds the NAC. "Approach" is defined as 1 dBA below the FHWA NAC. For example: a noise impact would occur at a Category B residence if the noise level is predicted to be 66 dBA or above.

Relative criterion: the predicted noise level substantially exceeds the existing noise level at a receiver even though the predicted noise level does not approach, equal, or exceed the FHWA NAC. "Substantially exceeds" is defined as more than 10 dBA. For example: a noise impact would occur at a Category B residence if the existing level is 54 dBA and the predicted level is 65 dBA (11 dBA increase).

When a traffic noise impact occurs, traffic noise abatement measures must be considered and evaluated for feasibility and reasonableness. A traffic noise abatement measure is any positive action taken to reduce the impact of traffic noise on an activity area.

To assess the ambient noise (existing conditions) within the Segments H and I-1 study area, noise monitoring was conducted in accordance with the TxDOT 2011 guidelines. Short-term noise measurements of 30-minute durations each were conducted at the selected monitoring sites using a Quest Technologies Sound Pro DL Integrating/Logging Sound Level Meter. The approximate location of these sites is shown in **Exhibit 3-7**. These ambient noise monitoring sites were chosen to represent the land use activity areas and to determine the existing background noise levels within the study area outlined in **Exhibit 3-1**. Simultaneous traffic counts were also recorded for nearby roadways as applicable. **Table 3-15** lists the existing noise level samples within the Segments H and I-1 study area.

Table 3-15: Representative Ambient Noise Levels in the Study Area

Site Location	Noise Level (dBA Leq)	Representative Receiver
SH 494	62.2	N/A
Roman Forest	51.7	R1A-R27
FM 1485*	57.4, 57.2	R28-R48A, R57, R58
FM 2100	59.1	R49-R56
FM 686	54.0	N/A
FM 1960	59.4	N/A
US 90	56.4	R59A, R59B

Source: Study Team, 2013
Notes: *Two noise reading were taken along FM 1485.
N/A: Non-applicable. No representative receivers were included in the noise model.

Existing background noise levels measured in the field at the various monitoring sites for the representative receivers ranged from 51 to 59 dBA Leq. The highest measured noise levels occurred south of FM 1960 in the eastern part of the study area. The lowest noise levels were measured at a site near a row of residences in the Roman Forest subdivision in the study area. These measured ambient sound levels characterize the existing noise conditions within the Segments H and I-1 study area.

3.6 WATER QUALITY

There are five regional watersheds found within the study area: Buffalo-San Jacinto, East Fork San Jacinto, Lower Trinity, North Galveston Bay, and West Fork San Jacinto. Many minor tributaries feed all major streams in the study area. The study area for water quality was determined by examining those areas of each watershed that fall within the study area outlined in **Exhibit 1-2**.

3.6.1 Watersheds

Five regional watersheds are found within the study area and smaller, or local, watersheds are within the regional watersheds. The Buffalo-San Jacinto and West Fork San Jacinto watersheds are found in the western limits of the H and I-1 study area and do not contain any smaller watersheds or major waterbodies. The majority of the study area and all major water features are inside the East Fork San Jacinto, North Galveston Bay, and Lower Trinity watersheds. The following is a description of each of the watersheds.

East Fork San Jacinto Watershed

The primary water bodies in the East Fork San Jacinto watershed are the East Fork San Jacinto River, Peach Creek, Caney Creek, and Luce Bayou. A smaller watershed is associated with each of these features and combined they form the portion of the East Fork San Jacinto watershed within the study area.

The East Fork San Jacinto River enters the study area from Liberty County and traverses southwest approximately 2 mi where it crosses the Montgomery County line. In the northwest portion of the study area, and beyond, the river watershed contains approximately 404 mi^2 at the confluence with Caney Creek. There are approximately 129 mi^2 of the watershed within the study area. The watershed is primarily Pineywoods and Blackland Prairie. The river extends upstream 75 mi to US 190 in Walker County. There is approximately 9.5 mi of the river's reach within the study area.

The East Fork San Jacinto River channel was analyzed by FEMA with specific roughness factors (Manning's "n") that indicate a channel with a moderate degree of irregularity, occasionally alternates,

medium density of vegetation and a moderate amount of meandering. The river contains some sluggish reaches, a substantial amount of weeds and deep pools. Over bank roughness values indicate floodplains with medium to dense brush and dense forests, in parts, with flood stage reaching branches. The large drainage area of the river, coupled with flat topography, results in slow runoff and longer duration floods.

The base flood elevation (BFE) at the river intersection within the northern study area is approximately 95 ft., which is equivalent to a 1 mi wide floodplain. The 100-yr peak discharge is approximately 57,000 cfs. Maximum water depth at flood stage is approximately 25 ft with a velocity of 2.5 fps. This location is within the limits of the City of Plum Grove. Approximately 2.75 mi downstream and near the intersection of the Montgomery, Harris, and Liberty county lines the 100-yr floodplain widens to over 6,500 ft. The BFE is 81.0 ft at this location with the depth at the center of the channel near 26 ft. The 100-yr flow is approximately 56,000 cfs with a corresponding velocity of 3.0 fps.

As the river traverses the east side of the Lake Houston Wilderness Park, the 100-year floodplain narrows to 1,500 ft. At the junction of the river and Caney Creek in the southern portion of the park the BFE is 57 ft. and the floodplain is approximately 1 mi wide. The river continues south for approximately 2.5 mi to the Luce Bayou junction. The floodplain in this location expands to 6,000 ft at a BFE of 50.5 ft. Approximately 4,500 ft downstream, the East Fork San Jacinto River discharges into Lake Houston just outside the study area, where the floodplain is 3,000 ft wide. The watershed at this point represents 2,900 mi^2. Normal pool elevation of the lake is approximately 44 ft. The BFE of Lake Houston is approximately 50 ft and the peak discharge of the river entering the lake is 252,000 cfs.

The Peach Creek watershed is primarily undeveloped. The geography of the watershed has similar characteristics to that of the East Fork San Jacinto River watershed with the major land use category being forest. The Peach Creek watershed area is 151 mi^2, encompassing land from its confluence with Caney Creek in Montgomery County north for 57 mi to SH 150 in Walker County. The creek enters the study area 2,500 ft north of US 59 (N)/I-69 at the southern limits of the City of Splendora and flows south over 6 mi to the confluence with Caney Creek. The Peach Creek floodplain at the City of Splendora is 2,200 ft wide with a BFE of 100 ft and a channel centerline water depth of approximately 15 ft. The 100-year peak discharge is approximately 39,000 cubic feet per second (cfs) with a velocity of 2.0 feet per second (fps). As the creek traverses south, it passes through the small towns of Patton Village, Woodbranch, and the City of Roman Forest, and crosses FM 1485 immediately west of the Lake Houston Wilderness Park.

Floodplain widths vary from 1,800 ft at US 59 (N)/I-69 and the UPRR to over 5,000 ft at the Caney Creek junction, which is approximately 4,000 ft north of the Harris County line. At the Caney Creek confluence, the Peach Creek BFE is 71 ft; the 100-year flow is approximately 44,000 cfs with a velocity slightly exceeding 2.0 fps. The flood stage water depth is approximately 25 ft.

The Caney Creek watershed is also largely undeveloped and the major land use category is forest. From its confluence with the East Fork San Jacinto River in Harris County, north through Montgomery County to SH 150 in Walker County, the watershed encompasses 222 mi^2. The reach length is also 57 mi long, of which approximately 7 mi lies within the study area. The creek enters the study area approximately 2,500 ft northwest of US 59 (N)/I-69 where the floodplain is approximately 1,500 ft wide. The BFE is 84 ft with a 100-year peak flow of approximately 27,000 cfs, and a velocity of slightly over 3.0 fps. The centerline floodwater depth would be approximately 24 ft. Caney Creek crosses FM 1485 approximately 2 mi downstream from its confluence with US 59 (N)/I-69 and establishes its confluence with Peach Creek approximately 3 mi further. The 100-year floodplain varies from approximately 3,000 ft wide near FM 1485 to approximately 1 mi wide at the Peach Creek junction.

At the junction, the BFE is approximately 71 ft; the 100-year peak discharge is 66,000 cfs with a velocity of approximately 2.5 fps. The main channel flood stage would be approximately 23 ft deep. The confluence of Caney Creek and White Oak Creek is approximately 1.5 mi south of the Harris County line. During a 100-year flood event this junction would experience backwater effects from the East Fork San Jacinto River, which has confluence with Caney Creek 4,400 ft downstream. At the White Oak Creek confluence, the BFE is 58.0 ft. This floodplain is 2,800 ft wide with a 100-year peak discharge of approximately 66,000 cfs. The corresponding velocity would be near 3.0 fps. At the confluence of Caney Creek and the East Fork San Jacinto River, the BFE is approximately 57.0 ft and the floodplain is approximately 1 mi wide.

Although White Oak Creek drains a sub-watershed within the Caney Creek watershed, it deserves mention here because its drainage area is 29.5 mi^2 and it contributes a 100-year peak discharge of over 4,000 cfs to the flow of Caney Creek, and subsequently the East Fork San Jacinto River. White Oak Creek has nearly 7 mi of stream reach within the study area. The floodplain is 2,000 ft wide at US 59 (N)/I-69 and narrows to 900 ft wide approximately 2 mi downstream. At the Harris County line, the floodplain is 4,000 ft wide and is indistinguishable from that of Caney Creek. Although the entire watersheds of the East Fork San Jacinto

River, as well as those of Peach and Caney Creeks are mostly undeveloped, there is substantial subdivision development within the study area.

The Luce Bayou watershed is located 3 mi north of Dayton in west central Liberty County, and flows from the northeast to the southwest as it transects the northeastern portion of the study area. The watershed is largely non-urbanized with an area of approximately 227 mi^2. Approximately 14 mi of the bayou's reach is within the study area. The watershed is primarily flat terrain with local escarpments and surface sandy loam soil, in places, that supports heavy forests and agriculture. Roughness values indicate the bayou channel is irregular, with the cross-section alternating frequently and displaying heavy vegetation. The floodplain is most often heavily wooded and exhibits tall grasses. Storm water runoff is slow and there are long duration flood concentrations. Flow is intermittent in the upper reaches and very sluggish elsewhere.

Luce Bayou enters the study area 1,000 ft upstream of SH 321 where the BFE is 97.5 ft and the floodplain is 7,500 ft wide. The 100-year peak discharge is approximately 4,000 cfs with a velocity of 0.5 fps. The centerline water depth, relative to the BFE, is approximately 13 ft. The Luce Bayou confluence with Tarkington Bayou is 4 mi downstream. At this juncture, the floodplain is approximately 3,000 ft wide. The 100-year flow is 16,900 cfs with a velocity of less than 2.0 fps. Backwater effects from Tarkington Bayou extend nearly 3 mi up Luce Bayou, which is indicative of the flat channel, floodplain, and watershed. The floodplain narrows to 1,000 ft wide in places downstream. Nine miles beyond Tarkington Bayou where Luce Bayou enters Harris County, the floodplain is 2,200 ft wide. Three miles farther the floodplain narrows to 1,700 ft at FM 2100. Approximately 7.3 mi downstream of the county line, Luce Bayou meets the East Fork San Jacinto River within a subdivision development. The 100-year peak discharge at this point is approximately 16,100 cfs, and the BFE is 50.5 ft with a floodplain width of 6,000 ft. The 100-year flood stage is 34.0 ft with a velocity of 1.0 fps.

North Galveston Bay Watershed

Cedar Bayou is the primary water body in the North Galveston Bay watershed. The 247 mi^2 Cedar Bayou watershed is characterized by level terrain that slopes gently to the south. There are approximately 144 mi^2 of the watershed in the study area. Headwaters of the bayou are found in Liberty County 7.5 mi northeast of the FM 1960 intersection with the Liberty County/Harris County line. The channel forms most of the boundary between Harris, Liberty, and Chambers counties, with approximately half of the watershed in Harris County. Much of the watershed is undeveloped with the exception of Mont Belvieu and the City of

Baytown. Flooding is frequent with extended periods of storm water concentrations. Based on the surface roughness or texture values, the bayou channel has a fairly high degree of irregularity, with the cross-section alternating frequently and often covered with heavy vegetation. Floodplain widths vary dramatically from 1,000 ft to 14,000 ft. The Harris County Flood Control District (HCFCD) maintains at least 14 channels within the study area that discharge into Cedar Bayou.

At the upstream end of Cedar Bayou the 100-year flow is approximately 900 cfs. Downstream 5.2 mi at the Liberty County/Harris County line the 100-year peak discharge is 4,400 cfs with an average velocity of less than 2.0 fps. The floodplain is 2,000 ft wide with a BFE of 71 ft and a centerline floodwater depth of 16 ft. Cedar Bayou intersects FM 1960 approximately 2,000 ft downstream where the floodplain widens to 14,000 ft, primarily on the west side of the channel. The channel grade line and associated floodplain flatten near FM 1960 with flood stage channel velocities generally less than 2.0 fps downstream. At the US 90 intersection 7.8 mi downstream the BFE is 57 ft; the 100-year flow is approximately 7,200 cfs and the floodplain is 4,500 ft wide. The flood stage water depth is 17 ft. At the confluence with Adlong Ditch 4.5 mi downstream, Cedar Bayou has a peak flow over 8,000 cfs with a floodplain width of approximately 10,000 ft. Harris, Liberty, and Chambers counties intersect approximately 2.3 mi downstream where the floodplain is 6,000 ft wide and the BFE is 36 ft. One mile south is the junction with Hickory Island Gully, a stream with a 6-mi reach which contributes a peak discharge of 1,600 cfs to Cedar Bayou. Approximately 3.2 mi downstream, Cedar Bayou passes FM 1942 where the floodplain narrows to 1,500 ft wide. The bayou exits the study area 3.6 mi downstream, approximately 1,500 ft south of I-10 (E). Flood stage water depth is over 30 ft at the channel centerline. The 100-year peak flow is 17,000 cfs and the floodplain is 3,000 ft wide.

The City of Mont Belvieu, in Chambers County, occupies a topographic high elevation in the southeast corner of the study area. Phase I of the Grand Parkway Segment I-2 has completed construction south of I-10 (E) to FM 1405 and intersects the interstate 2,300 ft south of the Mont Belvieu city limits. Smith Gully traverses the center of town as it drains 4.3 mi^2. It converges with Cedar Bayou north of I-10 (E) and west of Loop 207. The 100-year peak discharge is 2,400 cfs and the floodplain is approximately 700 ft wide, with out-of-bank flooding and shallow ponding common. The BFE north of Mont Belvieu is 54 ft and the BFE is 24 ft at SH 146 near Cedar Bayou.

Lower Trinity Watershed

The proposed intersection of I-10 (E) and Segment I-1 represents the western limits of the Lower Trinity River watershed. There are approximately 71 mi^2 of the watershed in the study area. The BFE is 32 ft with a 100-year peak flow of 2,000 cfs, where Hackberry Gully bisects the proposed I-10 (E) and Segment I-1 intersection. Approximately 2,000 ft south where Hackberry Gully exits the study area the BFE is 27 ft and the floodplain width is approximately 300 ft.

The remainder of the study area lies within the Lower Trinity River watershed, and the storm water runoff direction is generally from west to east. The terrain slopes gently and has low relief. Ground cover is typical for the Coastal Province. Roughness values indicate heavy brush with forests in the floodplains. The soils are principally dark clays and sandy loams. The City of Dayton in Liberty County is found at the east-central boundary of the study area. The western edge of the Trinity River 100-year floodplain is approximately 1 mi east of the intersection of US 90 and SH 146 where the BFE is 28.5 ft. The surrounding natural ground elevation is approximately 80 ft. Two branches of Linney Creek, a minor tributary of the Trinity River, are located approximately 2 mi north of Dayton. Linney Creek has yet to be studied by the Federal Emergency Management Agency (FEMA), but does not appear to be a major source of flooding. The East and West Dayton Ditches that intersect FM 1960 are located approximately 4 mi west of Dayton. Each ditch has a peak discharge of approximately 550 cfs. The floodplain is approximately 1 mi wide and has a BFE at FM 1960 of approximately 77.5 ft. The East Prong Old River crosses SH 146 approximately 3.8 mi south of Dayton, and the West Prong crossing is approximately 2 mi downstream. Neither of the watersheds have been studied in great detail by FEMA. Therefore, an additional hydrologic study would be required in the future.

Buffalo-San Jacinto and West Fork San Jacinto Watersheds

The Buffalo-San Jacinto and West Fork San Jacinto watersheds are mapped within the western portion of the proposed Segments H and I-1 study area. There is approximately 1 mi^2 of the West Fork San Jacinto watershed and 5 mi^2 of the Buffalo-San Jacinto watershed in the study area. Although drainage ditches and small tributaries are present, no significant watershed features are located within either the Buffalo-San Jacinto or West Fork San Jacinto watersheds within the study area. Within the Buffalo-San Jacinto watershed there are minor tributaries that flow to Lake Houston and Gum Gully.

3.6.2 Surface Water

The Texas Surface Water Quality Standards (TSWQS) apply to all surface water features in the state. These standards are enumerated in Title 30, Chapter 307 of the Texas Administrative Code. The standards were approved by the EPA in accordance with Section 303 of the Clean Water Act (CWA) and, as required by the statute, are updated every 3 years. The standards are typically designed to protect the most sensitive beneficial use within a water body. The Texas Commission on Environmental Quality (TCEQ) distributes the information provided by the TSWQS and administers compliance with the standards. Five general categories for water use are defined in the TSWQS: aquatic life use, contact recreation, general use, public water supply, and fish consumption.

The TCEQ carries out a regular program of monitoring and assessment to compare conditions in Texas surface waters to established standards and to determine which water bodies are meeting the standards. The results of the assessment are published periodically in the Texas Water Quality Inventory and 303(d) list, as required by Sections 305(b) and 303(d) of the CWA. The Texas Water Quality Inventory and 303(d) list is an overview of the status of surface waters of the state, including concerns for public health, fitness for use by aquatic species and other wildlife, and specific pollutants and their possible sources.

As a result of this assessment, the State of Texas must develop action plans to remediate those water bodies that are impaired through the development of a total maximum daily load (TMDL) which determines the maximum amount of pollutants that a water body can receive and still both attain and maintain its water quality standards and which allocates this allowable amount (load to point and non-point sources in the watershed). The TCEQ monitoring program divides the state's surface water into river basin data, and further divides this data into specific segments which are each allocated a segment identification number.

According to the 2010 Texas 303(d) list, two listed segments are within the study area. Cedar Bayou Above Tidal (Segment ID: 0902) is listed as impaired from a point 1.4 mi upstream of I-10 (E) in Chambers/Harris County to a point 4.6 mi upstream of FM 1960 in Liberty County, where it is listed as a Category 5c, Rank D because of low dissolved oxygen. Category 5 waters are those which do not meet applicable water quality standards or are threatened for one or more designated uses by one or more pollutants. Category 5c waters are those where additional information would be collected before a TMDL is scheduled. A rank of "D" indicates that additional data would be collected before a TMDL is scheduled. Cedar Bayou Tidal (Segment ID: 0901) is listed along its entire length as impaired due to dioxin in catfish

and crab tissue (Category 5a, Rank U). The Category 5a designation means that a TMDL is scheduled, underway or would be scheduled for the waterway in question. The Rank of "U" indicates that a TMDL study is underway.

3.6.3 Groundwater

The major aquifer underlying the study area is the Gulf Coast aquifer. This aquifer contains large quantities of fresh water that extend to a depth of 1800 ft below sea level (Anders, 1968). The Gulf Coast aquifer has been divided into five hydrostratigraphic units: Catahoula confining system, Jasper aquifer, Burkeville confining system, Evangeline aquifer, and Chicot aquifer (TWDB, 2006). These units dip from land surface southeastward at slight angles toward the Gulf of Mexico (United States Geological Survey [USGS], 2002). Recharge to the Gulf Coast aquifer mainly occurs from rainfall that falls on the outcrop areas (TWDB, 2006). Most of the rainfall is taken up by evapotranspiration (water loss from the surface of soils and plants) before reaching the zone of saturation. Water also drains into the aquifer from some reaches of the numerous streams that cross the Gulf Coast. Areas with extensive groundwater pumping, such as water and irrigation wells, can form large cones of depression and may capture recharged water that was naturally discharging to local streams. This could result in an increase of downdip recharge. Recharge through the unconfined, permeable, sandy portions of the aquifer may be relatively fast, while recharge to the confined portions of the aquifer may be considerably slow.

Throughout the early to mid-1900's, numerous studies in the region linked groundwater withdrawal to subsidence (HGSD, 2009). In 1961 when Hurricane Carla resulted in much more flooding than was expected, local governments began to look at what could be done about the impact of subsidence on the economy and quality of life in the area. As a result, in 1975 the Texas Legislature created the Harris-Galveston Subsidence District (HGSD), the first of its kind in the United States. The Lone Star Groundwater Conservation District (GCD) was created for Montgomery County in 2001 by the Texas Legislature. Authorized as regulatory agencies, the HGSD and Lone Star GCD were given authority to restrict groundwater withdrawals within their jurisdictions.

3.6.4 Water Well Review

Public well records from the TCEQ, private water well records, and driller's reports from the Texas Water Development Board (TWDB) were reviewed for the study area. Both agencies maintain a listing of existing water wells in the area. However, the databases only include wells that have been reported to the TCEQ or

the TWDB and may not include all water wells in the study area. The results of the water well review indicate that there are a total of 314 water wells within the study area (TCEQ, 2007 and TWDB, 2006). Of this total, 80 are public water supply wells. The remaining 234 are private which are not presently afforded protection by any regulations.

The state's Source Water Protection (SWP) program is a community based, voluntary pollution prevention program that was created by the 1996 Safe Drinking Water Act Amendments and the expansion of the Wellhead Protection Program. All public water supply systems are eligible to participate in the state's SWP program. This program establishes procedures and criteria for identifying the boundaries of areas which constitute the sources of water used by public water systems. It also sets out procedures for identifying potential sources of contaminants within these areas and provides for the development and implementation of plans for managing the potential sources to prevent contamination.

3.7 WATERS OF THE U.S., INCLUDING WETLANDS AND VEGETATIVE COMMUNITIES

3.7.1 Regional Setting

The study area lies at the southern edge of the Pineywoods and the northern and eastern portion of the Gulf Coastal Prairies and Marshes natural ecological regions as designated by the TPWD (**Exhibit 3-8**). Within the study area, the Pineywoods natural region covers the northern and western half of the study area, approximately 103,426 ac or 46 percent of the study area, while the Gulf Coastal Prairies and Marshes covers approximately 121,413 ac or 54 percent of the study area. The study area encompasses those wetlands and vegetative communities that exist within the project limits defined in **Exhibit 3-9**.

The study area, located in the Austroriparian Biotic Province **(Exhibit 3-10)**, is characterized as an ecotonal region including the Gulf coastal plain from the Atlantic Ocean to Eastern Texas. The western boundary of this province is approximated by a north-south line from western Harris County to Red River County. The western boundary of the Austroriparian Biotic Province is the western extent of pine and hardwood forests of the eastern Gulf plain. The vegetation of this biotic province within the study area includes the longleaf pine and the pine-oak forests. In recent decades, the faunal distribution within the study area has been primarily impacted by development, both urban and the clearing of forested land for agricultural use. Consequently, the distribution of forest habitat specialty species has become more restricted due to loss of habitat; many species once associated with the gulf coastal prairies are no longer found in many areas due to conversion of habitat to agricultural crop production.

3.7.2 Waters of the U.S.

The EPA and the United States Army Corps of Engineers (USACE) are charged with the protection of "Waters of the U.S." under the Federal Water Pollution Control Act of 1972, amended in 1977 to the CWA. The term "Waters of the U.S.," as defined in 33 CFR 328.3, denotes:

- All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
- All interstate waters including wetlands; and
- All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce.

To characterize surface drainage systems (streams), the designations perennial, intermittent, and ephemeral are used:

- Perennial streams flow year-round during a typical year. The water table is located above the stream bed for most of the year and groundwater is a primary source for stream flow. A perennial stream is typically capable of supporting aquatic life.
- Intermittent streams flow during certain parts of the year, typically seasonally, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Rainfall is a supplemental source of flow. Biological constituents are adapted to wet and dry fluctuations.
- Ephemeral streams only flow for short durations after precipitation. Ephemeral streams are located above the water table year round. Runoff from rainfall is the primary source of flow. Aquatic life is extremely scarce or typically absent. Not all ephemeral streams are USACE regulated waters. In order to be considered jurisdictional, ephemeral streams must have a hydrological connection to jurisdictional waters.

All tidal waters, interstate waters and intrastate waters whose use, degradation, or destruction could affect interstate commerce are considered jurisdictional and subject to USACE regulation. In practical application, this includes all perennial and intermittent streams and all ephemeral streams exhibiting an ordinary high water mark (OHWM). Also included are natural lakes and ponds with surface connections to navigable water or other ties to interstate commerce, all impounded lakes or ponds created from jurisdictional waters described above, and their adjacent wetlands.

Five regional watersheds are found within the study area: Buffalo-San Jacinto, East Fork San Jacinto, Lower Trinity, North Galveston Bay, and West Fork San Jacinto (**Exhibit 3-11**). Within these five

watersheds at least 52 named potential Waters of the U.S. were identified in the study area (**Exhibit 3-12** and **Exhibit 3-13**):

- Adlong Ditch
- Ash Gully
- Barbers Hill Canal
- Big Ditch
- Camp Branch
- Caney Creek
- Cary Bayou
- Casey Gully
- Casey Pond
- Cat Pond
- Cedar Bayou
- Cherry Point Gully
- Church House Gully
- Clawson Ditch
- Coastal Water Authority Canal
- Cotton Bayou
- Dayton Canal
- Dunks Ditch
- East Fork Cedar Bayou
- East Fork San Jacinto River
- East Prong Old River
- Ellis Branch
- Frost Reservoir
- Green Tree Ditch
- Gum Gully
- Hackberry Gully
- Harvard Ditch
- Hickory Island Gully
- Krenek Ditch
- Lakeland Lake
- Lick Branch
- Linney Creek
- Long John Creek
- Luce Bayou
- Lynchburg Canal
- Magee Gully
- Maple Branch
- Mare Branch
- Mexican Gully
- Orange Branch
- Orton Gully
- Patton Lake
- Peach Creek
- Peach Creek Lake
- Robinson Gully
- Rocky Branch
- Shadow Lake
- Shook Bayou
- Smith Gully
- Tarkington Bayou
- Taylor Gully
- West Prong Old River

Various other unnamed ponds, streams, and ditches were also identified in the study area.

3.7.3 Wetlands

Wetlands are zones of transition between terrestrial (upland) ecosystems and aquatic habitats. The wetlands in the study area are generally found near streams and rivers or as man-made or natural impoundments. Wetlands can also be found in depressional areas where the ground elevations result in the formation of ponds or areas that tend to remain wet longer than the surrounding landscape.

The term "wetlands" as applied in the CWA and by the USACE includes those areas that are "inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances typically do support, a prevalence of vegetation typically adapted for life in saturated soils." Inherent in this definition is the presence of three mandatory criteria: hydric soils, hydrophytic vegetation, and wetland hydrology.

The primary function of wetlands relates to their physical, chemical, and biological attributes. The CWA recognizes water quality benefits and the uniqueness of water habitat as the principle reasons for regulating wetlands and avoiding unnecessary impacts. Examples of wetland functions include flood flow alteration, wildlife habitat, filtering of contaminants, and groundwater recharge. The term "values" may be used to describe those functions that are generally regarded as beneficial to society. Recreation and uniqueness are examples of values. Values are typically associated and weighed by a combination of a wetland's inherent capabilities combined with the opportunity to perform those functions. Accordingly, a wetland might have the potential to remove contaminants from a waterway, but its value may be low because of the lack of opportunity to do so. All or part of society may not value some wetland functions. For example, nutrient removal and transformation may not be considered a value if that function leads to algal blooms and noxious odors.

Wetlands are especially valued because of their location on the landscape, the variety of functions they perform, and the uniqueness of their plant and animal communities. Individual landowners and members of the general public also value wetlands for their open space and aesthetic qualities, as locations of important historic and archeological sites and as locations for conveying floodwaters.

The United States Fish and Wildlife Service (USFWS), for the purpose of their designation and inventory of wetlands, defines "wetlands" as "lands transitional between the terrestrial and aquatic system where the water table is usually at or near the surface or the land is covered by shallow water." Many National

Wetland Inventory (NWI) wetlands are not jurisdictional wetlands regulated by the USACE. This fact is emphasized in the USACE 1987 Wetland Delineation Manual, which specifies that USFWS Cowardin NWI definition of wetlands only requires a positive indicator for one of the three parameters (hydric soils, hydrophytic vegetation, and wetland hydrology) required for consideration as a regulated wetland pursuant to Section 404 of the CWA.

The USFWS Wetland Designation System designates wetlands hierarchically by system, subsystem, class, and subclass. Additional modifiers (such as regime) and dominance type (dominant species present) may also be assigned. Hence, riverine wetlands are subsequently assigned to a subsystem based on flow (e.g., tidal, perennial, or intermittent), to a class based on general appearance of the environment (e.g., substrate or shoreline), to a subclass (e.g., finer distinction of substrate or shoreline), and to a regime (e.g., permanently or intermittently flooded). A dominance type may be assigned based on the species or species complex dominating the substrate or the upper level of emergent vegetation.

Wetland types identified within the study area include palustrine, riverine, and lacustrine. Refer to **Exhibit 3-12** for NWI wetlands within the study area which were utilized due to the lack of right of entry granted in the study area.

Palustrine System

The palustrine system includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent lichens, or mosses, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent. Palustrine systems are bounded by uplands or any of the other Cowardin systems. The palustrine system typically includes those areas called marshes, swamps, and bogs.

There are approximately 2,242 ac of palustrine wetlands within the study area. This acreage includes approximately 453 ac of forested wetlands, 78 ac of shrub-scrub wetlands, 296 ac of emergent herbaceous wetlands, 1,188 ac of farmed emergents (likely to be non-jurisdictional rice fields), 210 ac of unconsolidated bottom, 11 ac of aquatic bed, and 6 ac of unconsolidated shoreline. Unconsolidated bottom consists of all wetland and deepwater habitats that are characterized by less than 30 percent vegetative cover and a lack of large stable surfaces for plant and animal attachment. Aquatic bed consists of wetlands dominated by plants that grow on or beneath the surface of the water for most of the growing season. Unconsolidated

shoreline consists of wetlands having less than 75 percent rock cover, less than 30 percent vegetation cover, and flooded conditions.

It is likely that the 453 ac of forested wetlands, 296 ac of emergent herbaceous wetlands, and 78 ac of shrub-scrub wetlands would be jurisdictional provided they demonstrate a hydrologic connection to a navigable water. The jurisdictional status of the unconsolidated bed and shoreline areas and aquatic bed areas depends upon the hydrology and connection to navigable waters and would be determined during the USACE verification process.

Riverine System

Riverine systems include all wetland and deepwater habitats (greater than 6 ft deep) contained within a channel except for:

- wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens; and
- habitats with water containing ocean-derived salts in excess of 0.5 percent.

Riverine systems are bounded on the landward side by upland, by the channel bank, or by wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens. Approximately 218 ac of riverine wetlands are within the study area. These wetlands include areas in Caney Creek, Peach Creek, the East Fork of the San Jacinto River, Luce Bayou, Cedar Bayou, and the Dayton Canal. Riverine systems including wetlands are almost exclusively lower perennial systems and are likely to be jurisdictional. This determination would be made during the USACE verification process.

Lacustrine System

Lacustrine wetlands include wetlands with all of the following characteristics:

- situated in a topographic depression or dammed river channel;
- lacking trees, shrubs, persistent emergents, emergent mosses, or lichens with greater than 30 percent areal coverage; and
- total area exceeds 20 ac.

Similar habitats less than 20 ac can be classified as lacustrine if an active wave-formed or bedrock shoreline feature makes up part of the boundary or if water depth exceeds 6.5 ft at low water. Lacustrine wetlands may be tidal or nontidal, but must have an ocean-derived salinity of less than 0.5 percent.

There are approximately 250 ac of lacustrine wetlands within the study area. This includes open water areas greater than 6.5 ft deep (limnetic) and areas less than 6.5 ft deep, to the shoreward edge of the system. Dammed river channels and naturalized depressional areas with surface connections to navigable waters are potentially jurisdictional. Man-made depressions excavated from upland and/or isolated features may also be jurisdictional areas, and this determination would be made during the USACE verification process.

3.7.4 Vegetative Communities

The major ecological regions within the study area are the Pineywoods and the Gulf Coastal Prairies and Marshes (Gould, 1960). The designated TPWD vegetation types within the study area are dominated by the pine-hardwood forests in the north and crops found in the southern portion as shown on **Exhibit 3-9** (TPWD, 1984).

As depicted on the TPWD *Vegetation Types of Texas* (TPWD, 1984) map, there are four vegetation types mapped within the study area. A majority of the northern one-third of the study area is mapped as pine-hardwood forests. This area is interspersed with native pine-hardwood vegetation, farmlands, and pastures. A small area designated as young forest/grasslands is located in the northwest corner of the study area. This area exhibits various combinations and age classes of pine and re-growth of southern red oak (*Quercus falcata*), sweetgum (*Liquidambar styraciflua*), and other oaks resulting from recent harvesting of pine or pine-hardwood forests and the establishment of pine plantations or young pine-hardwood forests. A small area designated as other native or introduced grasses is located in the northeast portion of the study area. This area is a mixture of native and introduced grasses and forbs on grassland sites or mixed herbaceous communities resulting from the clearing of woody vegetation. The southern two-thirds of the study area is designated as crops with the exception of the land adjacent to Cedar Bayou which is designated as pine-hardwood forests. Of the 224,840 ac contained within the study area, approximately 122,650 ac (54.6 percent) are designated as crops, approximately 91,700 ac (40.8 percent) are designated as pine-hardwood forest, approximately 9,930 ac (4.4 percent) are designated as young forest/grasslands, and approximately 560 ac (0.2 percent) are designated as other native or introduced grasses. Generally, vegetation in the study area is consistent with the TPWD designations.

The typical vegetation species associated with the pine-hardwood forest vegetation type include shortleaf pine (*Pinus echinata*), water oak (*Quercus nigra)*, white oak (*Quercus alba),* southern red oak (*Quercus*

falcata), winged elm (*Ulmus alata)*, beech (*Fagus grandifolia)*, blackgum (*Nyssa sylvatica*), magnolia (*Magnolia grandiflora)*, American beautyberry (*Callicarpa americana*), American hornbeam (*Carpinus caroliniana*), flowering dogwood (*Cornus florida*), yaupon (*Ilex vomitoria*), hawthorn (*Crataegus sp.*), supplejack (*Berchemia scandens*), Virginia creeper (*Parthenocissus quinquefolia*), wax myrtle (*Myrica cerifera*), red bay (*Persea borbonia* var. *borbonia*), sassafras (*Sassafras albidum*), southern arrowwood (*Viburnum dentatum*), poison ivy (*Toxicodendron radicans*), greenbriar (*Smilax sp.*) and blackberry (*Rubus sp.*). The following species may be found within the study area along deep sand ridges: black hickory (*Carya texana*), sandjack oak (*Quercus incana*), common persimmon (*Diospyros virginiana*), sweetgum, beaked panicum (*Panicum anceps*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), three-awn (*Aristida sp.*), and bushclover (*Lespedeza sp.*).

TPWD maps indicate that the southern portion of the study area is designated as the crops vegetation type. This vegetation type includes either cover crops or row crops including rice fields. Crops may also include grasslands associated with crop rotations.

In addition, 2010 infrared aerials were obtained from the Texas Natural Resource Information System (TNRIS) and used to further identify the vegetative communities. Based off of this review, agricultural land, agricultural wetlands, forested land, forested wetlands, and riparian zones were identified within the study area.

Agricultural land within the study area closely matches the definition given by TPWD. Agricultural wetlands identified via infrared aerial interpretation would more than likely contain wetland plant species that are often associated with areas disturbed from recent agricultural activity. These species may consist of: green flat sedge (*Cyperus virens*), Dombey's spike-rush (*Eleocharis montana*), falling beakrush (*Rhynchospora caduca*), and broad leaf cattail (*Typha latifolia*). In general, the quality of this type of wetland is typically low especially in areas where agricultural activity is active and the land is routinely disturbed.

Forested land also closely fits the description provided by TPWD for pine-hardwood forest, as described above. Wetlands within these forested areas are considered important habitats for wildlife and are of value for the conservation of biological diversity (TPWD, 1984). Plant species composition within these areas generally consist of bald cypress (*Taxodium distichum*), water oak, willow oak (*Quercus phellos*), water hickory (*Carya aquatica*), green ash (*Fraxinus pennsylvanica*), buttonbush (*Cephalanthus occidentalis*),

swamp privet (*Forestiera acuminata*), swamp smartweed (*Polygonum hydropiperoides*), arrow head (*Sagittaria latifolia*), raven-foot sedge (*Carex crus-corvi*), Cherokee sedge (*Carex cherokeensis*), woodoats (*Chasmanthium sessiliflorum*), cutgrass (*Leersia hexandra*), lizard tail (*Saururus cernuus*), and spider lily (*Hymenocallis liriosme*).

Riparian zones are defined by areas that fall within a 100-year floodplain of a stream, or if a floodplain is absent, a zone hydrologically influenced by a stream or river (Hunt, 1988). Riparian ecosystems are maintained by high water tables and periodic flooding (Committee on Mitigating Wetland Losses, et. al, 2001, p152). Riparian zones are significant in ecology, environmental management, and civil engineering because of their role in soil conservation, biodiversity, and the influence they have on aquatic ecosystems. Vegetation within riparian zones can vary greatly depending on location. Within the study area vegetation would generally consist of water oak, willow oak, bald cypress, water hickory, raven-foot sedge, Cherokee sedge, switchgrass, Indian sea-oats (*Chasmanthium latifolium*), and various species of fern.

3.7.4.1 TxDOT-TPWD MOU

Of the special habitat features listed in the Memorandum of Understanding (MOU) between TxDOT and TPWD, bottomland hardwoods and water bodies have been identified in the study area. In accordance with Provision (4)(A)(ii) of the TxDOT-TPWD MOU, and at the TxDOT Houston District's discretion, habitats given consideration for non-regulatory mitigation during project planning include the following:

- habitat for federal candidate species (impacted by the project) if mitigation would assist in the preservation of the listing of the species;
- rare vegetation series (S1, S2, or S3) that also locally provide habitat for a state-listed species;
- all vegetation communities listed as S1 or S2, regardless of whether or not the series in question provide habitat for state-listed species;
- bottomland hardwoods, native prairies and riparian sites; and
- any other habitat feature considered locally important that the TxDOT District chooses to consider.

According to the TPWD Texas Natural Diversity Database (TxNDD), a water oak-willow oak rare vegetation series, which is a bottomland hardwood plant community with a state rank S3, and is located in the study area just north of Lake Houston (2013). These areas are accounted for within the 91,700 ac of pine-hardwood forest. Additionally, a loblolly pine-white oak-southern red oak series (Pinus taeda-Quercus

alba-Quercus falcata) occurs within the study area. Riparian sites are also present within the study area. No known habitat for federal candidate species or S1 or S2 vegetation communities within the study area.

3.7.4.2 Beneficial Landscape Practices

In accordance with the Executive Memorandum on Beneficial Landscape Practices of August 10, 1995, all agencies shall comply with the National Environmental Policy Act (NEPA) as it relates to vegetation management and landscape practices for all federally-assisted projects. The Executive Memorandum directs that where cost-effective and to the extent practicable, agencies would (1) use regionally native plants for landscaping; (2) design, use, or promote construction practices that minimize adverse effects on the natural habitat; (3) seed to prevent pollution by, among other things, reducing fertilizer and pesticide use; (4) implement water-efficient and run-off reduction practices; and (5) create demonstration projects employing these practices. Landscaping included with this project would be in compliance with the Executive Memorandum and the guidelines for environmentally and economically beneficial landscape practices.

3.7.4.3 Invasive Species

On February 3, 1999, the President issued EO 13112 to prevent the introduction of invasive species and provide for their control, and to minimize their economic, ecological, and human health impacts. In accordance with EO 13112 on Invasive Species and the Executive Memorandum on Beneficial Landscaping, landscaping would be limited to seeding or planting with native species of grasses or other vegetation, as appropriate.

3.8 WILDLIFE

This section provides an overview of the wildlife resources within the study area. The wildlife species having a potential to occur within the study area are described based upon vegetation types established for Texas by the TPWD, as shown on **Exhibit 1-2**.

Agriculture has substantially impacted most of the study area. Cultivated fields dominate the landscape in the southern portion of the study area. With the removal or decline of native vegetation and human encroachment into habitats, the wildlife species composition and diversity also show a decline from the abundant communities that probably once existed throughout the Pineywoods and Gulf Coastal Prairies and Marshes regions of East Texas.

Agricultural fields that may seem to have very little wildlife may support multiple species within the ecotonal areas along fence rows and in the isolated pockets or fields that still exhibit native or fallow vegetation. Species may also utilize crop and fallow fields for feeding and temporary shelter. Rodent species like the fulvous harvest mouse (*Reithrodontomys fulvescens*), can be found in crop fields and fence rows within the study area. Some species, such as the northern pygmy mouse (*Baiomys taylori*), may have expanded their ranges using fence rows as travel corridors. Larger wildlife species, like the hispid cotton rat (*Sigmodon hispidus*), the eastern cottontail (*Sylvilagus floridanus*), striped skunk (*Mephitis mephitis*), bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), and coyote (*Canus latrans*) may occasionally utilize ecotonal areas around agricultural fields. Many of these species, including the white-tailed deer (*Odocoileus virginianus*), are still present in parts of the study area. Avian species such as the chipping sparrow (*Spizella passerine*) and the lark sparrow (*Chondestes grammacus*) may utilize these farmland areas as permanent breeding residents and/or as wintering residents. The eastern meadowlark (*Sturnella magna*) is a permanent resident that may nest in hayfields or disturbed grasslands. Other avian species such as the broad-winged hawk (*Buteo platypterus*), red-shouldered hawk (*Buteo lineatus*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), loggerhead shrike (*Lanius ludovicianus*), and the barn owl (*Tyto alba*) can be found locally.

Some of the avian species that may be found in the Pineywoods natural region located in the northern and western portion of the study area include Bachman's sparrow (*Aimophila aestivalis*), swallow-tailed kite (*Elanoides forficatus*), red-cockaded woodpecker (*Picoides borealis*), and barred owl (*Strix varia*). Mammals that can be found in the Pineywoods natural region (forested) of East Texas include river otter (*Lutra canadensis*), swamp rabbit (*Sylvilagus aquaticus*), Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), southeastern myotis bat (*Myotis austroriparius*), and eastern spotted skunk (*Spilogale putorius*). Reptiles associated with the Pineywoods natural region of East Texas include timber rattlesnake (*Crotalus horridus*), Louisiana pine snake (*Pituophis ruthveni*), alligator snapping turtle (*Macrochelys temminckii*), and a variety of salamanders.

3.8.1 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) of 1918 states it is unlawful to kill, capture, collect, possess, buy, sell, trade, or transport any migratory bird, nest, or egg in part or in whole, without a federal permit issued in accordance with the Act's policies and regulations. Trees observed throughout the study area may provide migratory bird habitat.

3.9 THREATENED AND ENDANGERED SPECIES

The Endangered Species Act (ESA) of 1973 assigns the responsibility of enforcing the ESA to the Secretary of the Interior and the USFWS. Chapters 68 and 88 of the TPWD Code address the TPWD's responsibilities regarding state-listed threatened and endangered species. The study area was evaluated against the USFWS and TPWD's lists of federal- and state-listed threatened and endangered species for each county within the project limits. In addition, a check of the TPWD's "mimic" version of the TxNDD was requested on February 19, 2013 and obtained on February 24, 2013 for known locations of federal-listed threatened and endangered species.

3.9.1 U.S. Fish and Wildlife Service

The purpose of the ESA is to protect threatened and endangered species and their critical habitat. Endangered means a species is in danger of extinction throughout all or a substantial portion of its range. Threatened means that a species is likely to become endangered in the future throughout all or a substantial portion of its range. In addition, the USFWS maintains a list of "candidate" species. According to USFWS, candidate species are plants and animals for which the USFWS has sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities.

3.9.2 Texas Parks and Wildlife Department

In 1973, the Texas legislature authorized the TPWD to develop a list of threatened and endangered animal species. In 1988, the Texas legislature further authorized the TPWD to develop a list of threatened and endangered plants for the state. Chapter 68 of the TPWD Code requires the Department to manage and ensure the conservation and preservation of indigenous fish or wildlife that are threatened with extinction in the state. The protection of threatened and endangered plants is addressed in Chapter 88 of the TPWD Code.

The TPWD maintains a database, the TxNDD, which contains data on known locations of rare, threatened, and endangered species in the state. The TxNDD is comprised of data obtained from museum and herbarium collection records, peer reviewed publications, experts in the scientific community, organizations, qualified individuals, and on-site surveys conducted by the TPWD on public lands or private lands with written permission. However, because the majority of the state is in private ownership, substantial data gaps exist in the TxNDD data.

3.9.3 Listing and Monitoring Process

3.9.3.1 Federal-Listed Species

The ESA assigns the responsibility for determining whether to place a plant or animal on the endangered species list to the Secretary of the Interior. The Secretary of the Interior delegates the responsibility of approving petitions for listing species, the proposals for listing species, and the final listing determinations to the Director of the USFWS.

Section 4 of the ESA identifies five criteria for a species to be listed as threatened or endangered:

- the present or threatened destruction, modification, or curtailment of its habitat or range;
- overutilization for commercial, recreational, scientific, or educational purposes;
- disease or predation;
- the inadequacy of existing regulatory mechanisms; or
- other natural or manmade factors affecting its continued existence.

The proposed Segments H and I-1 of the Grand Parkway are located in Montgomery, Harris, Liberty, and Chambers counties. The federal-listed threatened and endangered species lists were obtained from the USFWS Region 2 office's website (USFWS, 2012) for these four counties and are presented in **Table 3-16**.

Table 3-16: Federal-Listed Threatened and Endangered Species Within the Study Area Counties

Common Name	Scientific Name	Listing Status	County	Habitat	Habitat Potential
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DM[1]	Chambers, Harris, Liberty, Montgomery	Near water areas, in tall trees	Yes
Brown pelican	*Pelecanus occidentalis*	DM,E[2]	Chambers	Islands near coastal areas	No
Red-cockaded woodpecker	*Picoides borealis*	E	Liberty, Montgomery	Nests in 60+ year pines, forages in 30+ year pines	Yes
Piping plover	*Charadrius melodus*	E,T[2]	Chambers	beaches and bayside mud or salt flats	No
Reptiles					
Green sea turtle	*Chelonia mydas*	E,T[2]	Chambers	Gulf and bay system	No
Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	E	Chambers	Gulf and bay system	No
Kemp's ridley sea turtle	*Lepidocheleys kempii*	E	Chambers	Gulf and bay system	No
Leatherback sea turtle	*Dermochelys coriacea*	E	Chambers	Gulf and bay system	No
Loggerhead sea turtle	*Caretta caretta*	T	Chambers	Gulf and bay system	No
Mammals					
West Indian manatee	*Trichechus manatus*	E	Chambers, Harris	Gulf and bay system	No
Plants					
Texas prairie dawn	*Hymenoxys texana*	E	Harris	Poorly drained areas in open grasslands; pimple mounds	Yes

AD – Proposed delisting; DM – Delisted taxon, recovered; E – Endangered; T – Threatened;
[1] The bald eagle is protected by the Bald and Golden Eagle Protection Act of 1940
[2] Multiple listing statuses are indicative of species with populations and/or subspecies that fall into more than one listing status category
Note: Species such as the Houston Toad and Whooping Crane are listed by the U.S. Wildlife Service; however, they are not listed to occur within these counties by the Clear Lake office of the U.S. Fish and Wildlife Service (2012)

On August 9, 2007, the bald eagle was removed from the USFWS threatened and endangered species list. Per the *Post-delisting Monitoring Plan for the Bald Eagle,* monitoring the status of the bald eagle is being done by collecting data on occupied nests over a 20 year period with sampling events held once every five years starting in early 2009 (USFWS, 2009). The USFWS could propose to relist the species if it appears that the bald eagle needs further protection under the ESA. Although the bald eagle is no longer protected under the ESA, it is currently protected under the Bald and Golden Eagle Protection Act and the MBTA. Bald eagles are known to occur in the vicinity of the proposed project. They have been known to feed along the riparian corridors of water ways that cross the proposed project area.

Potential habitat for the federal-listed endangered red-cockaded woodpecker and Texas prairie dawn exists within the study area. Red-cockaded woodpeckers prefer long-leaf pine forests; using 60-year and older pines for nesting and 30-year and older pines for foraging. Texas prairie dawn has relatively specific habitat requirements consisting of poorly drained areas in open grasslands. They are often on or at the base of pimple mounds.

The TxNDD data does not contain any known location records for the brown pelican, piping plover, or five sea turtle species in the study area. Although the TxNDD does not comprise a complete survey of all areas of the state, these species require coastal and pelagic (open sea) habitat not available within the study area. Therefore, these species are not expected to occur within the study area.

3.9.3.2 State-Listed Species

The county lists of state-listed threatened and endangered species, and species of concern, were obtained from the TPWD's Wildlife Diversity program for the four counties located within the study area. Known location data for state-listed threatened and endangered species was obtained from the TPWD's TxNDD on February 24, 2013. A list of state threatened and endangered species, and species of concern, is presented in **Table 3-17**.

Table 3-17: State-Listed Threatened and Endangered Species Within the Study Area Counties

Common Name	Specific Epithet	Listing Status[1]	County	Habitat	Habitat Potential
Amphibians					
Houston toad	*Anaxyrus houstonensis*	E	Harris, Liberty	Sandy soil, breeds in ephemeral pools	No
Birds					
American peregrine falcon	*Falco peregrinus anatum*	T	Chambers, Harris, Liberty, Montgomery	Potential migrant	Yes
Arctic peregrine falcon	*Falco peregrinus tundrius*	SOC	Chambers, Harris, Liberty, Montgomery	Potential migrant	Yes
Bachman's sparrow	*Aimophila aestivalis*	T	Liberty	Inhabits open pine forests with grassy understory or open habitats with dense ground cover of grasses and forbs	Yes
Bald eagle	*Haliaeetus leucocephalus*	T	Chambers, Harris, Liberty, Montgomery	Near water areas, in tall trees	Yes
Black Rail	*Laterallus jamaicensis*	SOC	Chambers, Harris	Salt, brackish, and freshwater marches, pond borders, wet meadows, and grassy swamps	Yes
Brown pelican	*Pelecanus occidentalis*	SOC	Chambers, Harris	Islands near coastal areas	No
Henslow's sparrow	*Ammodramus henslowii*	SOC	Chambers, Harris, Liberty, Montgomery	Weedy fields or cut-over areas	Yes
Mountain plover	*Charadrius montanus*	SOC	Harris	High plains or shortgrass prairie	No
Piping plover	*Charadrius melodus*	T	Chambers, Liberty, Montgomery	Beaches and bayside mud or salt flats	No
Red-cockaded woodpecker	*Picoides borealis*	E	Harris, Liberty, Montgomery	Nests in 60+ year pines, forages in 30+ year pines	Yes
Reddish egret	*Egretta rufescens*	T	Chambers	Brackish marshes, shallow salt ponds, and tidal flats; nests on dry coastal islands in brushy thickets	No
Snowy plover	*Charadrius alexandrinus*	SOC	Chambers, Harris	Potential migrant	Yes

Table 3-17: State-Listed Threatened and Endangered Species Within the Study Area Counties

Common Name	Specific Epithet	Listing Status[1]	County	Habitat	Habitat Potential
Southeastern snowy plover	*Charadrius alexandrinus tenuirostris*	SOC	Chambers, Harris	Beaches and bayside mud or salt flats	No
Western snowy plover	*Charadrius alexandrinus nivosus*	SOC	Chambers	Potential migrant	Yes
Sprague's Pipit	*Anthus spragueii*	SOC	Chambers, Montgomery, Harris, Liberty	Potential migrant. Strongly tied to native upland prairie, can be locally common in costal grasslands, uncommon to rare further west	No
Swallow-tailed kite	*Elanoides forficatus*	T	Chambers, Liberty	Lowland forests, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes	Yes
White-faced ibis	*Plegadis chihi*	T	Chambers, Harris, Liberty, Montgomery	Freshwater, brackish, or salt marshes	Yes
White-tailed hawk	*Buteo albicaudatus*	T	Harris	Coastal Prairies	Yes
Whooping crane	*Grus americana*	E	Harris, Montgomery	Winters in Aransas NWR	No
Wood stork	*Mycteria americana*	T	Chambers, Harris, Liberty, Montgomery	Prairie ponds and flooded pastures	Yes
Fishes					
American eel	*Anguilla rostrata*	SOC	Chambers, Harris, Liberty	Coastal waterways below reservoirs to gulf	Yes
Creek chubsucker	*Erimyzon oblongus*	T	Harris, Liberty, Montgomery	Variety of small rivers and creeks, prefers headwaters	Yes
Paddlefish	*Polyodon spathula*	T	Liberty, Montgomery	Free-flowing rivers, shallow water over gravel bars; larvae may drift from reservoir to reservoir	Yes
Smalltooth sawfish	*Pristis pectinata*	E	Chambers, Harris	Sheltered bays, on shallow banks, and in estuaries or river mouths	No
Insects					
A mayfly	*Tricorythodes curvatus*	SOC	Montgomery	Bankside vegetation	Yes
A mayfly	*Plauditus gloveri*	SOC	Montgomery	Bankside vegetation	Yes
Gulf coast clubtail	*Gomphus modestus*	SOC	Liberty, Montgomery	Medium river, moderate gradient, and streams with silty sand or rocky bottoms	Yes
Texas emerald dragonfly	*Somatochlora margarita*	SOC	Montgomery	East Texas pineywoods; springfed creeks and bogs; small sandy forested streams with moderate current	Yes
Mammals					
Black bear	*Ursus americana*	T/SA	Liberty	Desert lowlands, high elevation forests and woodlands; rock piles, cliff overhangs, caves	Yes
Louisiana black bear	*Ursus americana luteolus*	T	Chambers, Harris, Liberty, Montgomery	Bottomland hardwoods; large, undisturbed forested areas	No
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	T	Harris, Liberty, Montgomery	Cavity trees in hardwood forest, concrete culverts, abandon buildings	Yes

Table 3-17: State-Listed Threatened and Endangered Species Within the Study Area Counties

Common Name	Specific Epithet	Listing Status[1]	County	Habitat	Habitat Potential
Red wolf	*Canis rufus*	E	Chambers, Harris, Liberty, Montgomery	Extirpated; Brushy, forested areas, coastal prairies	No
Plains spotted skunk	*Spilogale putorius interrupta*	SOC	Chambers, Harris, Liberty, Montgomery	Open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands	Yes
Southeastern myotis bat	*Myotis austroriparius*	SOC	Chambers, Harris, Liberty, Montgomery	Cavity trees in bottomland hardwoods, concrete culverts, and abandoned man-made structures	Yes
Mollusks					
Creeper (squawfoot)	*Strophitus undulates*	SOC	Liberty, Montgomery	Small to large streams, prefers gravel or gravel and mud in flowing water	Yes
Fawnsfoot	*Truncilla donaciformis*	SOC	Liberty, Montgomery	Small and large rivers	Yes
Little spectaclecase	*Villosa lienosa*	SOC	Harris, Liberty, Montgomery	Creeks, rivers, and reservoirs	Yes
Louisiana pigtoe	*Pleurobema riddellii*	T	Chambers, Harris, Liberty, Montgomery	Streams and moderate-size rivers	Yes
Sandbank pocketbook	*Lampsilis satura*	T	Harris, Liberty, Montgomery	Small to large rivers on gravel, gravel-sand, and sand bottoms	Yes
Texas heelsplitter	*Potamilus amphichaenus*	T	Liberty	Quiet waters in mud or sand and also in reservoirs	Yes
Texas pigtoe	*Fusconaia askewi*	T	Harris, Liberty, Montgomery	Rivers with mixed mud, sand, and fine gravel	Yes
Wabash pigtoe	*Fusconaia flava*	SOC	Harris, Liberty, Montgomery	Creeks to large rivers on mud, sand, and gravel	Yes
Reptiles					
Alligator snapping turtle	*Macrochelys temminckii*	T	Chambers, Harris, Liberty, Montgomery	Deep water of rivers and canals	Yes
Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	E	Chambers	Gulf and bay system	No
Green sea turtle	*Chelonia mydas*	T	Chambers, Harris	Gulf and bay system	No
Gulf saltmarsh snake	*Nerodia clarkia*	SOC	Chambers, Harris	Saline flats, coastal bays, and brackish river mouths	No
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	Chambers, Harris	Gulf and bay system	No
Leatherback sea turtle	*Dermochelys coriacea*	E	Chambers, Harris	Gulf and bay system	No
Loggerhead sea turtle	*Caretta caretta*	T	Chambers, Harris	Gulf and bay system	No
Louisiana pine snake	*Pituophis ruthveni*	T	Liberty, Montgomery	Sandy, longleaf piney woods	Yes
Northern scarlet snake	*Cemophora coccinea copei*	T	Chambers, Liberty	Mixed hardwood scrub on sandy soils	Yes
Smooth green snake	*Liochlorophis vernalis*	T	Chambers, Harris	Gulf coastal prairies, prefers dense vegetation	Yes
Texas diamondback terrapin	*Malaclemys terrapin littoralis*	SOC	Chambers	Coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches	No
Texas horned lizard	*Phrynosoma cornutum*	T	Chambers, Harris, Liberty, Montgomery	Open, semi-arid regions, with bunch grass	No
Timber/Canebrake rattlesnake	*Crotalus horridus*	T	Chambers, Harris, Liberty, Montgomery	Swamps/floodplains of hardwood and upland pine	Yes

Table 3-17: State-Listed Threatened and Endangered Species Within the Study Area Counties

Common Name	Specific Epithet	Listing Status[1]	County	Habitat	Habitat Potential
Plants					
Bristle nailwort	*Paronychia setacea*	SOC	Montgomery	Flowering vascular plant endemic to eastern southcentral Texas, occurring in sandy soils	No
Coastal gay-feather	*Liatris bracteata*	SOC	Harris	Black clay soils of prairie remnants	Yes
Correll's false dragon-head	*Physostegia correllii*	SOC	Montgomery	Wet soils including riverbanks, streamsides, creekbeds, roadside ditches, and irrigation channels	Yes
Florida ladies-tresses	*Spiranthes brevilabris* var. *floridana*	SOC	Harris	Moist to wet, relatively open sites of pine-dominated landscapes, meadows, pitcher plant and seepage bogs, wet prairies and savannahs, and flatwoods	No
Giant sharpstem umbrella-sedge	*Cyperus cephalanthus*	SOC	Harris	Remnant coastal prairies	No
Houston daisy	*Rayjacksonia aurea*	SOC	Harris	Seasonally wet, saline barren areas	No
Neglected coneflower	*Echinacea paradoxa var. neglecta*	SOC	Harris	Rocky prairies, glades, and crosstimber open woodlands	No
Panicled indigobush	*Amorpha paniculata*	SOC	Harris	Grows in acid seep forests, peat bogs, wet floodplain forests, and seasonal wetlands on the edge of Saline Prairies	No
Texas ladies'-tresses	*Spiranthes brevilabris* var. *brevilabris*	SOC	Harris	Sandy soils in moist prairies, incl. blackland/Fleming prairies, calcareous prairie pockets surrounded by pines, pine-hardwood forest, open pinelands, wetland pine savannahs/flatwoods	No
Texas meadow-rue	*Thalictrum texanum*	SOC	Harris	Mesic woodlands or forests	Yes
Texas prairie dawn	*Hymenoxys texana*	E	Harris	Poorly drained areas in open grasslands; pimple mounds	Yes
Texas windmill-grass	*Chloris texensis*	SOC	Chambers, Harris	Open to sometimes barren areas in prairies and grasslands	Yes
Threeflower broomweed	*Thurovia triflora*	SOC	Harris	Black clay soils of remnant grasslands, also tidal flats	Yes

[1] T-Threatened, E-Endangered, T/SA-Threatened by Similarity of Appearance, SOC – Species of Concern
Source: TPWD, 2012

There are 43 state-listed species that may have potential habitat within the study area. The American peregrine falcon, arctic peregrine falcon, snowy plover, and western snowy plover are all migrants and may utilize the study area for feeding or resting during their migration. The pine forests may provide suitable habitat for the Bachman's sparrow, red-cockaded woodpecker, and Louisiana pine snake.

Suitable habitat may be present in, or adjacent to, the streams within the study area for three state-listed fish species, four state-listed insects, eight state-listed mollusks, and the alligator snapping turtle. The streams and their riparian corridors may also provide suitable habitat for the bald eagle, black rail, wood stork, swallow-tailed kite, white-faced ibis, timber/canebrake rattlesnake, and Correll's false dragon-head.

Upland herbaceous areas may provide suitable habitat for Henslow's sparrow, plains spotted skunk, coastal gay feather, Texas prairie dawn, Texas windmill grass, and threeflower broomweed. Suitable habitat may be present in the coastal prairies for the white-tailed hawk and smooth green snake. Upland and bottomland hardwoods may provide suitable habitat for the black bear, Rafinesque's big-eared bat, Northern scarlet snake, southeastern myotis bat, and Texas meadow-rue.

Numerous colonial waterbird rookeries associated with riparian, bottomland, wetland, swamp, and marshland areas are known to occur throughout the study area. Rookeries are common in these areas as well as along the many impoundments and lakes within the study area, and along the nearby coastal areas of Trinity Bay, Burnet Bay, and Scott Bay. Anhinga (*Anhinga anhinga*), great blue herons (*Ardea herodias*), little blue herons (*Egretta caerulea*), cattle egrets (*Bubulcus ibis*), great egrets (*Casmerodius albus*), snowy egrets (*Egretta thula*), white ibis (*Eudocimus albus*), white-faced ibis, olivaceous cormorants (*Phalacrocorax olivaceus*), and roseate spoonbills (*Ajaia ajaja*) are known to congregate and nest in rookeries throughout the study area.

According to the TxNDD, two state-listed threatened species, three state-listed species of concern, and two rare plant communities have been documented within a 1.5-mi radius of the study area. There have been no other recorded sightings of any federal- or state-listed species within close proximity of the study area. However, it should be noted that an absence of data for a particular species does not mean an absence of occurrence for threatened, endangered, and rare species. The following provides a description of the element of occurrences, including the element of occurrence identification (EOID), within 1.5 mi of the study area.

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) – EOID 5412

This is a state-listed threatened species and TxNDD indicates an element of occurrence within the study area. Rafinesque's big-eared bat is a medium-sized bat with long rabbit-like ears (27-37 millimeters). The bat has large facial glands protruding from each side of its snout. Its fur is grayish brown above and

conspicuously bicolored underneath; it has a forearm length of 39-43 millimeters and weighs 7-13 grams. Rafinesque's big-eared bats roost in cave entrances, hollow trees, abandoned buildings, and under bridges in the forests of southeastern United States. Like others in the order Chiroptera, these bats are insectivores (eat only insects). They also hibernate during the winter. Rafinesque's big-eared bat has the potential, or a known presence, in multiple counties in eastern Texas, including Harris, Liberty, and Montgomery counties within the study area.

Bald eagle (*Haliaeetus leucocephalus*) – EOID 7972

This is a state-listed threatened species and TxNDD indicates an element of occurrence 0.29 mi from the study area. The bald eagle is a large raptor generally weighing seven to ten pounds with a wingspan sometimes reaching more than seven feet. Adult bald eagles are easily recognized with their stark white coloration on the head contrasting with a solid black or dark brown body. Bald eagles are opportunistic predators and commonly feed on water birds, bottom dwelling fish, and turtles in Texas. In Texas, bald eagles nest from October to July in nests measuring up to six feet in width and weighing hundreds of pounds (TPWD, 2013). In Texas, the winter and nesting range for the bald eagle is generally restricted to the eastern portion of the state.

Correll's false dragon-head (*Physostegia correllii*) – EOID 4512

This is a state-listed species of concern and TxNDD indicates an element of occurrence 0.11 mi from the study area. Correll's false dragon-head is a perennial herbaceous plant that flowers from May to September. Extent populations of Correll's false dragon-head are found in Texas, Louisiana, and Mexico. Habitat for this plant in Texas includes riverbanks, streamsides, creekbeds, roadside ditches, and irrigation canals.

Threeflower broomweed (*Thurovia triflora*) – EOID 7357

This is a state-listed species of concern and TxNDD indicates an element of occurrence within the study area. Threeflower broomweed is a herbaceous annual endemic to coastal Texas. Threeflower broomweed is found in black clay soils of remnant grasslands, tidal flats, and sparsely vegetated, saline areas in coastal prairie. Threeflower broomweed blooms from September to October.

Texas windmill-grass (*Chloris texensis*) – EOID 7812

This is a state-listed species of concern and TxNDD indicates element of occurrence 0.87 mi from the study area. Texas windmill-grass is a tufted perennial grass that flowers in October and November. Texas windmill grass occurs in open or barren areas within prairies along the Texas coast. Microhabitat for Texas windmill grass includes sandy openings on or at the base of pimple mounds.

Loblolly pine-white oak-southern red oak series (*Pinus taeda-Quercus alba-Quercus falcata* series) – EOID 1489 and EOID 5487

This is a state-listed special habitat (G4, S4) and TxNDD indicates an element of occurrence within the study area. This vegetation supports many animal species, such as the state threatened Rafinesque's big-eared bat, that depend on mature, bottomland hardwood habitats. Plant species commonly associated with this vegetation series include sweetgum, cherrybark oak (*Q. pagoda*), ash (*Fraxinus* spp.), and overcup oak (*Q. lyrata*). Ironwood, eastern hop-hornbeam (*Ostrya virginiana*), deciduous holly (*Ilex decidua*), and Florida maple (*Acer barbatum*) often compose the understory of this vegetation series.

Water oak-willow oak series (*Quercus nigra-Quercus phellos* series) – EOID 1910 and EOID 1092

This is a state-listed special habitat (G4, S3) and TxNDD indicates element of occurrence within the study area and 0.42 mi from the study area. The water oak/willow oak vegetation series is known to occur within the Lake Houston Wilderness Park and surrounding areas. The water oak/willow oak habitat is a deciduous bottomland hardwood forest located in often inundated floodplains of East Texas.

Those species listed in the TxNDD could potentially occur in areas of suitable habitat within the study area.

3.10 FLOODPLAINS

Floodplains (Zone A – 100 Year) in the study area are depicted on **Exhibit 3-13**. FEMA administers the National Flood Insurance Program (NFIP). All counties in the study area are participating members of the NFIP. The floodplains encountered are all Zone A. Zone A signifies a special flood hazard area that is inundated by 100-yr flood events.

FEMA has examined in detail the majority of the rivers, bayous and streams within the study area, and flood hazard areas have been established. They delineated Zones A, which are 100-yr floodplains with no BFE. They also delineated Zones AE, which are 100-yr floodplains that exhibit BFEs. Both zones are annotated on the Flood Insurance Rate Maps, also known as FIRM panels. Both zones were digitized by

FEMA as Quality Level 3 Digital FIRM (Q3). The Q3 flood data is controlled to the USGS mapping at 1:24,000 scale. The FEMA Flood Insurance Studies contain water surface profiles for the 10-, 50-, 100- and 500-yr floods.

Elevations of all types cited herein for Montgomery, Liberty, and Chambers counties are referenced to the National Geodetic Vertical Datum of 1929 (NGVD) with various updates. Harris County elevations are based on Tropical Storm Allison Recovery Project data (TSARP), which is year 2001 surface data with considerations for subsidence since 1973. TSARP technology resulted in 2-ft contour intervals for Harris County. The USGS mapping (Q3), used for the majority of the study area, is based on 5-ft contour intervals. According to the literature, a number of technical differences in the new TSARP approach make direct comparisons to the old studies or adjacent studies inappropriate. A direct relationship between TSARP in Harris County would only be established as other areas are mapped with the same technology.

There are three drainage basins that envelop the study area: the San Jacinto River Basin (5,600 mi^2), the transitional Trinity-San Jacinto Coastal Basin (247 mi^2) and the Lower Trinity River Basin (750 mi^2). The individual watersheds, water bodies, and floodplains within the study area are described in **Section 3.6**. Flooding commonly occurs along all reaches of the streams studied with 100-yr velocities typically slow, at less than 4.0 fps. In many cases, the peak discharges are attenuated downstream due to over bank storage. Many minor tributaries feed all major streams in the study area.

It should be noted that a floodway is considered the channel of a stream, including some adjacent floodplain area that must be kept free of encroachment. The 100-yr peak discharge conveyed within the floodway is not allowed to create substantial increase in the BFE. FEMA has instituted a 1 ft maximum increase provided high velocities are not created. The floodway fringe is the area between the floodway and the outer limits of the floodplain. For floodway computations, equal conveyance reduction from each side of the floodplain is normally used. Thus, it is possible to ascertain topographical change based on the floodway location relative to the entire 100-yr floodplain.

FEMA Q3 GIS data was used to approximate the acreages of floodway and 100-yr floodplain within the study area for each major river or stream. The approximated acreages of floodways and 100-yr floodplains are shown in **Table 3-18.**

Table 3-18: Study Area Floodways and 100-year Floodplains

Stream	Floodways within the Study area (acres)	100-year Floodplains within the Study area (acres)
Caney Creek	1,077.9	2,363.0
Cedar Bayou	3,577.4	11,817.0
East Fork Cedar Bayou	65.0	230.2
East Fork San Jacinto River	2,477.8	5,396.4
Luce Bayou	1,899.3	4,028.0
Peach Creek	893.4	2,508.3
Total	**9,990.8**	**26,342.9**

Source: FEMA Digital Q3 Data, 2010

3.11 WILD AND SCENIC RIVERS

The Wild and Scenic Rivers Act of October 2, 1968 was enacted to preserve outstandingly remarkable rivers in free-flowing condition, and to protect their immediate environments for the benefit and enjoyment of present and future generations. There are no rivers or river segments within the study area that are listed as part of, or under study for designation to, the National Inventory of the National Wild and Scenic River System.

3.12 COASTAL BARRIERS

The Coastal Barrier Resources Act of 1982 encourages conservation of coastal barriers by restricting federal expenditures that encourage development (USFWS, 1982). There are no coastal barriers located within the study area.

3.13 COASTAL ZONE MANAGEMENT

The Coastal Zone Management Act of 1972, administered by the National Oceanic and Atmospheric Administration (NOAA), provides for management of the nation's coastal resources and balances economic development with environmental conservation. The Texas Coastal Management Program was approved by NOAA in 1996 to improve the management of the state's coastal resources. The southern limit of the study area abuts I-10 (E), the northern Coastal Zone boundary in Chambers County. A portion of the study area at I-10 (E) is included in the coastal zone management program.

3.14 ESSENTIAL FISH HABITAT

In 1996, Congress revised the Magnuson-Stevens Act and emphasized the need to protect fish habitat. The Act requires that fishery management plans identify essential fish habitat (EFH), areas that are necessary to fish for their basic life functions. EFH areas were obtained from the NOAA Essential Fish Habitat Mapper (NOAA, 2009). According to NOAA, EFH for coastal migratory pelagic species, reef fish,

red drum, shrimp, and stone crab is located within the study area in the East Fork San Jacinto River, to approximately 3 mi upstream from Lake Houston. Additionally, Cedar Bayou is mapped as tidally influenced up to 1.4 mi north of I-10 (E) on the west side of Mont Belvieu and may potentially contain EFH.

3.15 CULTURAL RESOURCES

NEPA requires consideration of important historic, cultural and natural aspects of our national heritage. Important aspects of our national heritage that may be present have been considered under Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended. The Act requires federal agencies to take into account the effect that an undertaking will have on cultural resources. Cultural resources are structures, buildings, archeological sites, districts, (a collection of related structures, buildings and/or archeological sites), cemeteries, and objects of historical significance. Both federal and state laws require consideration of cultural resources during project planning. In addition, the project also falls under the purview of the Antiquities Code of Texas (ACT) because it involves lands owned or controlled by the State of Texas or any city, county, or local municipality.

In addition, compliance with NHPA requires federal agencies to take into account the effect that an undertaking will have on cultural resources. Compliance with these laws may require consultation with the Texas Historical Commission (THC)/Texas State Historic Preservation Officer (SHPO) and/or federally-recognized tribes to determine the project's effects on cultural resources. Review and coordination of this project would follow approved procedures for compliance with federal and state laws.

3.15.1 Archeological Resources

According to the Houston Potential Archeological Liability Map (PALM) GIS database compiled by TxDOT ENV, the study area traverses Map Units 1, 2, 2a, 3, 3a, and 4. For Map Unit 1, a surface survey is recommended, and deep reconnaissance is recommended if deep impacts are anticipated. For Map Unit 2, a surface survey is recommended, and deep reconnaissance is not recommended. For Map Unit 2a, a surface survey of mounds is recommended, and deep reconnaissance is not recommended. For Map Unit 3, a surface survey is not recommended; however, deep reconnaissance is recommended if deep impacts are anticipated. For Map Unit 3a, a surface survey is not recommended; however, deep reconnaissance is recommended only if severe deep impacts are anticipated. For Map Unit 4, no survey is recommended. PALM Map data is limited to only those portions of the study area which fall inside Harris

and Montgomery Counties (**Exhibit 3-14**). PALM Map data is not available for Liberty and Chambers Counties.

Known archeological site locations were researched using the THC's online Texas Archeological Sites Atlas. These records revealed a total of 1,882 previously recorded sites in the study area, including: Montgomery (215), Harris (1,149), Liberty (112), and Chambers (406) counties. Of these sites, 264 (Montgomery = 2, Harris = 252, Liberty = 5, and Chambers = 5) are listed on the National Register of Historic Places (NRHP), and 125 (Montgomery = 0, Harris = 95, Liberty = 14, and Chambers = 16) are identified as State Archeological Landmark (SAL) properties. Nine of these sites are present within the study area; four of these sites are in Liberty County and five in Harris County. No known archeological sites are known to exist within the study area for either Chambers or Montgomery counties. Attributes for the nine known archeological sites are summarized in **Table 3-19**. Each site is individually described below by county.

Table 3-19: Known Archeological Sites

County	Site Number	Historic or Prehistoric	Site Type	Cultural Affiliation	National Register Status	Further Work
Liberty	41LB44	Prehistoric	Occupation	Unknown	Unknown	Unknown
Liberty	41LB45*	Prehistoric	Occupation	Unknown	Unknown	Unknown
Liberty	41LB46*	Prehistoric	Occupation	Unknown	Unknown	No
Liberty	41LB50	Historic	Historic House	Unknown	Unknown	Unknown
Harris	41HR313	Prehistoric	Unknown	Unknown	Unknown	Unknown
Harris	41HR639	Prehistoric	Mound	Orcoquisac	Unknown	Yes
Harris	41HR641	Prehistoric	Occupation	Unknown	Unknown	Yes
Harris	41HR642	Prehistoric	Occupation	Unknown	Unknown	Yes
Harris	41HR684	Prehistoric	Occupation	Orcoquisac	Unknown	No

*Sites destroyed by previous activities
Source: THC, 2012

As shown in **Table 3-20**, the number of sites per square mile varies by county. These numbers do not necessarily reflect the actual occurrence of sites per county, but likely reflect the greater amount of surveys conducted in particular counties (i.e. Harris County).

Table 3-20: Number of Archeological Sites and County Acreage

County	# of Sites*	# of Surveys	County Square Mile**	Sites per Square Mile	Surveys per Square Mile
Chambers	402	208	606	0.7	0.3
Harris	1085	1048	1,778	0.6	0.6
Liberty	108	93	1,174	0.1	0.1
Montgomery	225	221	1,047	0.2	0.2
Average	**455**	**392**	**1,151**	**0.4**	**0.3**

* Data for archeological surveys obtained from the online Texas Archeological Sites Atlas, maintained by the THC. http://nueces.thc.state.tx.us/
** Data for county size obtained from the Texas State Historical Association, The Handbook of Texas Online http://www.tsha.utexas.edu/handbook/online/

The prehistory of Texas spans at least 13,000 years from at least 11,500 B.C. to the time of the European contact in the seventeenth century. The periods of Texas' prehistory are divided into three broad periods; Paleoindian, Archaic, and the Late Prehistoric.

3.15.1.1 Paleoindian (11,500 B.C. – 6,000 B.C.)

The Paleoindian period represents the earliest known occupation in East Central Texas. People during this period relied on mega fauna (predominantly mammoth and *Bison antiquus*) as well as broader-based hunting and gathering for their subsistence needs. Paleoindian artifacts included distinctive lanceolate projectile points, side scrapers, end scrapers, gravers, modified flake tools, and drills. These tools are sometimes found associated with the remains of extinct mega fauna species. Typically, Paleoindian sites are located near playa lakes and relict streambeds or along small rises and ridges. These sites are usually ephemeral and may be difficult to recognize. Differences in topographic settings and artifact and faunal assemblages have led archeologists to interpret Paleoindian sites in terms of function classes based on the activities inferred to have taken place there. Typical site types of this period include camp sites, kill sites, processing sites, and quarry sites. During the Paleoindian period, the climate was vastly different than it is today. It has been marked by continuous environmental change over several thousand years. During the earlier phases, the environment was wetter and cooler. Throughout the course of the Paleoindian period, the climate became increasingly arid with greater seasonal variation. These conditions resulted in shifting vegetation patterns and faunal extinctions, which in turn, affected Paleoindian subsistence strategies, settlement patterns, and lithic technologies (Aten 1983, Story 1990).

3.15.1.2 Archaic (6,000 B.C. – 700 A.D.)

The Archaic period, lasting some 5,000 to 6,000 years, is ascribed more longevity than other prehistoric cultural periods. Despite the fact that many sites in East Central Texas have been assigned to the Archaic period, relatively little is known about this time period. Subsistence adaptations during the Archaic period are thought to have generally changed from a reliance on big game hunting to a more broad-based hunting and foraging strategy. Archaic period occupations are distinguished from earlier and later occupations by side- and corner-notched projectile points, bifaces, flake scrapers, and drills. These sites typically consist of lithic and fire-cracked rock scatters that are often situated in areas that overlook drainages (Aten, 1983, Patterson 1979, Story 1990).

3.15.1.3 Late Prehistoric (700 A.D. to Historic Period)

Beginning sometime between A.D. 600 and 900 and continuing to as late as A.D. 1550, the archeological record of southeastern East Central Texas reflects increasing regional and interregional variability. Also during this period several technological developments occurred, namely the development of the bow and arrow, ceramics, and other distinctive types of stone tools. These developments marked a change of this period from the preceding Archaic. Cultural identifiers during the Late Historic Period include material culture, and hunting patterns. Settlement patterns included sedentary villages, and ceremonial centers. Social-cultural features included an established social hierarchy. One distinctive aspect of the Late Prehistoric was widespread, long-distance trade (Aten 1983).

3.15.2 Non-Archeological Historic Resources

Regulatory Requirements

In accordance with the Advisory Council on Historic Preservation (ACHP) regulations pertaining to the protection of historic properties (36 CFR 800.4), federal agencies are required to identify and evaluate historic-age non-archeological resources for NRHP eligibility and assess the effects that the undertaking would have on historic resources. A historic-age resource as defined in accordance with 36 CFR 60 is a building, structure, object, district or site that is within the area of potential effects (APE) and at least 50 years old at the time of project letting. The Programmatic Agreement for Transportation Undertakings (PA-TU) authorized among FHWA, the ACHP, the SHPO, and TxDOT outlines a streamlined approach for conducting Section 106 consultation and review with the SHPO. The document provides regulatory authority to TxDOT ENV to identify and evaluate cultural resources for NRHP eligibility and, when NRHP listed or eligible resources are present, assess potential project impacts and/or effects.

The proposed project also falls under the purview of the ACT. The ACT allows for all such resources to be considered as SAL, and requires that each be examined in terms of possible significance. Standards for the code are outlined under Chapter 26 of the THC Rules of Practice and Procedure for the ACT and closely follow those of the Secretary of the Interior's Standards and Guidelines.

If an effect is determined to be adverse, the agency must take steps to avoid, minimize, and/or mitigate the adverse effect. The consultation process of identification, evaluation, and assessment used to address the requirements of Section 106 of NHPA is codified in the PA-TU. If a transportation activity has the potential to adversely affect a historic resource and includes the proposed taking or use of the property for a

transportation activity, the special provision of Section 4(f) of the United States Department of Transportation (USDOT) Act of 1966 (now 23 CFR 774) must also be addressed. Considerations must include any feasible and prudent alternatives and planning to minimize harm.

3.15.2.1 Determination of the Proposed Area of Potential Effects, the Survey Study Area (SSA) and the Historic-Age Cut-off Date

An APE of 300 feet from the edge of the proposed ROW was approved by TxDOT ENV as part of the approved Research Design. The APE was justified because the majority of the proposed project is on new location. A survey study area (SSA) of 1300 feet beyond the proposed ROW was also approved as part of the Research Design to include resources that contribute to the development of historic contexts through a broader understanding of the project area.

The criterion of 50 years prior to the construction letting date to define historic-age is prescribed within the Secretary of the Interior's guidelines for NRHP eligibility and the current PA-TU among FHWA, ACHP, SHPO and TxDOT. However, a 45 year cut-off (45 years prior to the letting date) to allow for project changes and/or delays is suggested in the September 8, 2006, Draft Historic Resources Section 106 Review and NEPA Guide, published by ENV. The proposed letting date for the proposed project is 2016; therefore, resources dating to 1971 and earlier will be surveyed.

3.15.2.2 File Review Methodology

A file review of available records was completed to identify previously recorded historic resources within the APE and SSA. Repositories consulted included the Texas Historical Commission's Texas Historic Sites Atlas (Atlas). The historian specifically reviewed for listings in the NRHP, SAL, and Recorded Texas Historic Landmarks (RTHL). In addition, historians researched historic markers of all types including Official Texas Historic Markers (OTHM) and all cemeteries, including Historic Texas Cemeteries (HTC). Various published materials, including on-line resources were consulted in the development of the historic contexts for the APE. High resolution aerial photographs, current and historic topographic maps and highway maps, as well as other historic and non-historic maps were used to locate potential historic-age resources within the APE. A complete list of sources that were consulted is located in **Appendix F.**

3.15.2.2.1 Results of File Review

The review of available records resulted in the identification of no listed NRHP, SAL, or RTHL resources within the APE or SSA. No historic markers of any type, including OTHM, were identified within the APE or SSA. Two resources were identified within the APE that were previously determined NRHP-eligible. These resources are portions of the Dayton Canal rice irrigation system and include the Main Canal, and the Big Ditch drainage canal. A Draft Non-Archeological Historic-Age Resources Survey (HRSR) that was prepared for another project was identified during the records review entitled, 'Historic Resources Reconnaissance Survey SH 146: from US 90 in Dayton, Texas to the Chambers County Line, Liberty County, Texas, completed in April 2006 (TxDOT CSJ# 0389-01-036). In the report, an APE was surveyed in which the Dayton Canal was identified as a prominent feature and a historic-age resource. The report recommended an Intensive Survey to determine the NRHP eligibility of the Dayton Canal and the subsequent Intensive Survey entitled, 'Dayton Canal along SH 146 Liberty, County, Texas,' was completed in September 2006. The Dayton Main Canal and the Big Ditch (main drainage ditch) were determined eligible for the NRHP under Criterion A, at the local level of significance, in the area of Agriculture, and within the period of significance 1910-1927 and 1935-1964. The APE for both the previous reconnaissance and intensive surveys is west of and outside of the APE for Segments H and I-1. The APE determined in the previous reports does not overlap any portion of the APE for Segments H and I-1. However, because of the linear nature of canal systems, portions of both of the NRHP eligible features of the Dayton Canal are present within the APE for Segments H and I-1. One cemetery, the East River Baptist Church Cemetery in Montgomery County is listed in the Atlas as cemetery MQ-C024. The previously recorded historic resources within the APE and SSA are shown on **Exhibit 3-15.**

As a result of consultation with TxDOT ENV historians, a Non-Archeological Historic Resources Preliminary Survey was conducted in July 2007. The survey used an APE of 300 feet from the proposed ROW of each reasonable alternative being considered at that time. The projected letting date in 2007 was 2018, thus 1973 was the criteria used to determine the historic-age criteria cut-off date. The purpose of the survey was to identify previously designated NRHP, RTHL or SAL resources, as well as to identify historic-age resources considered to have NRHP eligibility potential, in an effort to avoid these resources to the maximum extent practicable during future alternatives analysis decision-making. Historic-age resources that were considered not to have NRHP eligibility potential, or were not visible or accessible from public

venues were intended to be fully documented during a future reconnaissance-level survey and subsequent HRSR.

3.15.2.3 Historic Resources Survey Report Methodology

A Draft Non-Archeological Historic-Age Resources Survey (HRSR) has been prepared and submitted to the TxDOT Houston District and to TxDOT ENV for their review. TxDOT ENV will make the final determinations of eligibility and effects to historic properties and will coordinate with SHPO per the First Amended Programmatic Agreement of Transportation Undertakings (PA-TU).

3.16 HAZARDOUS MATERIALS

Land uses within the study area are a mixture of industrial, commercial, residential, and agricultural. Major concentrations of developed areas are located at the northern and southern boundaries. Large rural tracts used for farming and other types of agricultural uses are located throughout the study area. The developed area in the northern section is primarily residential. The overall region is known for its petroleum-based industries, including numerous oil and gas refineries. These large petroleum-based facilities are located throughout the study area, with a heavy concentration in the southern portion.

There are also numerous oil and gas wells, including pipelines, within the study area. Two salt domes are located in the study area. One is located in Mont Belvieu at the southern end of the study area, and another is located northwest of Dayton in the northern portion of the study area. A salt dome can form pockets and reservoirs where petroleum and natural gas can collect. Oil from these pools can be extracted and is used as a major source of petroleum produced along the Gulf of Mexico.

Hazardous materials are generally defined as any material that has or would have, when combined with other materials, an adverse effect on humans or the natural environment. Characterized as reactive, toxic, infectious, flammable, explosive, corrosive, or radioactive, hazardous materials may be solid, sludge, liquid, or gas. Potential hazardous materials sites include service stations, landfills, salvage yards, and industrial sites, as well as aboveground and underground storage tanks (ASTs and USTs). The EPA and TCEQ maintain various databases of regulated sites, including landfills and facilities that transport, store, and treat hazardous materials.

A records search was conducted for hazardous materials sites and/or areas of potential concern and is provided as a GIS database. In addition, the Railroad Commission of Texas (RRC) was also contacted and

GIS spatial data layers were obtained, providing locations of oil and gas wells and pipelines for all four counties within the study area. Ortho-photography along with limited field visits was also used in locating and defining additional areas of concern.

3.16.1 Hazardous Materials Sites

There are 432 hazardous materials sites located within the study area. **Table 3-21** provides a summary of the potential hazardous materials sites identified during the initial search of the study area. **Exhibit 3-16** depicts the locations of the potential hazardous materials sites within the study area. Refer to **Appendix G** for individual in-depth site information.

Table 3-21: Federal Regulatory Database Search

Database Abbreviation	Database Description	Number of Sites
NPL	*National Priorities List* – Priority sites for cleanup under the federal Superfund program. EPA has determined that these sites pose a threat to human health and remediation is required.	0
CERCLIS	*Comprehensive Environmental Response, Compensation, and Liability Information System* – Listing of Superfund sites that the EPA has investigated or is currently investigating for a release or threatened release of hazardous substances. Contains sites which are either proposed or on the NPL and sites which are in the screening and assessment phase for possible inclusion on the NPL.	1
CERCLIS –NFRAP	*CERCLIS "No Further Remedial Action Planned"* –Contains information on sites that have been removed and archived from the inventory of Superfund sites. Archive status indicates that, to the best of EPA's knowledge, federal Superfund assessment of a site is complete and it has been determined that no further steps would be taken to list the site on the NPL.	6
CORRACTS	*Corrective Action Report* – Identifies Hazardous Waste Handlers with RCRA Corrective Action Activity.	6
RCRA	*Resource Conservation and Recovery Act Information* – Identifies sites that generate, transport, store, treat and/or dispose of hazardous waste.	103
ERNS	*Emergency Response Notification System* – Records and stores information on reported releases of oil and hazardous substances.	110
HMIRS	*Hazardous Material Incident Report System* – Contains hazardous material spill incidents reported to the DOT.	13
TRIS	*Toxic Chemical Release Inventory System* – Identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.	5
TSCA	*Toxic Substance Control Act* – Identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list.	12
FTTS	*FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)* –Tracks administrative cases and pesticide enforcement actions.	5
PADS	*PCB Activity Database* – Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA.	1
MINES	*Mines Master Index File* – Contains all mine identification numbers issued for mines active or opened since 1971.	1
FINDS	*Facility Index System* – Contains both facility information and 'pointers' to other sources that contain more detail.	169
	Total	432

Source: Environmental Data Resources (EDR), 2012

3.16.1.1 State Superfund Site

There is one state Superfund site in the study area, the Cox Road Dump (also known as Liberty Waste Disposal Landfill), which is located 1 mi north of FM 1413 on the west side of County Road (CR) 491 (Cox Road), in Dayton (Liberty County) (Texas Secretary of State, 2006). This site was evaluated in August 2004 using the Hazard Ranking System (HRS) which is the principle screening guide used by TCEQ and was given a ranking of 13.14 (TCEQ, 2006). This ranking is used to determine if a site qualifies as a state funded or a federal funded site. In order for a location to be eligible as a federally-funded site, it must have an HRS score of at least 28.5. If the site has an HRS score between 5 and 28.5 it is eligible for designation as a state Superfund site. Therefore, the Cox Road Dump site meets the state Superfund site criteria. On February 10, 2006, a legal notice was published in the Texas Register (31 TexReg 907-908) proposing the site for listing on the state Superfund registry. The site falls within the TCEQ Region Houston-12.

The Cox Road Dump is an 83-ac landfill that was operated by the Joiner Oil Company from 1969 to 1983. The site is now owned by the Joiner Liquidating Trust. The TCEQ cited at a public meeting held March 16, 2006, that numerous parties had been identified as responsible for dumping at this location. Analytical results of soil and water as reported by TCEQ indicate the presence of arsenic, barium, boron, chromium, lead, mercury, Aroclor 1016, cadmium, cobalt, cyanide, phenol, toluene, xylene, and pesticide 4,4-DDE (dichlorodiphenyldichloroethylene) (TCEQ, 2006).

Aerial photography and site visits were used to determine the boundary for the Cox Road Dump site. The boundary around the Cox Road Dump site was set as a constraint for alternatives analysis and a 1-mi buffer was also created to provide adequate avoidance distances for preliminary alternatives and reducing the possibility of impacting potential contaminated areas. The size of the buffer was determined by the search criteria set by TxDOT for a state Superfund site as noted in TxDOT's *Hazardous Materials in Project Development Guidance Document* (TxDOT, 2006). In April 2006 and during the planning process, the Cox Road Dump site's regulatory status changed with its acceptance into the Voluntary Cleanup Program. This allowed the engineer to remove the avoidance buffer for later alignment revisions.

3.16.1.2 Oil Wells

The Railroad Commission of Texas (RRC) Information Service Division was contacted and the digital well location mapping, including the American Petroleum Institute database information, was acquired for the study area. The RRC regulates and issues permits for drilling of oil and gas wells within the State of Texas.

All permitted wells are maintained in a GIS database by the RRC. An estimated 6,644 oil and/or gas wells were identified within the study area for Segments H and I-1.