

Appendix F:
Desktop Environmental Review

**LOWER BRAZOS
FLOOD PROTECTION
PLANNING STUDY
APPENDICES**

March 2019

Appendix F –Desktop Environmental Review

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Supporting Information

EMST Vegetation Descriptions

Environmental Constraint Analysis Geodatabase Description

USFWS IPaC Report

Acronyms

AHPA	Archaeological and Historical Preservation Act of 1974
ARPA	Archaeological Resources Protection Act of 1979
AU	Assessment Unit
BRA	Brazos River Authority
DFIRM	Digital Flood Insurance Rate Maps
ECOS	Environmental Conservation Online System
EMST	Ecological Mapping System of Texas
EOR	Element Occurrence Record
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAC	Facultative
FACU	Facultative Upland
FACW	Facultative Wetland
FEMA	Federal Emergency Management Agency
FPPA	Federal Farmland Protection Policy Act
GIS	Geographic Information Systems
GMA	Groundwater Management Area
GWCD	Groundwater Conservation
Halff	Halff Associates, Inc.
HWP	High Wetland Potential
IPaC	Information for Planning and Consultation
LBRED	Lower Brazos River Environmental Database
LESA	Land Evaluation and Site Assessment
LWP	Low Wetland Potential
MWP	Moderate Wetland Potential
NED	National Elevation Dataset
NEPA	National Environmental Policy Act
NHD	National Hydrography Dataset
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWP	Nationwide Permit
OBL	Obligate
RA	River Authorities
RHA	Rivers and Harbors Act of 1899
RWPA	Regional Water Planning Areas
SDR	Submitted Drillers Report
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SLD	Special Law Districts
SWCD	Soil and Water Conservation District
TASA	Texas Archaeological Sites Atlas

TCEQ	Texas Commission on Environmental Quality
THC	Texas Historical Commission
TNRC	Texas Natural Resources Code
TPWD	Texas Parks and Wildlife Department
TSSWCB	Texas State Soil and Water Conservation Board
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
TXNDD	Texas Natural Diversity Database
TXRRC	Texas Railroad Commission
UPL	Upland
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geologic Survey

F.1.0 Introduction

As a component of the *Lower Brazos Floodplain Protection Planning Study*, Halff Associates, Inc. (Halff) has been tasked by the Brazos River Authority (BRA) to conduct a Geographic Information System (GIS)-based evaluation of environmental resources and potential environmental constraints near the Brazos River. For this analysis, a constraint is defined as something that may affect the location of, or be affected by the location of, a flood mitigation project. Certain activities pertaining to flood risk reduction have the potential to be regulated under Section 404 of the Clean Water Act (Section 404), Section 7 of the Endangered Species Act, Section 106 of the National Historic Preservation Act, the National Environmental Policy Act (NEPA), as well as various state, regional, and municipal regulations. For this evaluation, the study area¹ is defined as approximately 2,700 square miles along the Lower Brazos River corridor in Austin, Brazos, Fort Bend, Waller, Washington, and Wharton Counties, Texas (Figure F-1.0). Through this GIS-based evaluation process, Halff has compiled a geographic dataset for the entire study area representing environmental features with the potential to present regulatory constraints (i.e. potential permitting and/or mitigation). The purpose of this dataset is to provide BRA with a planning and scoping tool for prospective flood mitigation projects within the Lower Brazos River Basin. To facilitate ease-of-use for BRA personnel, Halff has included footnotes throughout the document referencing the location of constraints data in the Lower Brazos River Environmental Geodatabase (LBRED).

F.2.0 Waters of the United States

F.2.1 Introduction

Federal regulations (33 CFR Section 328.3(a)) note that waters of the United States may include intrastate rivers and streams, including impoundments and other waters (e.g. wetlands). Section 404 of the Clean Water Act (Section 404) establishes a program to regulate the discharge of dredged or fill material into waters of the United States. Activities in waters of the United States regulated under this program include fill for development, water resource projects (e.g. dams and levees), infrastructure development, and mining projects². The U.S. Army Corps of Engineers (USACE) Galveston District is the final authority on the jurisdictional status of all aquatic features within the study area and has the regulatory authority to review and issue permits for unavoidable impacts to waters of the United States.

F.2.2 Streams and Impoundments

Generally, the presence of mapped streams on a United States Geologic Survey (USGS) 7.5 feet topographic map and/or the USGS National Hydrography Dataset (NHD) is a reliable indicator of linear aquatic features with the potential to be considered waters of the United States. Likewise, the presence of on-channel impoundments on the USGS map and/or the NHD is a reliable

¹ Bridged\Basemap_Features\Study_Area

² <https://www.epa.gov/cwa-404/section-404-permit-program>

indicator of open water features with the potential to be considered waters of the United States. Halff recommends field verification of all potential waters of the United States prior to construction of any project. However, the presence of these features within the above referenced datasets should be sufficient for planning purposes. As such, the NHD stream centerlines³ and open water⁴ features have been included in the LBRED⁵. Figure F-2.2 depicts the NHD layers within a portion of the study area.

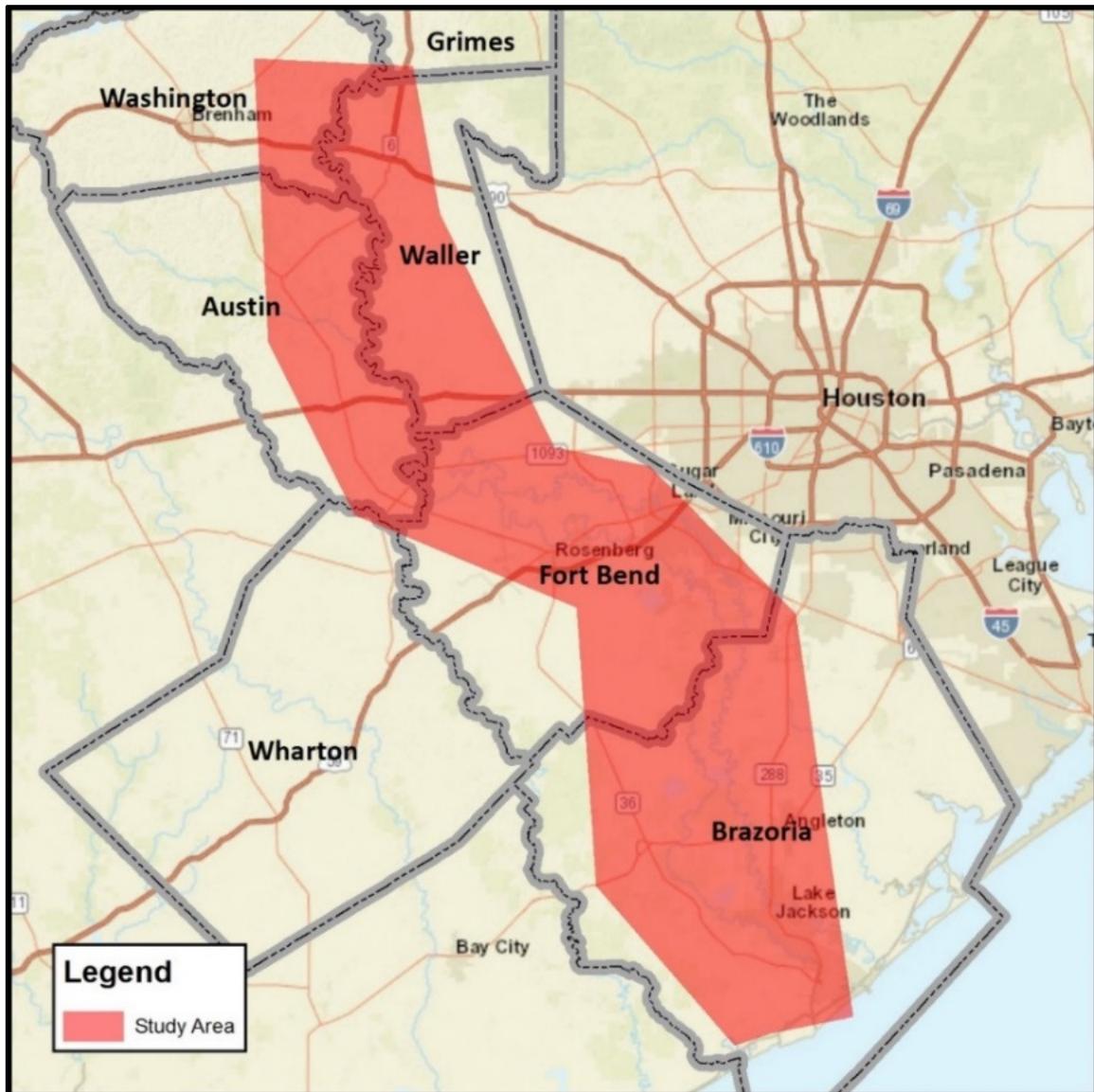


Figure F-1.0 – Study Area Map

³ LBRED.gdb\Hydrology\NHD_Stream_Centerlines

⁴ LBRED.gdb\Hydrology\NHD_Waterbodies

⁵ LBRED.gdb

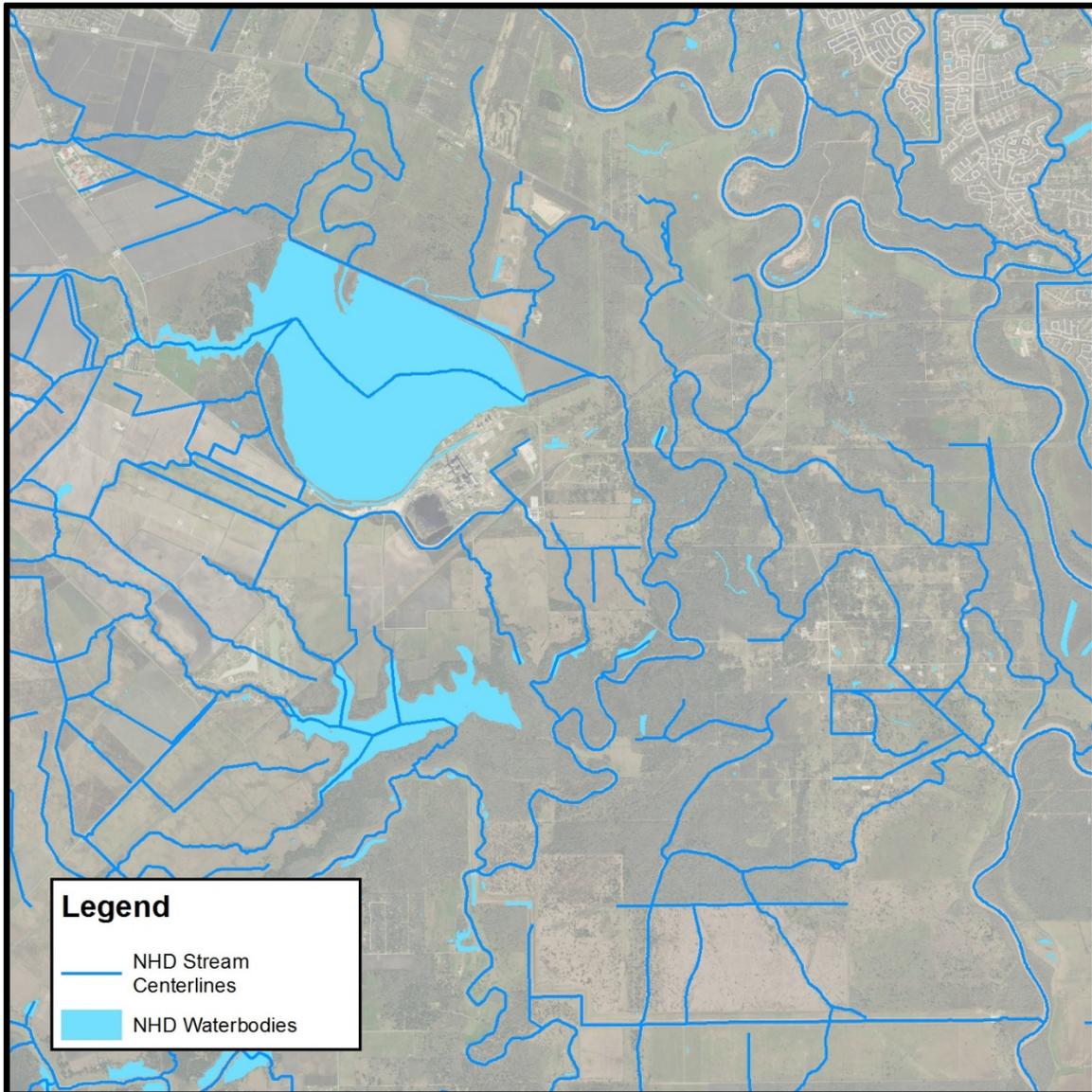


Figure F-2.2 – Example NHD Map

F.2.3 Wetlands

The U.S. Environmental Protection Agency (EPA) and the USACE jointly define wetlands as:

“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 do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.”⁶

⁶ Section 404 of the Clean Water Act: How Wetlands are Defined and Identified:
<https://www.epa.gov/cwa-404/section-404-clean-water-act-how-wetlands-are-defined-and-identified> (Accessed May 31, 2017)

Per the 1987 USACE Wetland Delineation Manual⁷, wetlands (as defined above) have the following general diagnostic characteristics:

1. **Vegetation** - *The prevalent vegetation consists of macrophytes that are typically adapted to areas having hydrologic and soil conditions described above.*
2. **Soil** - *Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing soil conditions.*
3. **Hydrology** - *The area is inundated either permanently or periodically at mean water depths ≤ 6.6 ft., or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation.*

Except in problematic situations (identified and described in the 1987 manual), evidence of one positive indicator from each of the parameters (vegetation, soil, and hydrology) must be observed to make a positive wetland determination. For discrete geographic locations these characteristics must be evaluated in the field to make accurate determinations. However, in situ observations are not practical when performing planning/scoping activities at a broad geographical scale. Unfortunately, there is no publicly available GIS data that reliably indicates the presence of wetlands. The United States Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) Maps⁸ provide areas of potential wetlands, but used alone this data may be insufficient, and is frequently inconsistent with USACE regulations.

In the absence of reliable GIS data to predict the presence of jurisdictional wetlands, Halff developed the following methodology based on the three-parameter wetland determination guidelines, utilizing publicly available GIS data as an analog for data typically collected in the field. While this methodology utilizes measurable geospatial data, the ranking analysis is based on a qualitative assessment relying on Halff's expertise in field identification of wetlands as well as years of experience conducting "desktop" wetland evaluations as a vital step in scoping and planning field delineation efforts.

F.2.3.1 Hydrology

Three sources of background data were evaluated to generate a ranked raster GIS layer representing the potential for wetland hydrology within the study area. This data included Federal Emergency Management Agency (FEMA) Digital Flood Insurance Rate Maps (DFIRM)⁹, USFWS, NWI maps, and the 2013 National Elevation Dataset (NED) topography data¹⁰. Wetland hydrology, especially as it pertains to USACE jurisdiction, is influenced by the hydrologic fluctuations (e.g. overbank flood events, water table fluctuations, etc.) of the surface tributary system, and the floodplain. The FEMA 100-year floodplain¹¹ is publicly available data that can

⁷ Corps of Engineers Wetlands Delineation Manual:

<http://www.cpe.rutgers.edu/Wetlands/1987-Army-Corps-Wetlands-Delineation-Manual.pdf> (Accessed May 31, 2017)

⁸ LBRED.gdb\Hydrology\NWI_Features

⁹ FEMA Flood Map Service Center: <https://msc.fema.gov/portal> (Accessed May 31, 2017)

¹⁰ LBRED.gdb\T2013_DEM

¹¹ LBRED.gdb\Hydrology\FEMA_Floodplains

represent potential for overbank flooding. The USFWS digitized NWI wetland features were also evaluated to estimate potential wetland hydrology. The NWI data was generated by the USFWS from aerial imagery and represents areas where signatures on aerial imagery suggest inundation or saturated soil conditions (i.e. wetland hydrology). Finally, wetland hydrology tends to occur in depressional topography. A “sink” raster was created from the NED data that identifies closed contour (depressional) areas.

Utilizing these three datasets, a ranked raster dataset for each data source was created to represent potential wetland hydrology for the study area. Initially ranked rasters with values of zero and one were generated for each of the datasets. These datasets were then combined utilizing a raster calculation to generate a ranked data set representing the potential for wetland hydrology to occur. This process resulted in a raster with values from 0 to 3¹². These values were then squared¹³ to weight areas with multiple wetland hydrology factors more highly in the final Wetland Mapper raster analysis. Table F-2.3.1a and Table F-2.3.1b summarize the raster calculations and the results, and Figure F-2.3.1 displays the results of this operation geographically.

Table F-2.3.1a – Wetland Hydrology Factors

Wetland Hydrology Factors	Rank	Description
FEMA Floodplain ¹⁴	0	Outside the 100-year floodplain
	1	Inside the 100-year floodplain
NWI Features ¹⁵	0	Outside NWI wetland limits
	1	Inside NWI wetland limits
NED “Sink” Raster ¹⁶	0	All other areas
	1	“sink” or closed-contour depression

Table F-2.3.1b – Wetland Hydrology: Overall Ranking Analysis

Rank	Description	Explanation
0	Low Potential for Wetland Hydrology	No wetland hydrology factors
1	Moderate Potential for Wetland Hydrology	1 wetland hydrology factor
4	High Potential for Wetland Hydrology	2 wetland hydrology factors
9	Very High Potential for Wetland Hydrology	3 wetland hydrology factors

¹² LBRED.gdb\WetlandMapperRasters\Hydrology_Linear_Rank

¹³ LBRED.gdb\WetlandMapperRasters\Hydrology_Squared_Rank

¹⁴ LBRED.gdb\WetlandMapperRasters\Floodplain_Rank

¹⁵ LBRED.gdb\WetlandMapperRasters\NWI_Rank

¹⁶ LBRED.gdb\WetlandMapperRasters\Wetland_Topography_Rank

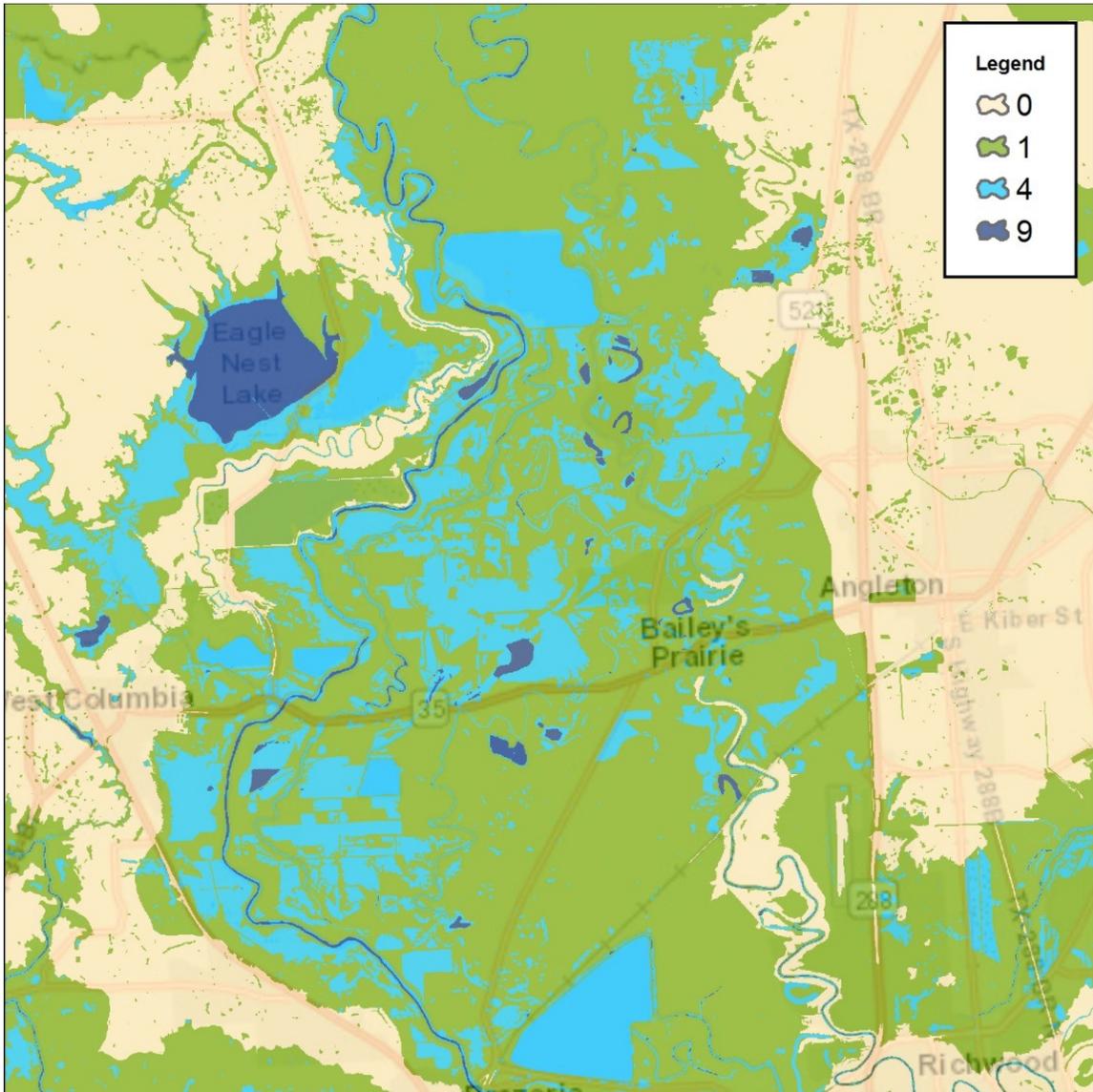


Figure F-2.3.1 – Example Wetland Hydrology Ranking Map

F.2.3.2 Soils

The United States Department of Agriculture (USDA) Soil Surveys¹⁷ for the study area, along with the 2014 Natural Resources Conservation Service (NRCS) Hydric Soil Database¹⁸, were utilized to create a GIS layer¹⁹ representing the likelihood of hydric soils within the study area. The NRCS database lists soil map units with known hydric components and provides a percentage of the map unit in which these hydric components are known to occur. Halff utilized these percentages to develop a ranked dataset representing the likelihood of hydric soils within the study area by

¹⁷ USDA NRCS Web Soil Survey: <https://websoilsurvey.sc.egov.usda.gov/app/HomePage.html> (Accessed May 31, 2017)

¹⁸ USDA NRCS Hydric Soils: <https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/> (Accessed May 31, 2017)

¹⁹ LBRED.gdb\WetlandMapperRasters\Hydric_Soil_Rank

multiplying the percentage of hydric soil components by ten. Table F-2.3.2a details the classes of potentially hydric soils. Figure F-2.3.2 depicts the result of the soil ranking within the study area.

Table F-2.3.2a – Hydric Soil Ranking

Hydric Components*	Hydric Soil Ranking
No known hydric components	0
1%	0.1
2%	0.2
3%	0.3
4%	0.4
5%	0.5
7%	0.7
10%	1
15%	1.5
55%	5.5
60%	6
85%	8.5
90%	9
95%	9.5
100%**	10

** This represents the percentage of the overall soil mapped unit acreage that is known to contain hydric components.*

***This includes areas mapped as water or pits where soil descriptions suggest near constant inundated or saturated conditions.*

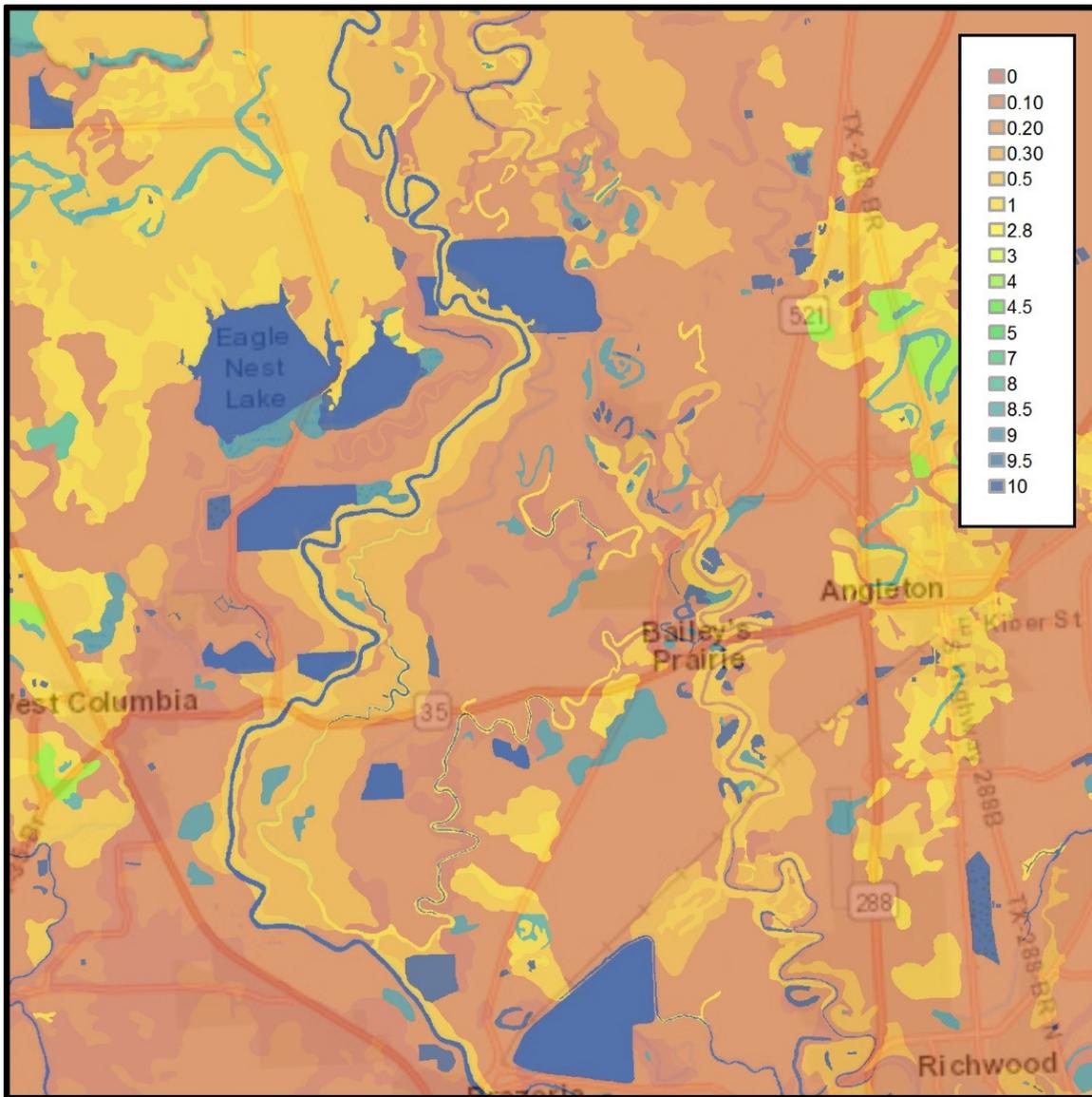


Figure F-2.3.2 – Example Hydric Soil Ranking Map

F.2.3.3 Vegetation

The Texas Parks and Wildlife Department (TPWD) Ecological Mapping System of Texas (EMST) dataset²⁰ provides a 398-category land classification map for the entire State of Texas. This dataset was assembled by attributing land cover and abiotic variables to 10-meter resolution objects generated from aerial photographs, then comparing these attributions with more than 14,000 in situ land cover observations and vegetation sampling (the largest effort of this kind ever in Texas). Based on these observations, the statewide vegetation database is considered to have

²⁰ LBRED.gdb\Vegetation\TPWD_EMST

an accuracy range of 74% to 90%²¹. For this analysis, Halff clipped the statewide EMST dataset to the study area boundary. This revealed 53 different vegetation classes within the study area.

During in situ delineations, individual plant species are identified and assigned aerial coverage percentages to determine the dominant species present within a community. Then, utilizing wetland indicator status ratings²² (Table F-2.3.3a), a community dominance or prevalence index is calculated to determine if the community is dominated by hydrophytic vegetation. As a desktop analog, Halff evaluated the EMST vegetation class descriptions to obtain potentially dominant species, then assigned each vegetation class a wetland indicator status. Utilizing the wetland indicator assignment for each vegetation class, Halff calculated a weighted rank representing the probability of hydrophytic communities to occur. Initially these ranks were assigned to the vector EMST data²³, then converted to raster²⁴ for use in the wetland mapper analysis. Table F-2.3.3b details how the different community indicator statuses are ranked and weighted. Tables with detailed descriptions of the 53 vegetation classes within the study area are included after this appendix. Figure F-2.3.3 depicts the results of the vegetation ranking for a portion of the study area.

Table F-2.3.3a – Wetland Indicator Status Descriptions

Indicator status (abbreviation)	Occurrence in Wetlands (%)
Obligate (OBL). Occur almost always under natural conditions in wetlands.	99
Facultative Wetland (FACW). Usually occur in wetlands but occasionally found in non-wetlands.	67-99
Facultative (FAC). Equally likely to occur in wetlands and non-wetlands.	34-66
Facultative Upland (FACU). Usually occur in non-wetlands but occasionally found in wetlands.	1-33
Upland (UPL). Occur in wetlands in another region but occur almost always under natural conditions in non-wetlands in the region specified.	1

Table F-2.3.3b – Community Indicator Status Ranking

Community Indicator Status	Linear Value	Weight Calculation	Weighted Rank
NI/UPL	1	$UPL = 1 - (1 * 0.99)$	0.01
FACU	2	$FACU = 2 - (2 * 0.83)$	0.34
FAC-	3	$FAC- = 3 - (3 * 0.50)$	1.5
FAC	3	n/a	3
FAC+	3	$FAC+ = 3 + (3 * .50)$	4.5

²¹ TPWD Ecological Mapping Systems: <http://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/> (Accessed December 13, 2016)

²² US Army Corps of Engineers National Wetland Plant List Indicator Rating Definitions: <https://www.fws.gov/wetlands/documents/national-wetland-plant-list-indicator-rating-definitions.pdf> (Accessed June 13, 2017)

²³ LBRED.gdb\Wetland_Mapper\Ranked_EMST_Vegetation_Layer

²⁴ LBRED.gdb\WetlandMapperRasters\Hydrophytic_Vegetation_Rank

Community Indicator Status	Linear Value	Weight Calculation	Weighted Rank
FACW	4	$FACW = 4 + (4 \times 0.83)$	7.32
OBL	5	$OBL = 5 + (5 \times 0.99)$	9.95

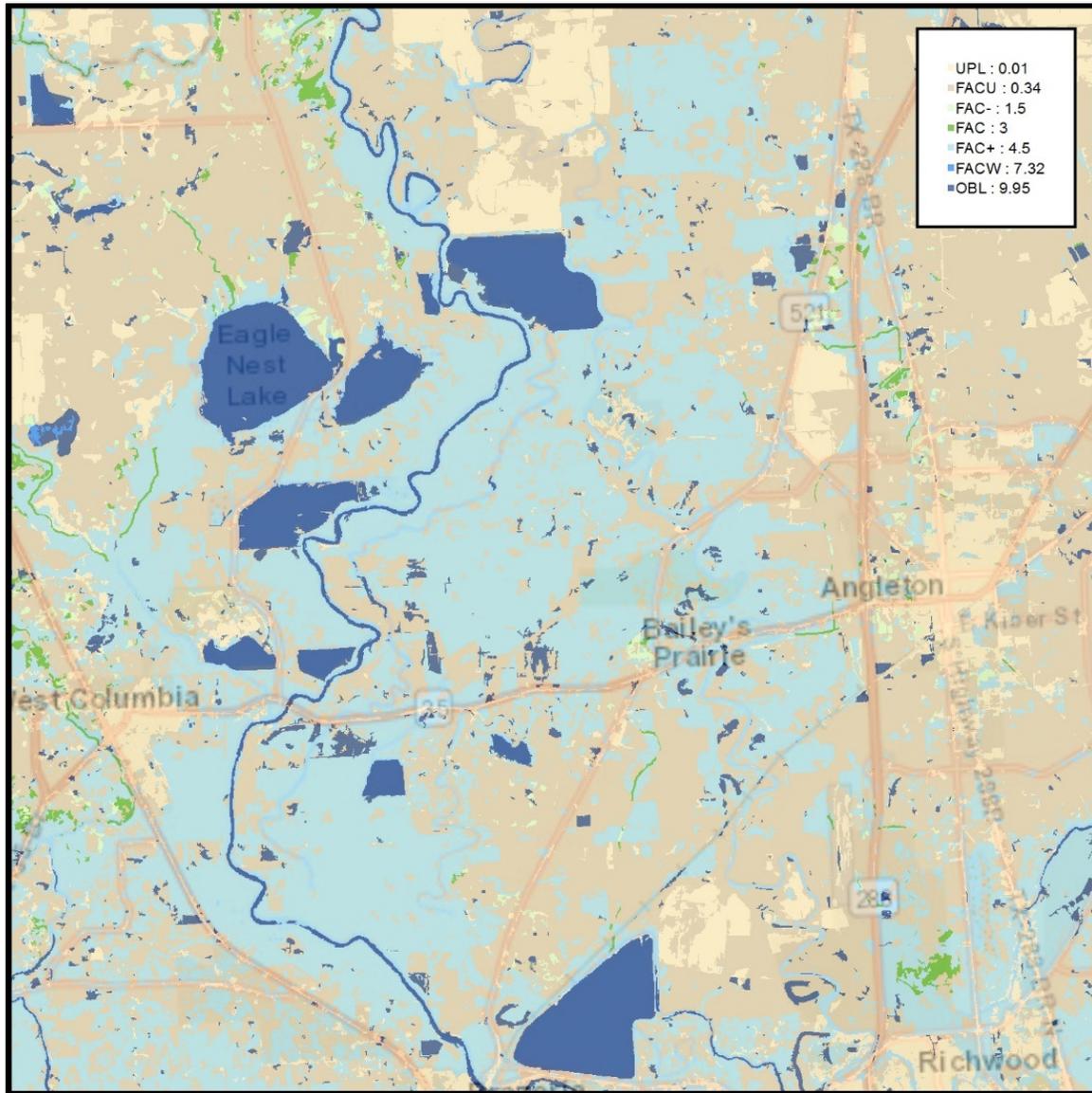


Figure F-2.3.3 – Example Vegetation Cover Ranking Map

F.2.3.4 Wetland Mapper Results

Utilizing the qualitatively ranked raster GIS layers (hydrology, soil, and vegetation) a final Wetland Mapper raster²⁵ was calculated for all acreage within the study area by finding the sum of all

²⁵ LBRED.gdb\WetlandMapperRasters\Wetland_Mapper_Final

three layers. Scores ranged from 0.01 to 28.95, with 0.01 representing the lowest potential for conditions conducive to wetland formation and 28.95 representing the highest potential for conditions conducive to wetland formation. Figure F-2.3.4a displays the results of the wetland mapper process for a portion of the study area. The data was then reclassified, using median values, into three classes: low wetland potential (LWP), moderate wetland potential (MWP), and high wetland potential (HWP). Table F-2.3.4a details this reclassification. Areas of MWP and HWP were converted from the reclassified raster to a polygon feature class²⁶ in the LBRED geodatabase. Figure F-2.3.4b depicts the Potential Wetland Areas feature class for a portion of the study area.

Table F-2.3.4a – Wetland Mapper Reclassification

Final Rank Value	Wetland Class	Acreage in Study Area
0.01 – 7.25	LWP	1,077,764
7.26 – 14.5	MWP	153,035
14.51 – 28.95	HWP	88,765

²⁶ LBRED.gdb\Hydrology\Potential_Wetland_Areas

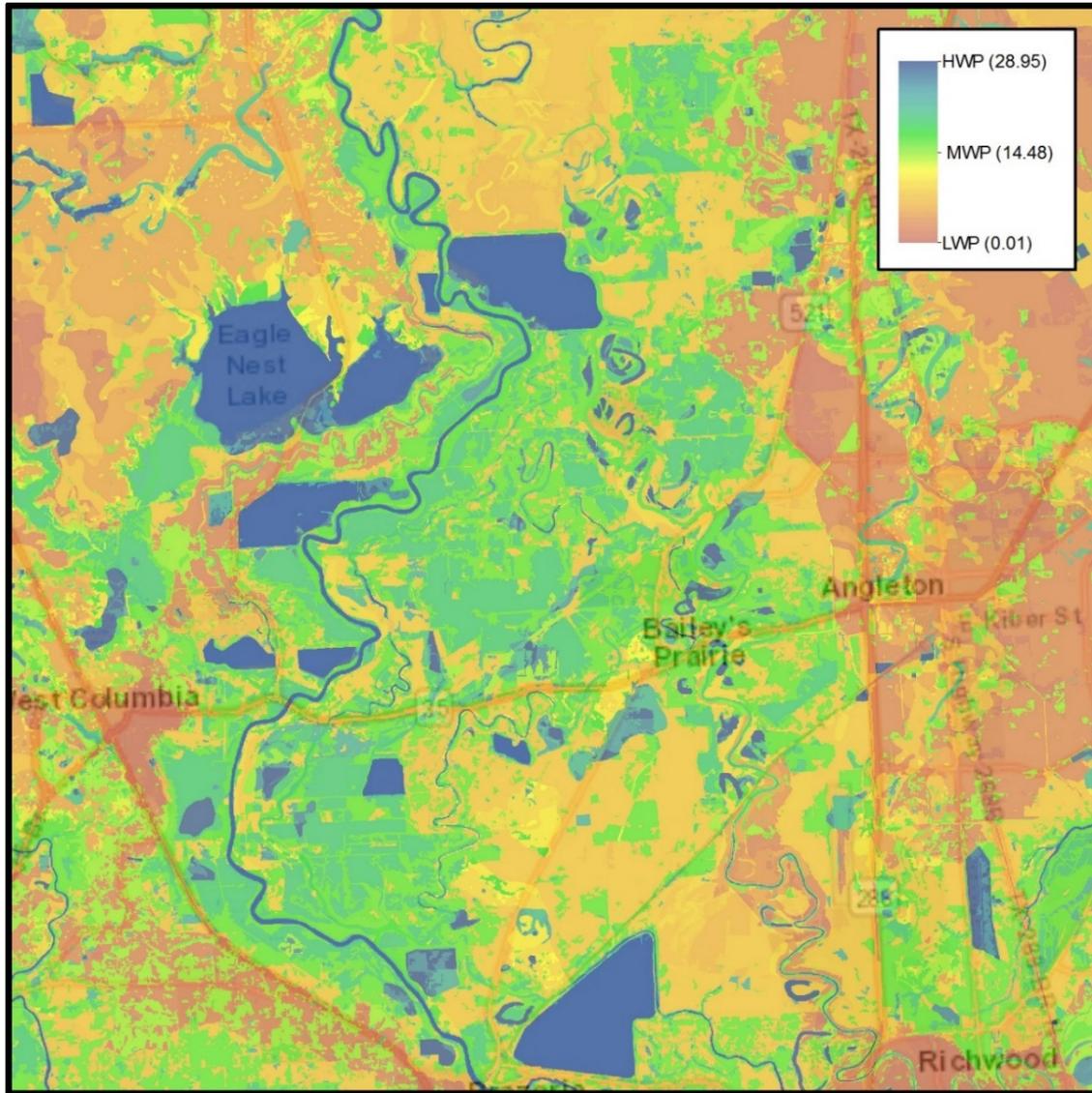


Figure F-2.3.4a – Example Wetlands Mapper Results

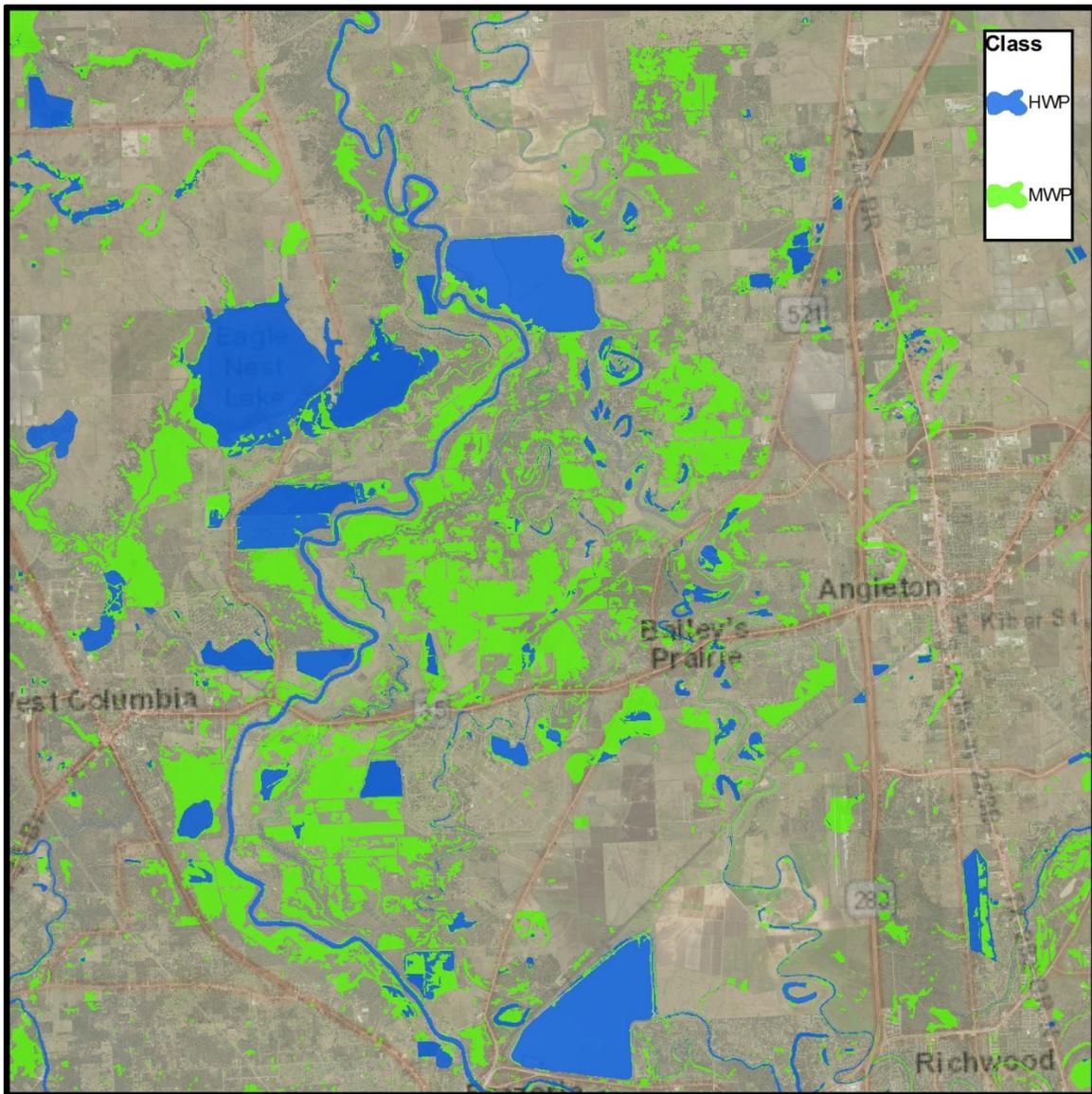


Figure F-2.3.4b – Example Potential Wetland Areas Map

F.3.0 Hydrology

F.3.1 Impaired Surface Waters

The Texas Commission on Environmental Quality (TCEQ), in accordance with the Federal Clean Water Act Sections 303(d) and 305(b), provides a report on the status of surface waters every two years. This report, the *Texas Integrated Report for Clean Water Act, Sections 305(b) and 303(d)*²⁷,

²⁷ 2014 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d): <https://www.tceq.texas.gov/waterquality/assessment/14twaj/14txir> (accessed June 13, 2017)

uses collected data to determine if a water body does not meet the applicable water quality standard. The TCEQ then specifies a category to each water body based on the impairment. Table F-3.1 describes these categories.

Table F-3.1 – Categories included in the Texas Integrated Report²⁸

Category	Definition
1	Attaining the water quality standard and no use is threatened.
2	Attaining some of the designated uses; no use is threatened; and insufficient or no data and information are available to determine if the remaining uses are attained or threatened.
3	Insufficient or no data and information to determine if any designated use is attained. Many of these water bodies are intermittent streams and small reservoirs.
4	Standard is not supported for one or more designated uses but does not require the development of a TMDL. This category is broken into three subcategories: <ul style="list-style-type: none"> • 4a- All TMDLs have been completed and approved by EPA. • 4b- Other control requirements are reasonably expected to result in the attainment of all standards. • 4c- Nonattainment is shown to be caused by pollution, not by pollutants and that the water quality conditions cannot be changed by the allocation and control of pollutants through the TMDL process
5	The water body does not meet applicable water quality standards for one or more designated uses by one or more pollutants. This category is broken into three subcategories- <ul style="list-style-type: none"> • 5a- TMDLs are underway, scheduled, or will be scheduled for one or more parameters • 5b- A review of the standards for one or more parameters will be conducted before a management strategy is selected, including a possible revision to the TSWQSSs. • 5c- Additional data or information will be collected and/or evaluated for one or more parameters before a management strategy is selected.

For this analysis, only Category 5 waterbody Assessment Units (AU) were included. AUs were downloaded from the TCEQ GIS Database²⁹ and overlaid with the USGS NHD Stream Centerlines. NHD streams that overlapped the Category 5 AUs were attributed as "YES" under *Impaired* field for the feature class. Segments that did not overlap the Category 5 AUs were attributed as "NO" for the *Impaired* field. Impaired segments were extracted to create a new feature class³⁰ containing more detailed information from the TCEQ database about the impairment including the parameter, category, and the type of water quality impairment. Figure F-3.1 depicts the location of TCEQ impaired surface waters within the study area.

²⁸ Table reproduced from "Executive Summary 2014 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/14txir/2014_exec_summ.pdf" (accessed July 11, 2017)

²⁹ TCEQ GIS Database- <https://www.tceq.texas.gov/gis/download-tceq-gis-data> (accessed June 13, 2017)

³⁰ LBRED.gdb\Hydrology\TCEQ_Impaired_Segments

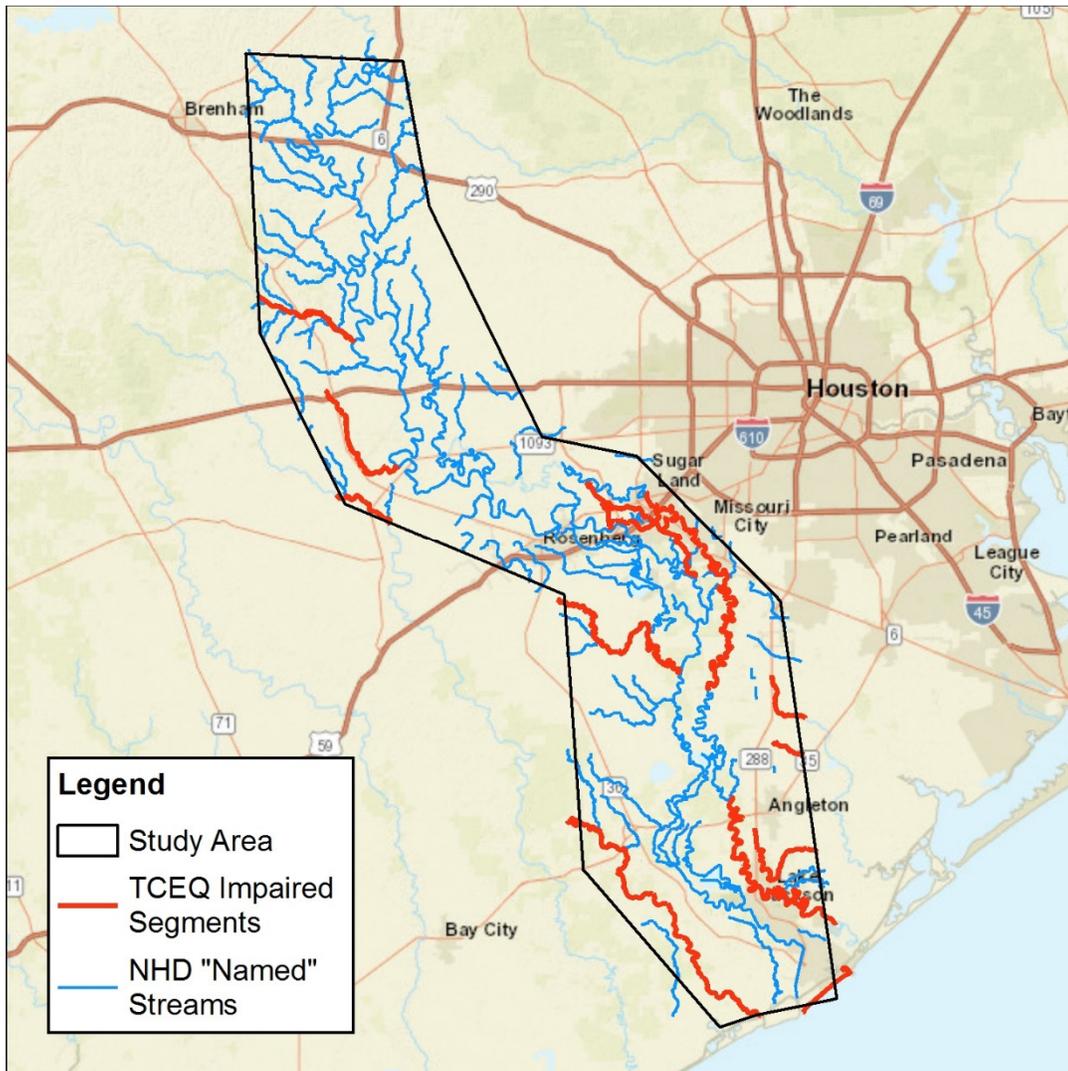


Figure F-3.1 – TCEQ Impaired Surface Waters

F.3.2 Groundwater Resources

Groundwater resources in Texas are divided into two categories: major (aquifers that produce large amounts of water over large areas) and minor aquifers (aquifers that produce minor amounts of water over large areas or large amounts of water over small areas)³¹. GIS data representing the boundaries of major³² and minor³³ aquifers were downloaded from the Texas Water Development Board (TWDB) GIS database³⁴ and clipped to the study area. Figure F-3.2 depicts the major and minor aquifers within the study area.

³¹ TWDB Texas Aquifers: <http://www.twdb.texas.gov/groundwater/aquifer/index.asp> (accessed July 11, 2017)

³² LBRED.gdb\Hydrology\Major_Aquifers

³³ LBRED.gdb\Hydrology\Minor_Aquifers

³⁴ TWDB GIS Database: <http://www.twdb.texas.gov/mapping/gisdata.asp> (accessed June 17, 2017)

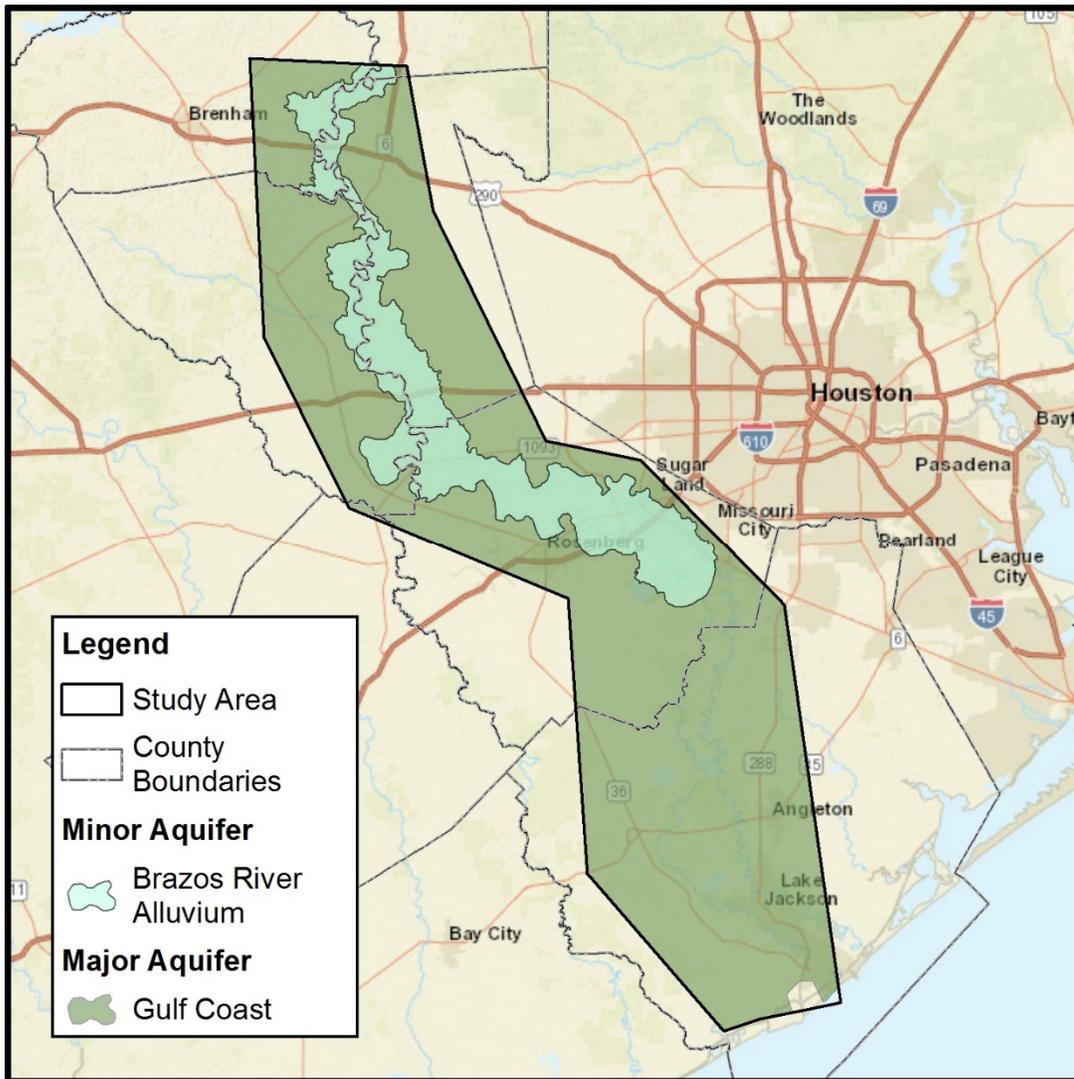


Figure F-3.2 – Major and Minor Aquifers within the Study Area

F.3.3 Water Management Entities

Groundwater Management Areas (GMA), delineated by the TWDB, are created “to provide for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions, consistent with the objectives of Section 59, Article XVI, Texas Constitution, groundwater management areas may be created”³⁵. While water management entities are not technically a constraint (as defined herein), they do represent stakeholders with interests that could represent management and/or regulatory constraints. This feature class³⁶ was downloaded from the TWDB GIS Database and clipped to the study area. Figure F-3.3a depicts GMAs within the study area.

³⁵ Texas Water Code §35.001: <http://www.statutes.legis.state.tx.us/Docs/WA/htm/WA.35.htm> (Accessed July 17, 2017)

³⁶ LBRED.gdb\Water_Management_Entities\GMA_Boundaries

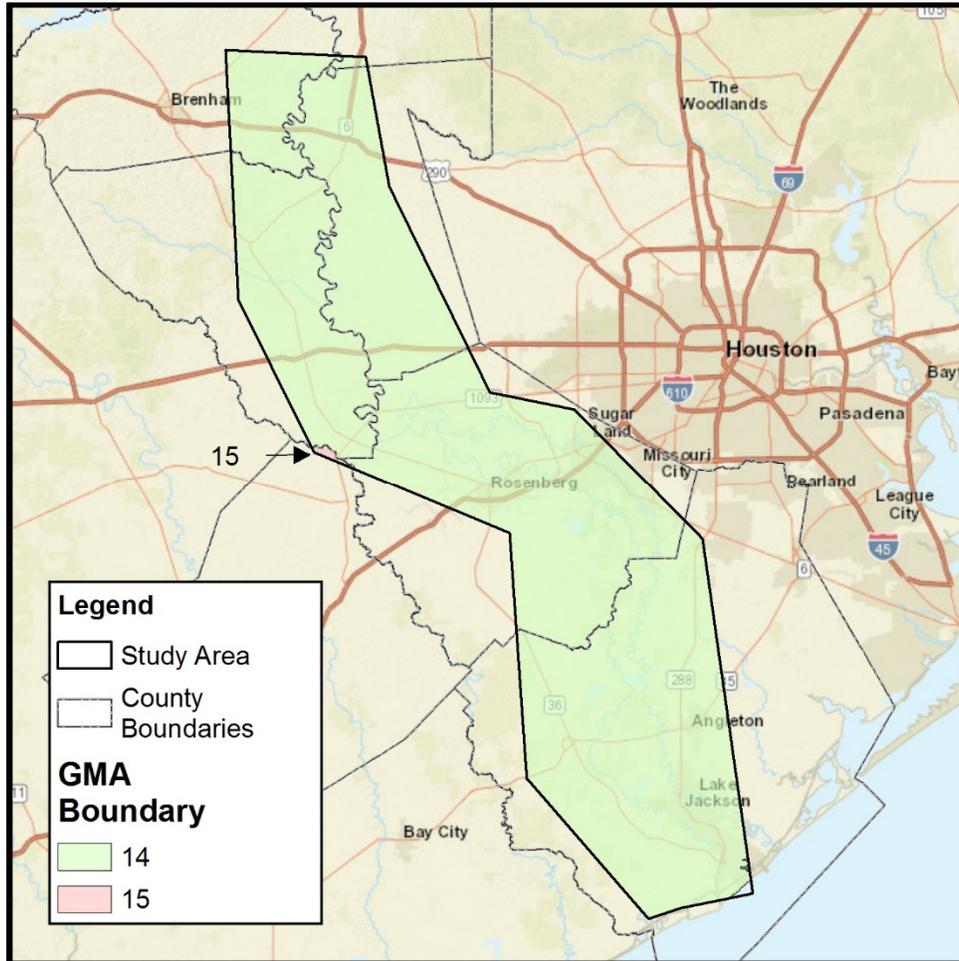


Figure F-3.3a – Groundwater Management Areas within the Study Area

Groundwater Conservation Districts (GWCD) are charged with managing and protecting groundwater resources within the boundaries of the district³⁷. Not all areas within the state are covered by a GWCD and new GWCD must be approved by the TWDB. This feature class³⁸ was downloaded from the TWDB GIS Database and clipped to the study area. Figure F-3.3b depicts GWCDs within the study area.

³⁷ Texas Water Development Board Groundwater Conservation Districts: https://www.twdb.texas.gov/groundwater/conservation_districts/ (accessed July 11, 2017)

³⁸ LBRED.gdb\Water_Management_Entities\GWCD_Boundaries

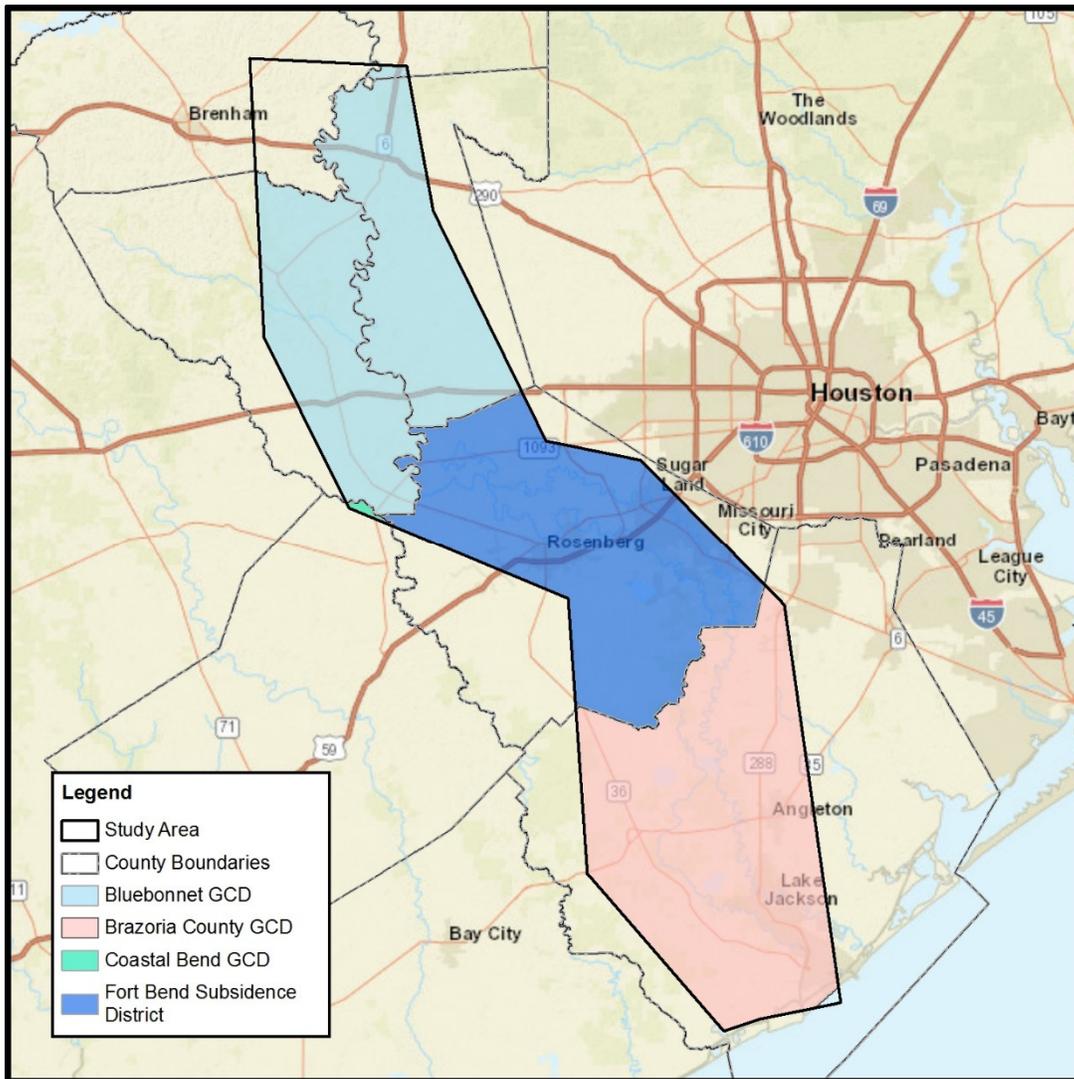


Figure F-3.3b – Groundwater Conservation Districts within the Study Area

Regional Water Planning Areas (RWPA) are commissioned by the TWDB to administer and assist in the development of regional and state water plans³⁹. This feature class⁴⁰ was downloaded from the TWDB GIS Database³⁴ and clipped to the study area. Figure F-3.3c depicts Regional Water Planning Areas within the study area.

³⁹ Regional Water Planning in Texas: <https://www.twdb.texas.gov/publications/shells/RegionalWaterPlanning.pdf> (accessed July 11, 2017)

⁴⁰ LBRED.gdb\Water_Management_Entities\RWPA_Boundaries

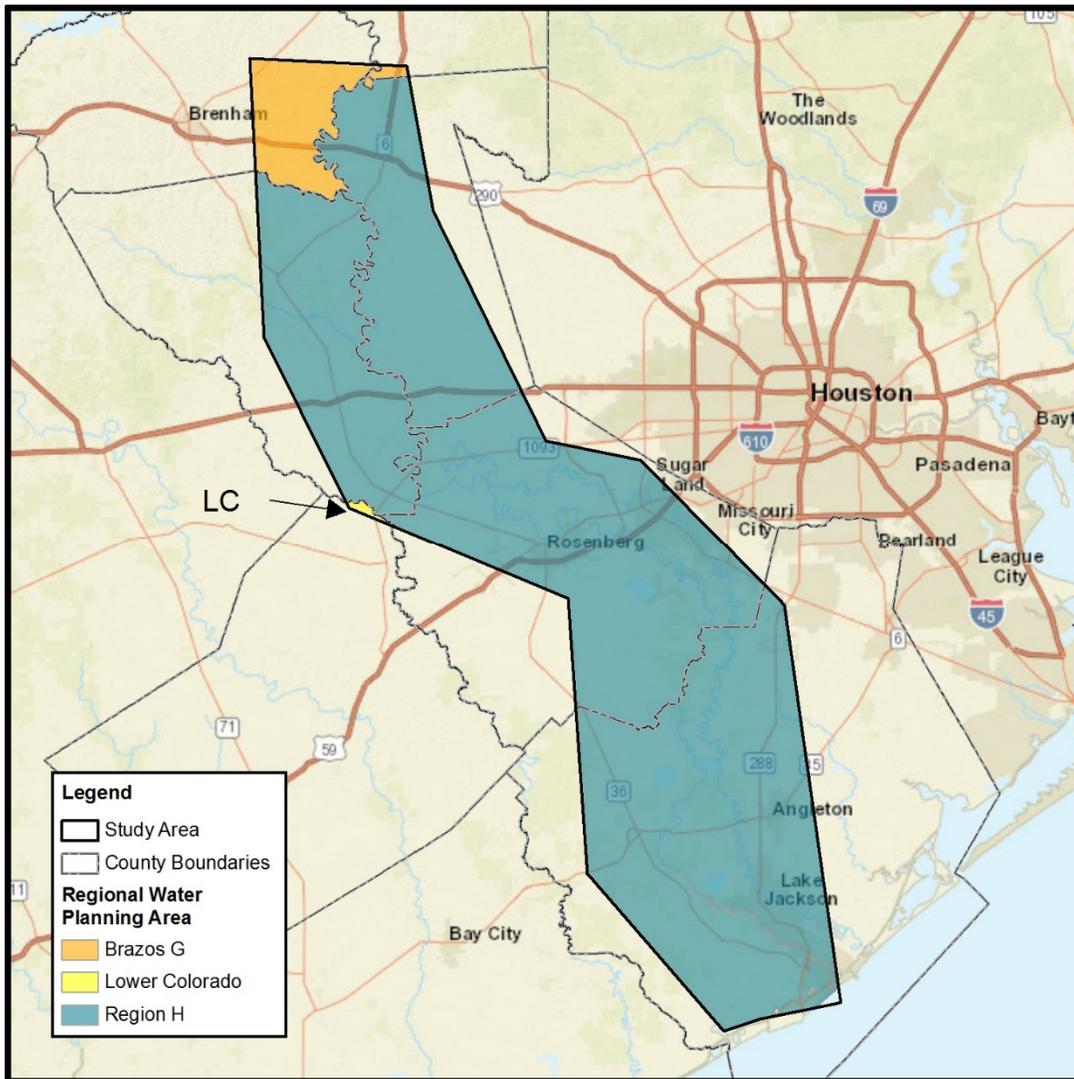


Figure F-3.3c – Regional Water Planning Areas within the Study Area

River Authorities (RA) and Special Law Districts (SLD) are created to develop and manage the waters within an entire river basin. Other responsibilities can include flood control, wastewater services and recreational facilities⁴¹. This feature class⁴² was downloaded from the TWDB GIS Database and clipped to the study area. Figure F-3.3d depicts River Authorities and Special Law Districts within the study area.

⁴¹ TCEQ Texas Water Districts: A General Guide (https://www.tceq.texas.gov/publications/gi/gi-043.html/at_download/file) (accessed July 11, 2017)

⁴² LBRED.gdb\Water_Management_Entities\RiverAuthorityBoundaries

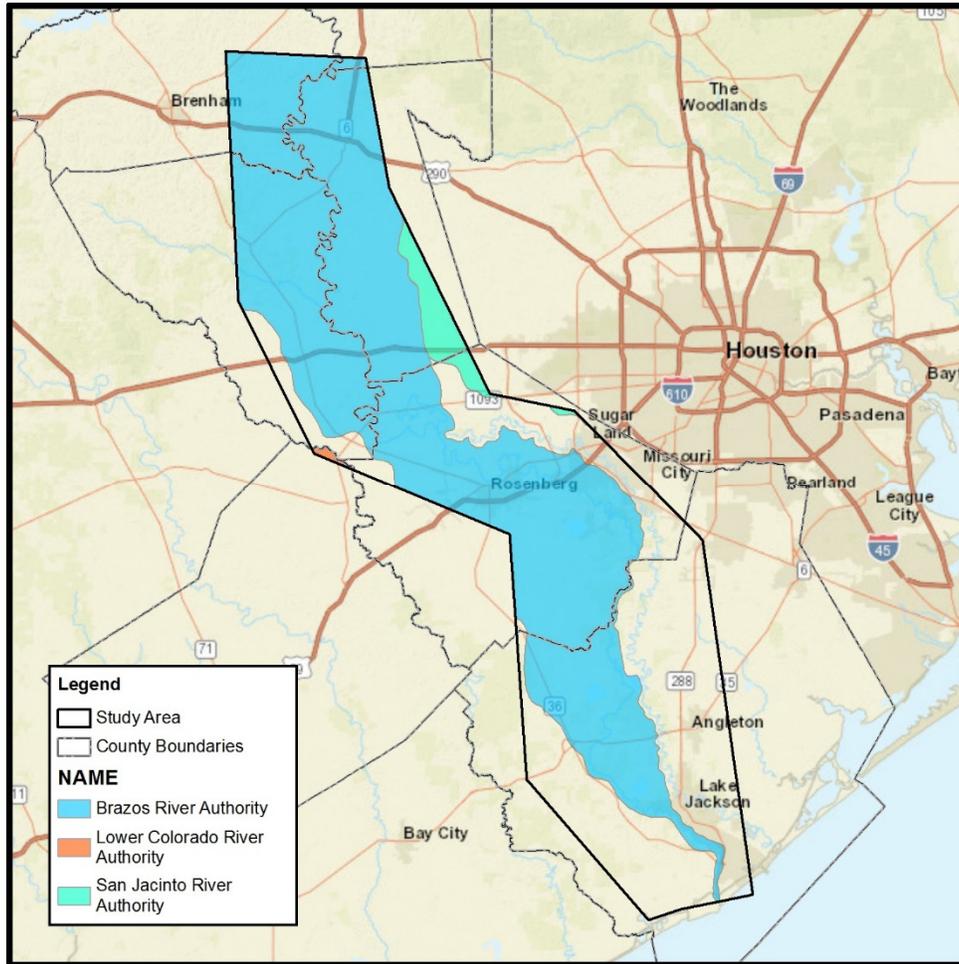


Figure F-3.3d – River Authorities and Special Law Districts within the Study Area

TCEQ Water Districts provide services to its customers relating to the specific type of water district, which can include municipal utility districts, water control and improvement districts, and special utility districts⁴¹. This feature class⁴³ was downloaded from the TCEQ GIS Database and clipped to the study area. Figure F-3.3e depicts water districts within the study area based on the type of district.

⁴³ LBRED.gdb\Water_Management_Entities\TCEQ_Water_District_Boundaries

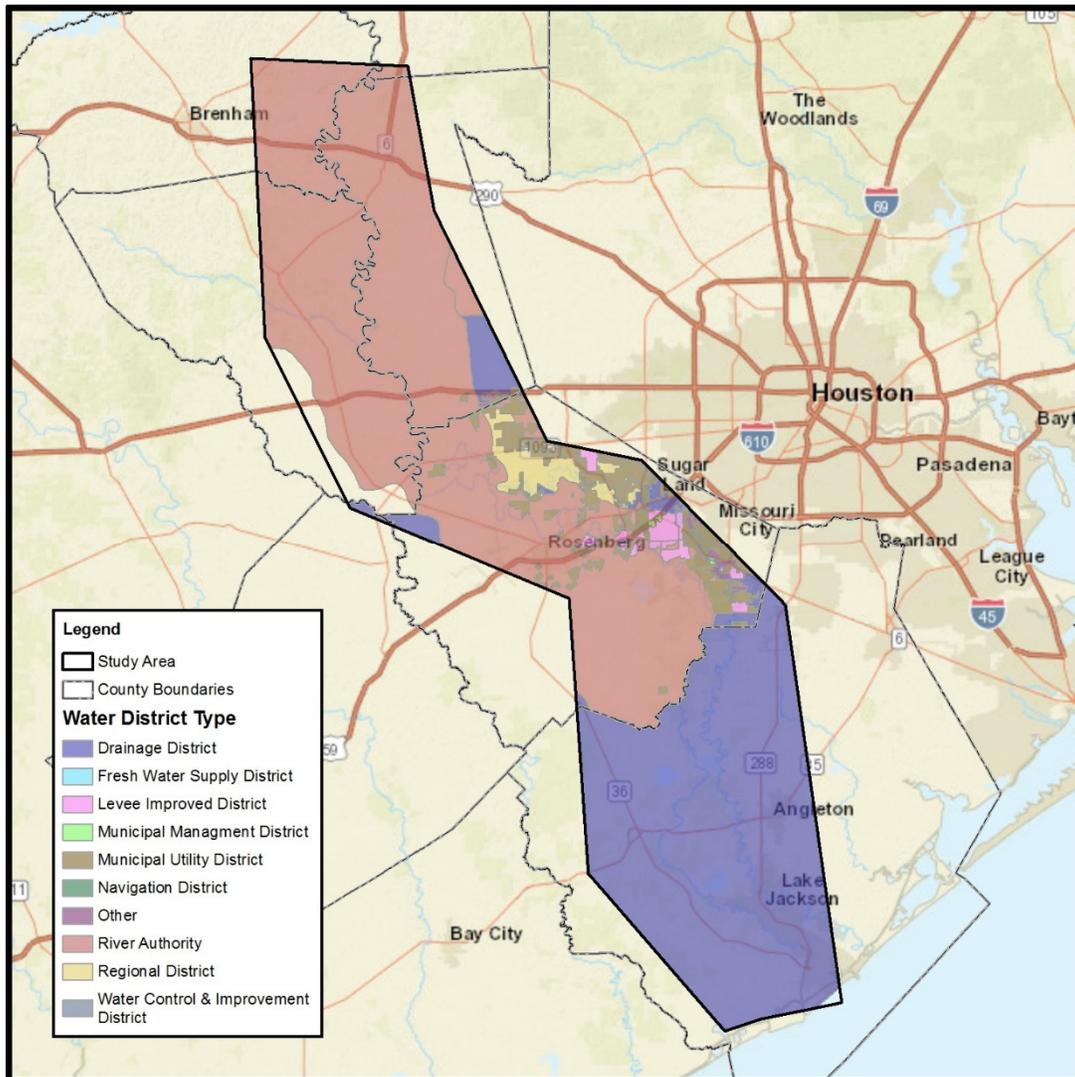


Figure F-3.3e – TCEQ Water Districts within the Study Area

Soil and Water Conservation Districts (SWCD), managed by the Texas Soil and Water Conservation Board (TSSWCB), are charged with the protection of soil and water resources within the district boundaries⁴⁴. This feature class⁴⁵ was downloaded from the TSSWCB GIS Database⁴⁶. Figure F-3.3f depicts SWCDs within the study area.

⁴⁴ Texas Soil and Water Conservation Districts: <http://www.tsswcb.texas.gov/swcds/info> (accessed July 11, 2017)

⁴⁵ LBRED.gdb\Water_Management_Entities\SWCD_Boundaries

⁴⁶ TSSWCB GIS Database: <https://www.tsswcb.texas.gov/en/programs/gis> (accessed June 13, 2017)

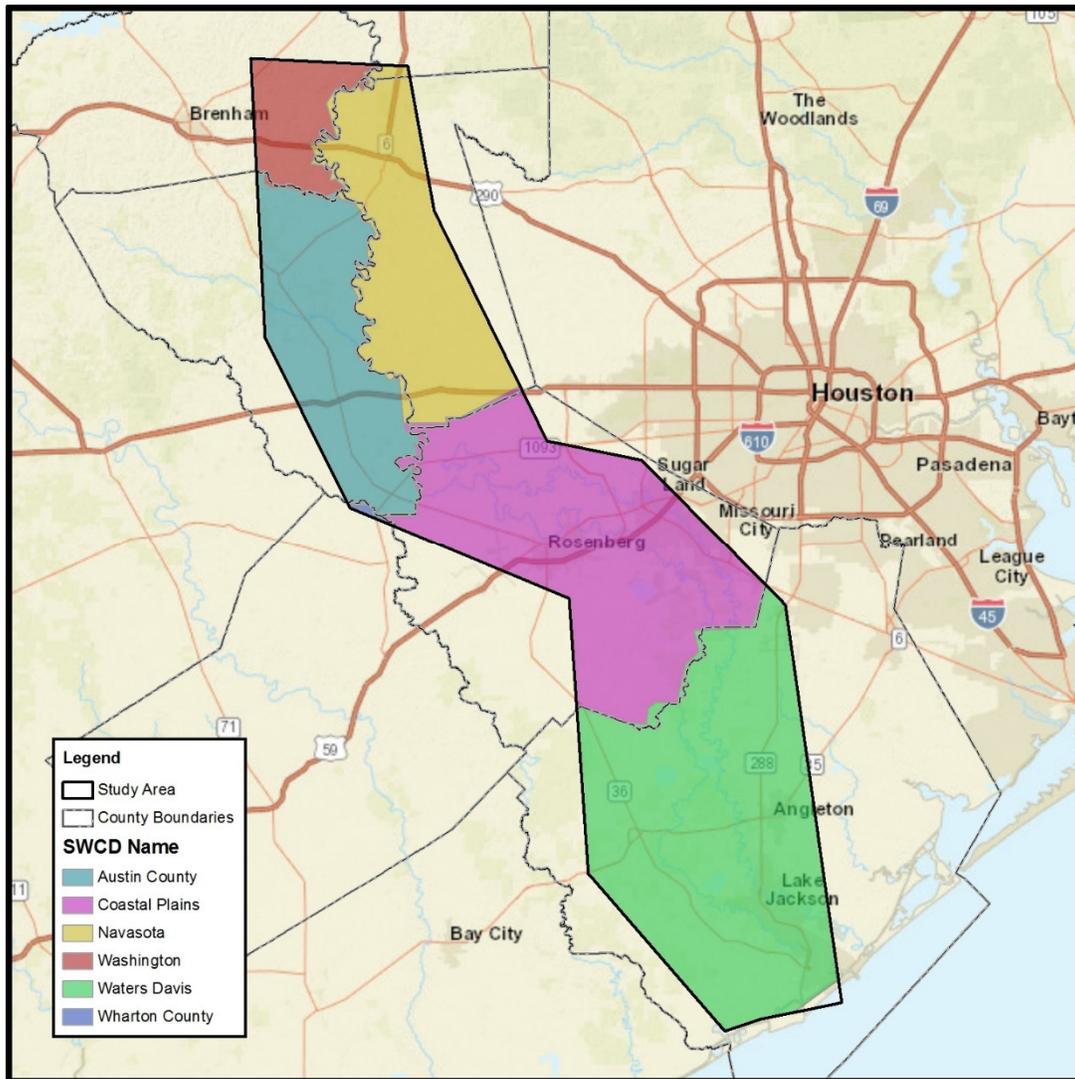


Figure F-3.3f – Soil and Conservation Districts within the Study Area

F.3.4 Groundwater Wells

Groundwater wells throughout the state of Texas are registered with the TWDB Submitted Drillers Report (SDR)⁴⁷. These features, downloaded from the TWDB GIS Database⁴⁸ and clipped to the study area, include information regarding the type of well, well depth, aquifer used, and location of each well. TWDB updates this layer nightly on the TWDB GIS Database. The data⁴⁸ contained in the BRA Environmental Constraints Geodatabase was downloaded on July 7, 2017. Figure F-3.4 depicts the location of groundwater wells for the study area.

⁴⁷ TWDB SDR Database: <http://www.twdb.texas.gov/groundwater/data/drillersdb.asp> (accessed July 12, 2017)

⁴⁸ LBRED.gdb\Hydrology\Groundwater_Well_Locations

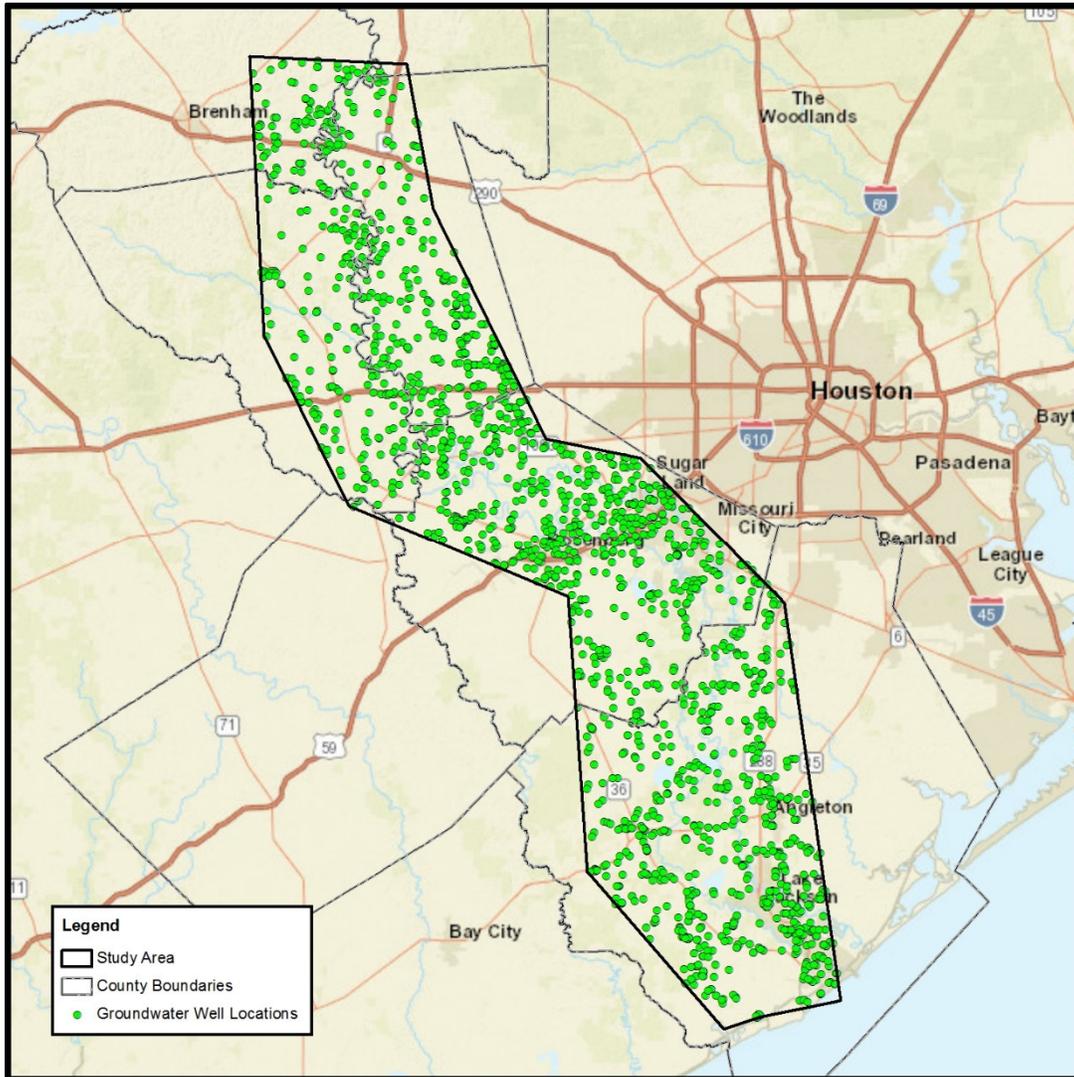


Figure F-3.4 – TWDB Well Locations

F.4.0 Threatened and Endangered Species

F.4.1 Regulatory Review

- **Endangered Species Act**

The USFWS has authority under the Endangered Species Act (ESA) to list and monitor the status of species whose populations are considered imperiled. USFWS regulations that implement the ESA are codified and regularly updated in 50 CFR Part 17. The federal process identifies potential candidates based upon the species' biological vulnerability. The vulnerability decision is based upon many factors affecting the species within its range and is linked to the best scientific data available to the USFWS at the time. Species listed

as threatened or endangered by the USFWS are afforded full protection under the ESA, including a prohibition of indirect take such as destruction of known critical habitat (i.e., areas formally designated by USFWS in the Federal Register).

- **Texas Parks and Wildlife Code**

Texas endangered species legislation in 1973 and subsequent amendments have established a state regulatory program for the management and protection of endangered species (i.e., species in danger of extinction) and threatened species (i.e., likely to become endangered within the foreseeable future). Chapters 67 and 68 of the TPWD Code authorize TPWD to formulate lists of threatened and endangered fish and wildlife species and to regulate the taking or possession of the species. Under this statutory authority, TPWD regulates the taking, possession, transport, export, processing, selling or offering for sale, or shipping of threatened or endangered species of fish and wildlife.

- **Bald and Golden Eagle Protection Act**

Bald eagles are afforded protection under the BGEPA. Under the BGEPA it is unlawful to take, possess, sale, purchase, barter, offer to sell, possess, transport, export or import, any bald or golden eagle, alive or dead, including any part (including feathers), nest (this includes inactive nests), or egg, unless allowed by permit. A "take" under the law is defined as to "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." The term "disturb" under the BGEPA was recently defined, via final rule published in the Federal Register on June 5, 2007 (Volume 72, page 31332), as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, but substantially interfering with normal breeding, feeding, or sheltering behavior."

- **Migratory Bird Treaty Act**

Listed avian species, as well as any other migratory birds, receive additional protection under the MBTA. The 1918 MBTA states that it is unlawful to pursue, hunt, take, capture, kill, collect, possess, buy, sell, trade, or transport any migratory bird, nest, young, feather, or egg, without a federal permit issued in accordance with the policies and regulations of the MBTA. Take is defined as to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture or collect migratory birds. The term collect only refers to nests. The MBTA does not prohibit the destruction of the bird nest alone (without birds or eggs) provided that no possession of the nest occurs during destruction. The USFWS is the lead agency in determining whether a permit may be necessary for the removal or destruction of a nest.

F.4.2 Database Review, Suitable Habitat Analysis, and Critical Habitat

Under the ESA, species can be listed as either threatened (any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range⁴⁹), endangered (any species that is in danger of extinction throughout all or a significant

⁴⁹ <https://www.fws.gov/endangered/esa-library/pdf/t-vs-e.pdf>

portion of its range⁵⁰), or a candidate species (any species that the USFWS has sufficient information on their biological status and threats to propose them as endangered or threatened⁵¹). The following tables (F-4.2a through F-4.2h) contain descriptions of the ESA status and suitable habitat for species whose known ranges extend into the study area. The USFWS also has the authority under the ESA to designate critical habitat for listed species. The database review only returned a small area of critical habitat for the piping plover (*Charadrius melodus*) within the study area. This critical habitat area was included within the LBRED⁵² and Figure F-4.2a depicts its location within the study area. These species included were determined using the USFWS Information for Planning and Consultation (IPaC) system⁵³. TPWD county lists were also used to determine threatened and endangered species. Differences between the two lists are due to the method to determine home ranges for these species⁵⁴.

Also included in Tables F-4.2a through F-4.2h are descriptions for species that are protected under the TPWD Code. Under the TPWD Code species can be listed as endangered, threatened, not tracked, or species of greatest conservation Need (SGCN)⁵⁵. SGCN labelled species are those species that are declining or rare and in need of attention to recover or to prevent the need to list under state or federal regulation⁵⁶. The state and national status of species are listed below, with a description of suitable habitat. To provide a GIS-based analog to in situ habitat assessments for each listed species, Halff personnel evaluated the TPWD EMST vegetation data and selected potentially suitable habitat for each of the 58-listed species whose ranges extend into the study area. A feature class⁵⁷ (named by the scientific name of the species) representing areas of potentially suitable habitat was created for each listed species. Figure F-4.2b depicts an example of the suitable habitat GIS analysis.

⁵⁰ <https://www.fws.gov/endangered/esa-library/pdf/t-vs-e.pdf>

⁵¹ USFWS Candidate Species: https://www.fws.gov/endangered/esa-library/pdf/candidate_species.pdf (Accessed July 17, 2017)

⁵² LBRED.gdb\Threatened_Endangered_Species\USFWS_Critical_Habitat

⁵³ <https://ecos.fws.gov/ipac/>

⁵⁴ TPWD County Lists of Protected Species and Species of Greatest Conservation Need Frequently Asked Questions: http://tpwd.texas.gov/gis/rtest/County_lists_FAQ_20150415.pdf (Accessed July 17, 2017)

⁵⁵ TPWD County Lists of Protected Species and Species of Greatest Conservation Need Frequently Asked Questions: http://tpwd.texas.gov/gis/rtest/County_lists_FAQ_20150415.pdf (Accessed July 17, 2017)

⁵⁶ TPWD Species of Greatest Concern: http://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/tcap/sacn.phtml (Accessed July 17, 2017)

⁵⁷ LBRED.gdb\Threatened_Endangered_Species

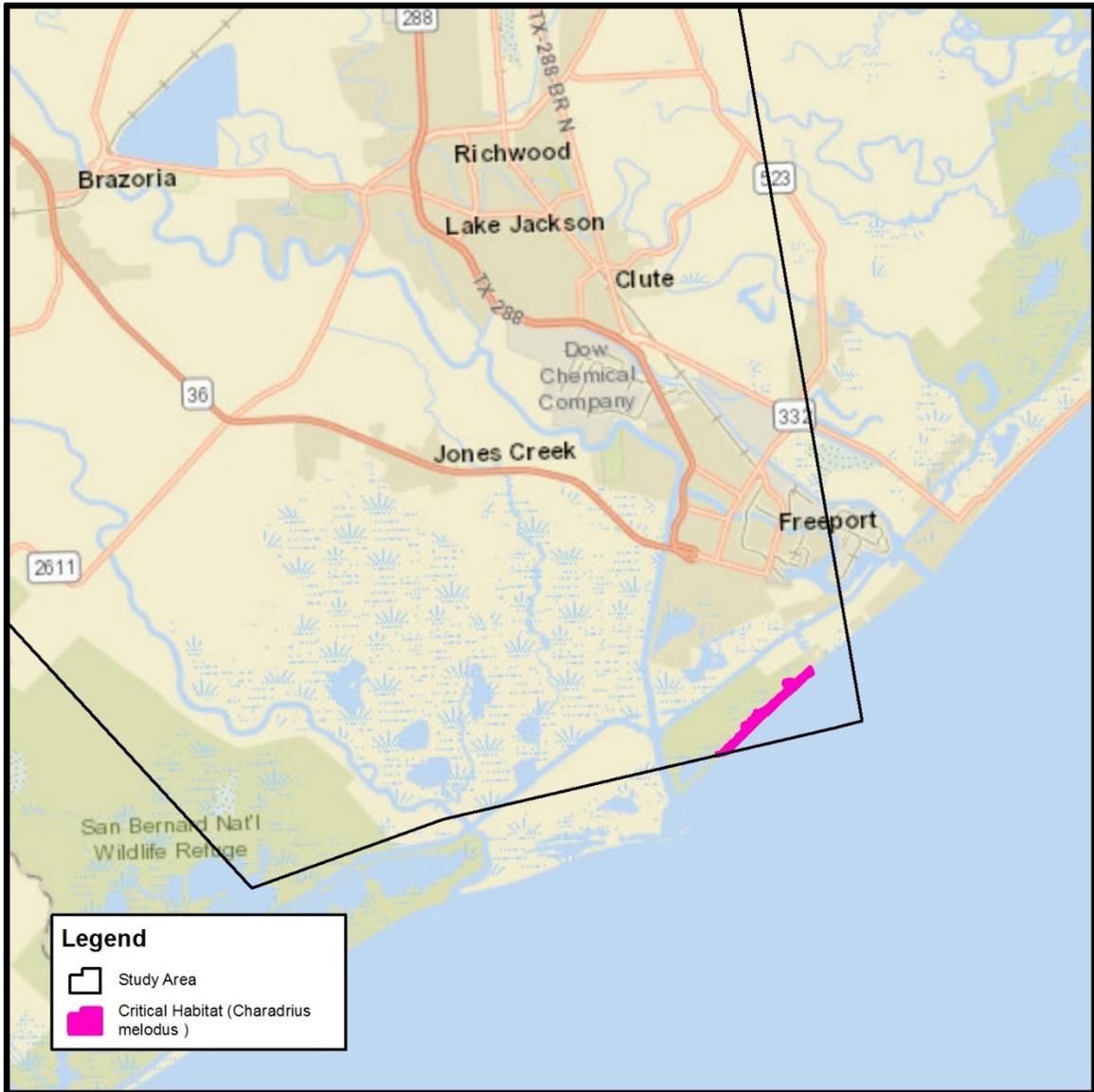


Figure F-4.2a – USFWS Critical Habitat

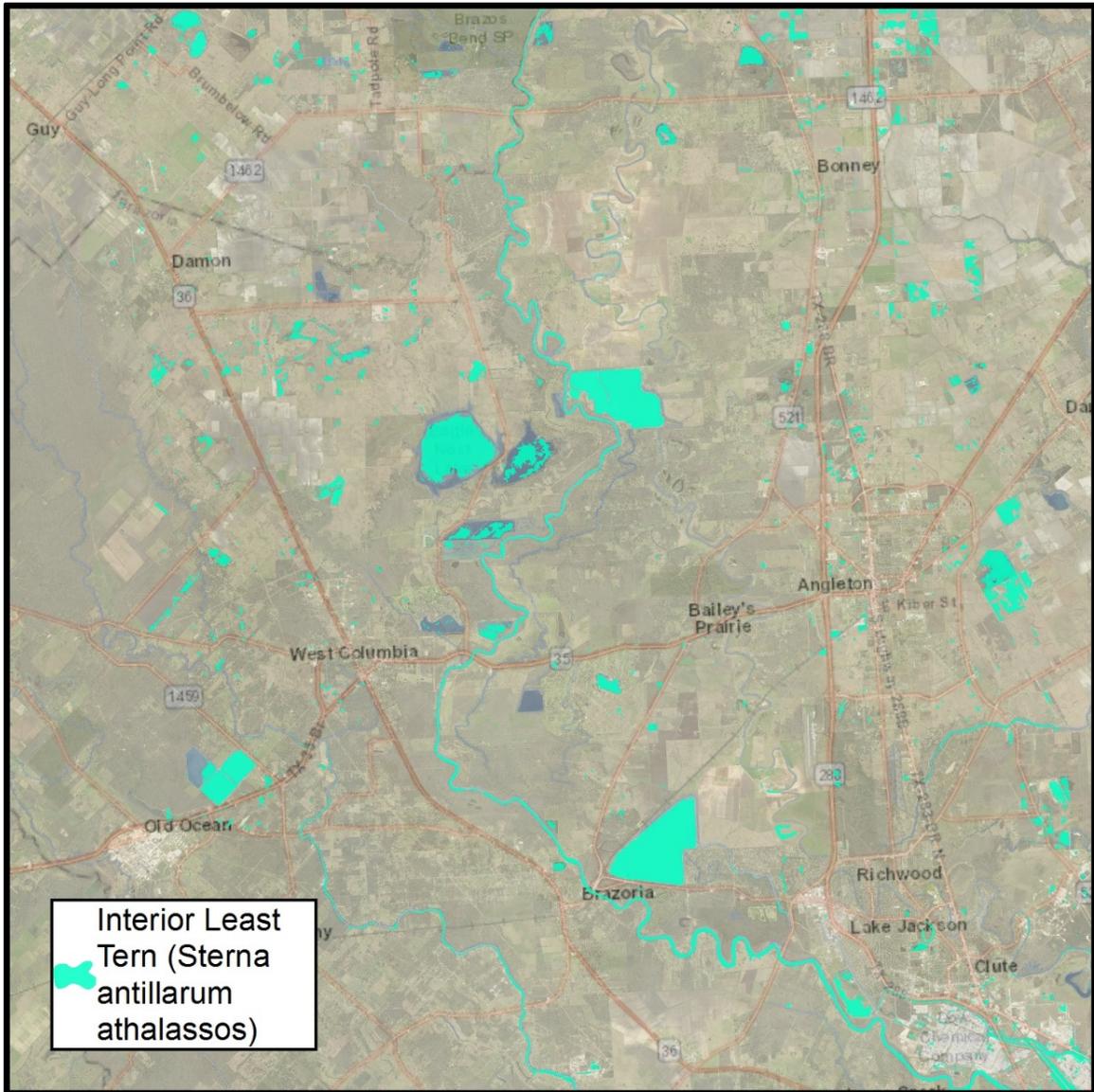


Figure F-4.2b – Example Suitable Habitat Map

Table F-4.2a – Threatened and Endangered Amphibian Species

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Anaxyrus houstonensis</i>	Houston Toad	Endangered	Endangered	restricted to soft sandy soils, forested areas (conifer, hardwood, pine, mixed deciduous), coastal prairie, shallow water, and temporary ponds ⁵⁸	602, 604, 613, 1801, 1802, 1803, 1804, 1902, 1904, 3001, 4702, 4703, 4704, 4712, 4713, 4714, 9104, 9124
<i>Lithobates areolatus areolatus</i>	Southern Crawfish Frog	n/a	SGCN	found in abandoned crawfish holes and small mammal burrows, moist meadows, pasturelands, pine scrub, and river flood plains ⁵⁹	207, 602, 604, 613, 1907, 4702, 4703, 4704, 4706, 4707, 4712, 4713, 4714, 4715, 4716, 4717, 4724, 4727, 4737, 5207, 5307, 9104, 9105, 9106, 9116, 9124, 9197, 9305, 9307

Table F-4.2b – Threatened and Endangered Bird Species

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Ammodramus henslowii</i>	Henslow's Sparrow	Not Listed	SGCN	weedy fields or cut-over areas with grasses, vines and brambles ⁵⁹	207, 607, 4707, 5207, 9007, 9116
<i>Anthus spragueii</i>	Sprague's Pipit	Not Listed	SGCN	native upland prairie and coastal grasslands ⁵⁹	1907, 4727, 4737, 6307, 6507
<i>Athene cunicularia hypugaea</i>	Western Burrowing Owl	n/a	SGCN	open grasslands, prairie, plains, and savanna ⁵⁹	207, 607, 2207, 4707, 4727, 5207, 6307, 9197, 9307, 9317
<i>Buteo albicaudatus</i>	White-tailed Hawk	n/a	Threatened	near coast in prairies, cordgrass flats, scrub-live oak, mesquite and oak savannas, and mixed savanna-chaparral ⁵⁹	2206, 2207, 4702, 4703, 4704, 4705, 4706, 4707, 4714, 4715, 4717, 4727, 4737, 5207, 5307, 5600, 5605, 5607, 5616, 5617, 6307, 6507, 9105, 9107, 9116, 9124, 9214
<i>Calidris canutus rufa</i>	Red Knot	Threatened	SGCN	primarily seacoasts on tidal flats and beaches, herbaceous wetland, and tidal flat/shore ⁵⁹	2206, 2207, 5600, 5605, 5607, 5616, 5617, 6200, 6307, 6507

⁵⁸ NatureServe Explorer *Bufo houstonensis*: <http://explorer.natureserve.org/servlet/NatureServe?searchName=Bufo+houstonensis> (Accessed June 13, 2017)

⁵⁹ Rare, Threatened, and Endangered Species of Texas by County: <http://tpwd.texas.gov/gis/rtest/> (accessed June 13, 2017)

Table F-4.2b – Threatened and Endangered Bird Species

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Charadrius alexandrinus</i>	Snowy Plover	Not Listed	SGCN	bare upper beaches and sandy flats ⁵⁹	5600, 6200, 6307, 6507
<i>Charadrius alexandrinus nivosus</i>	Western Snowy Plover	Not Listed	SGCN	barren to sparsely vegetated sand beaches, and salt flats ⁵⁹	5600, 5605, 5607, 5616, 5617, 6200, 6307, 6507
<i>Charadrius melodus</i>	Piping Plover	Threatened	Threatened	sandy upper beaches with scattered grass tufts, sparsely vegetated shores, and islands of shallow lakes, ponds, rivers, and impoundments	5600, 5607, 5617
<i>Charadrius montanus</i>	Mountain Plover	Not Listed	SGCN	high plains or shortgrass prairie, plowed fields	207, 607, 2207, 4707, 4727, 5207, 6307, 6507, 9197, 9307
<i>Egretta rufescens</i>	Reddish Egret	Not Listed	Threatened	brackish marshes, shallow salt ponds, tidal flats, and brushy thickets	2206, 5307, 5600, 5605, 5607, 5616, 5617, 6307, 6507
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	Federally Delisted	Threatened	tall cliff eyries, urban areas, coast and barrier islands, lake shores and coastlines	2206, 2207, 5207, 5307, 5600, 5605, 5607, 5616, 5617, 6307, 6507, 9105, 9106, 9116, 9124, 9126, 9204, 9410, 9411
<i>Falco peregrinus tundrius</i>	Arctic Peregrine Falcon	Federally Delisted	SGCN	coast and barrier islands, urban areas, lake shores, coastlines and barrier islands	2206, 2207, 5207, 5307, 5600, 5605, 5607, 5616, 5617, 6307, 6507, 9105, 9106, 9116, 9124, 9126, 9204, 9410, 9411
<i>Grus americana</i>	Whooping Crane	Endangered	Endangered	wetland, coastal marshes and estuaries, inland marshes, lakes, ponds, wet meadows and rivers, agricultural fields	2206, 2207, 4707, 4717, 4727, 4737, 5600, 5605, 5607, 5616, 5617, 9107, 9600
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Federally Delisted	Threatened	near rivers and large lakes, tall trees or cliffs near water ⁶⁰	602,603,604, 3001, 4702, 4703, 4704, 4712, 4713, 4714, 4715, 4716, 9104, 9105, 9106, 9124, 9214
<i>Mycteria americana</i>	Wood Stork	Threatened	Threatened	prairie ponds, flooded pastures or fields, ditches and other shallow standing	9600

⁶⁰ NatureServe Explorer *Charadrius melodus*: <http://explorer.natureserve.org/servlet/NatureServe?searchName=Charadrius+melodus> (Accessed June 14, 2017)

Table F-4.2b – Threatened and Endangered Bird Species

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
				waters; associated with other wading birds ⁵⁹	
<i>Numenius borealis</i>	Eskimo Curlew	Endangered	Endangered	grasslands, pastures, plowed fields, marshes, and mudflats ⁵⁹	207, 607, 1824, 2207, 4707, 4717, 4724, 4727, 4737, 5307, 5607, 5616, 5617, 6307, 6507, 9007, 9197, 9307, 9317, 9600
<i>Pelecanus occidentalis</i>	Brown Pelican	Federally Delisted	SGCN	coastal and near shore areas, islands and spoil banks ⁵⁹	5207, 5307, 5600, 5605, 5607, 5616, 5617, 6200, 6307, 6507, 9000, 9410, 9411, 9600
<i>Picoides borealis</i>	Red-cockaded Woodpecker	Endangered	Endangered	longleaf, shortleaf, and loblolly pine dominated forests ⁵⁹	1801, 1805, 1903, 3001, 9101, 9105, 9301, 9305
<i>Plegadis chihi</i>	White-Faced Ibis	Not Listed	Threatened	freshwater marshes, sloughs, irrigated rice fields, brackish and saltwater habitats ⁵⁹	2207, 5207, 5605, 5607, 5616, 5617, 9507, 9004, 9007
<i>Sterna antillarum</i>	Least Tern	Endangered	n/a	sandy beaches, mudflats, salt pond dikes, seacoast, estuaries, lagoons, lakes, rivers, sandy or gravelly beaches, and riverine sandbars or salt flats ⁶¹	5307, 5600, 5605, 5607, 5616, 5617, 6200, 6307, 9600
<i>Sterna antillarum athalassos</i>	Interior Least Tern	Endangered	Endangered	sand and gravel bars with braided streams and rivers, inland beaches, wastewater treatment plants, etc ⁵⁹	5307, 5600, 5605, 5607, 5616, 5617, 6200, 6307, 9600
<i>Sterna fuscata</i>	Sooty Tern	n/a	Threatened	coastal small islands, above flood tides, sparsely vegetated, and fairly open areas ⁶²	5307, 5600, 5605, 5607, 5616, 5617, 6200, 6307, 9600
<i>Tympanuchus cupido attwateri</i>	Attwater's Greater Prairie-Chicken	Endangered	Endangered	coastal prairies dominated by Tall Dropseed, Little Bluestem, Sumpweed, Broomweed, Ragweed, and Big Bluestem,	4707, 4727, 5207, 5307, 9126, 9197

⁶¹ NatureServe Explorer *Sterna antillarum*: <http://explorer.natureserve.org/servlet/NatureServe?searchName=Sterna+antillarum> (Accessed June 13, 2017)

⁶² The Texas Breeding Bird Atlas: Sooty Tern <http://txibba.tamu.edu/species-accounts/sooty-tern/> (Accessed July 11, 2017)

Table F-4.2b – Threatened and Endangered Bird Species

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
				fallow rice fields, pasture, croplands, and natural grassy flats with low vegetation ⁶³	

Table F-4.2c – Threatened and Endangered Crustacean Species

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Cambarellus texanus</i>	Brazos Dwarf Crayfish	n/a	SGCN	shallow water, ditches with emergent vegetation ⁵⁹	9600
<i>Procambarus brazoriensi</i>	Brazoria Crayfish	Not Listed	SGCN	shallow water, herbaceous wetland, riparian areas, temporary pools, cropland/hedgerow, grassland/herbaceous, suburban/orchard, woodland and conifer forests ⁶⁴	207, 1801, 1802, 1803, 1804, 1824, 1902, 1903, 1904, 1907, 4702, 4703, 4704, 4707, 4713, 4717, 4724, 4727, 4737, 5307, 5607, 5616, 5617, 6307, 6507, 9004, 9007, 9104, 9197, 9317, 9301, 9305, 9307, 9600

Table F-4.2d – Threatened and Endangered Fish Species

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Anguilla rostrata</i>	American Eel	Not Listed	SGCN	coastal waterways below reservoirs to gulf, ocean, muddy bottoms, still waters, large streams, and lakes ⁵⁹	9600
<i>Cycleptus elongatus</i>	Blue Sucker	Not Listed	Threatened	larger portions of major rivers, channels and flowing pools ⁵⁹	9600
<i>Erimyzon oblongus</i>	Creek Chubsucker	n/a	Threatened	small rivers and creeks, prefers headwaters ⁵⁹	9600

⁶³ NatureServe Explorer *Tympanuchus cupido attwateri*: <http://explorer.natureserve.org/servlet/NatureServe?searchName=Tympanuchus+cupido+attwateri> (Accessed June 13, 2017)

⁶⁴ NatureServe Explorer *Procambarus brazoriensi*: <http://explorer.natureserve.org/servlet/NatureServe?searchName=Procambarus+brazoriensis> (Accessed June 15, 2017)

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Notropis buccula</i>	Smalleye Shiner	Endangered	SGCN	Brazos River, medium to large prairie streams with sandy substrate and turbid to clear warm water ⁵⁹	9600
<i>Notropis oxyrhynchus</i>	Sharpnose Shiner	Endangered	SGCN	Brazos River drainage and other large turbid rivers ⁵⁹	9600
<i>Pristis pectinata</i>	Smalltooth Sawfish	Endangered	Endangered	close to shore in muddy and sandy bottoms, sheltered bays, estuaries or river mouths, mangroves, reefs, seagrass and coral environments ⁵⁹	9600

Table F-4.2e – Threatened and Endangered Insect Species

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Pseudocentropiloides morihari</i>	n/a	n/a	SGCN	Shoreline vegetation ⁵⁹	1902, 1903, 1904, 1906, 1907, 4712, 4717, 4724, 4737, 5307, 5600, 5605, 5607, 5616, 5617, 9004, 9007, 9507

Table F-4.2f – Threatened and Endangered Mammal Species

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Canis rufus</i>	Red Wolf	Endangered	Endangered	brushy, forested areas, and coastal prairies ⁵⁹	602, 603, 604, 607, 613, 624, 1805, 1806, 1906, 2206, 2207, 4705, 4706, 4715, 4716 5207, 5307, 5616, 5617, 6307, 6507, 9101, 9105, 9116, 9124, 9126, 9197, 9204, 9214
<i>Herpailurus yaguarondi</i>	Jaguarundi	Endangered	Endangered	thick brush lands near water ⁵⁹	4705, 4706, 9105
<i>Leopardus pardalis</i>	Ocelot	Endangered	Endangered	dense chaparral thickets, mesquite-thorn scrub and live oak mottes ⁵⁹	604, 1806, 1906, 4716, 9104, 9106, 9124, 9116, 9126, 9204
<i>Myotis austroriparius</i>	Southeastern Myotis Bat	Not Listed	SGCN	bottomland hardwood forests, man-made structures, hollow trees closely associated with water ^{59 65}	1803, 1804, 1903, 1904, 4703, 4704, 4713, 4714, 9410, 9411

⁶⁵ The Mammals of Texas- Online Edition <http://www.nsr.ttu.edu/tmot1/myotaust.htm> (Accessed July 11, 2017)

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Spilogale putorius</i>	Eastern Spotted Skunk	n/a	SGCN	forested habitats, forest edges, upland prairie grasslands ⁶⁶	602, 5207, 9307
<i>Spilogale putorius interrupta</i>	Plains Spotted Skunk	Under Review	SGCN	open fields, prairies, croplands, fence rows, farmyards, forest edges and woodlands, prefers wooded, brushy areas and tallgrass prairie ⁵⁹	602, 603, 604, 4704, 4707, 4714, 4716, 4717, 4727, 5207, 9104, 9124, 9197, 9307
<i>Trichechus manatus</i>	West Indian Manatee	Threatened	Endangered	marine and freshwater habitats, warm water sites (springs, deep water areas, industrial plants, power plants, paper mills), freshwaters with cord grass, alga, turtle grass, shoal grass, manatee grass, and eel grass ⁶⁷	9600
<i>Ursus americanus luteolus</i>	Louisiana Black Bear	Federally Delisted	Threatened	bottomland hardwood forests, large tracks of inaccessible forested areas ⁵⁹	4702, 4703, 4704, 4705, 4706, 4707, 4712, 4713, 4714, 4715, 4716, 4717, 4724, 4727, 4737

Table F-4.2g – Threatened and Endangered Mollusk Species

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Fusconaia askewi</i>	Texas Pigtoe	n/a	Threatened	rivers with mixed mud, sand, and fine gravel in slow flow areas (areas with fallen trees or other structures ⁵⁹	9600
<i>Quadrula houstonensis</i>	Smooth Pimpleback	Candidate	Threatened	open water, small to moderate size streams, rivers, and reservoirs ⁶⁸	9600
<i>Quadrula petrina</i>	Texas Pimpleback	Candidate	Threatened	open water, mud, gravel and sand substrates, and waters with slow flow rates ⁵⁹	9600

⁶⁶ The IUCN Red List of Threatened Species *Spilogale putorius*: <http://www.iucnredlist.org/details/41636/0> (Accessed June 14, 2017)

⁶⁷ USFWS Environmental Conservation Online System (ECOS) West Indian Manatee (*Trichechus manatus*): <https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=A007> (Accessed June 14, 2017)

⁶⁸ NatureServe Explorer *Quadrula houstonensis*: <http://explorer.natureserve.org/servlet/NatureServe?searchName=Quadrula+houstonensis> (Accessed June 14, 2017)

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Trucilla macrodon</i>	Texas Fawnsfoot	Candidate	Threatened	rivers, larger streams, reservoirs, and rice irrigation canals ⁶⁹	9600

Table F-4.2h – Threatened and Endangered Reptile Species

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Caretta</i>	Loggerhead Sea Turtle	Threatened	Threatened	open sea, bays, estuaries, lagoons, creeks, mouths of rivers, and open sandy beaches ⁷⁰	5600, 6200
<i>Chelonia mydas</i>	Green Sea Turtle	Threatened	Threatened	gulf and bay systems, and barrier island beaches ⁵⁹	5600, 6200
<i>Crotalus horridus</i>	Timber Rattlesnake	Not Listed	Threatened	swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland, and prefers dense ground cover ⁵⁹	1824, 1903, 4712, 4713, 4714, 4715, 4716, 4717, 4724, 4727, 4737, 9104, 9105, 9124, 9126, 9301, 9305
<i>Dermochelys coriacea</i>	Leatherback Sea Turtle	Endangered	Endangered	open water, bays and estuaries, and sloping sandy beaches with little vegetation near deep water and rough seas (only for nesting) ⁷¹	5600, 6200
<i>Eretmochelys imbricata</i>	Hawksbill Sea Turtle	Endangered	Endangered	shallow coastal waters with rocky bottoms, coral reefs, beds of sea grass or algae, mangrove-bordered bays and estuaries, submerged mud flats, and deep sand insular or mainland beaches ⁷²	5600, 6200

⁶⁹ NatureServe Explorer *Trucilla macrodon*: <http://explorer.natureserve.org/servlet/NatureServe?searchName=Trucilla+macrodon> (Accessed June 14, 2017)

⁷⁰ NatureServe Explorer *Caretta*: <http://explorer.natureserve.org/servlet/NatureServe?searchName=Caretta+caretta> (Accessed June 14, 2017)

⁷¹ NatureServe Explorer *Dermochelys coriacea*: <http://explorer.natureserve.org/servlet/NatureServe?searchName=Dermochelys+coriacea> (Accessed June 14, 2017)

⁷² NatureServe Explorer *Eretmochelys imbricata*: <http://explorer.natureserve.org/servlet/NatureServe?searchName=Eretmochelys+imbricata> (Accessed June 13, 2017)

Table F-4.2h – Threatened and Endangered Reptile Species

Scientific Name	Common Name	Federal Status	State Status	Suitable Habitat	Suitable EMST Vegetation MoRAP Codes
<i>Lepidochelys kempii</i>	Kemp's Ridley Sea Turtle	Endangered	Endangered	shallow coastal and estuarine waters with sandy or muddy bottoms, and well elevated sandy dunes ^{73 74}	5600, 6200
<i>Liochlorophis vernalis</i>	Smooth Green Snake	n/a	Threatened	Gulf Coastal Plain, and mesic coastal shortgrass prairie vegetation ⁵⁹	5207, 5307
<i>Macrochelys temminckii</i>	Alligator Snapping Turtle	n/a	Threatened	perennial water bodies, rivers, canals, lakes, oxbows, swamps, bayous and ponds ⁵⁹	9600
<i>Malaclemys terrapin littoralis</i>	Texas Diamondback Terrapin	Not Listed	SGCN	coastal marshes, tidal flats, coves, estuaries, lagoons behind barrier beaches, brackish and salt water ⁵⁹	2206, 2207, 5600, 5605, 5607, 5616, 5617, 6200, 6307, 6507
<i>Phrynosoma cornutum</i>	Texas Horned Lizard	Not Listed	Threatened	open, arid and semi-arid regions with sparse vegetation, grasses, cactus, scattered brush or scrubby trees ⁵⁹	607, 4705, 4706, 6200, 9106, 9205, 9214
<i>Thamnophis sirtalis annectens</i>	Texas Garter Snake	Not Listed	SGCN	marshy areas, flooded pastureland or meadows, grassy or brushy terrain, near streams, ponds, and other water sources ⁷⁵	1804, 1807, 4702, 4703, 4704, 4705, 4706, 4707, 4717, 5207

⁷³ USFWS Environmental Conservation Online System (ECOS) Kemp's Ridley sea turtle (*Lepidochelys kempii*): <https://ecos.fws.gov/ecp0/profile/speciesProfile?slid=5523> (Accessed June 13, 2017)

⁷⁴ NatureServe Explorer *Lepidochelys kempii*: <http://explorer.natureserve.org/servlet/NatureServe?searchName=Lepidochelys+kempii> (Accessed June 13, 2017)

⁷⁵ NatureServe Explorer *Thamnophis sirtalis annectens* <http://explorer.natureserve.org/servlet/NatureServe?searchName=Thamnophis+sirtalis+annectens> (Accessed July 11, 2017)

F.4.3 Texas Natural Diversity Database

To further analyze the potential occurrence of rare, threatened, and endangered species and/or habitat within the study area, the Texas Natural Diversity Database (TXNDD) was downloaded from TWPD⁷⁶. The TXNDD maintains information on over 700 natural resource “Elements” including threatened or endangered species, native plant communities, and/or animal aggregations (e.g. rookeries). A database record for any element is known as an Element Occurrence Record (EOR), and the TXNDD contains spatial data representing the geographic locations of an element observation⁷⁷.

For inclusion in the LBRED, Halff clipped the TXNDD EOR shapefile to the study area, creating a new feature class⁷⁸. While a TXNDD EOR can support potential species occurrence within the study area, the geographical boundaries are typically broad and are often times a radius around an observation representing the species’ home range. To enhance the predictive/ explanatory power of the TXNDD records, Halff recommends overlaying the suitable habitat layer for a given species⁷⁹ with the EOR. This will allow BRA to view potentially suitable habitat within an area that has recorded observations of a species. Figure F-4.3 depicts an example of this operation.

⁷⁶ Texas Natural Diversity Database (TXNDD) https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/txndd/ (accessed June 13, 2017)

⁷⁷ Texas Natural Diversity Database (TXNDD): Methodology https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/txndd/about.phtml (accessed July 14, 2017)

⁷⁸ LBRED.gdb\Threatened_Endangered_Species\NDD_EORs

⁷⁹ LBRED.gdb\Threatened_Endangered_Species

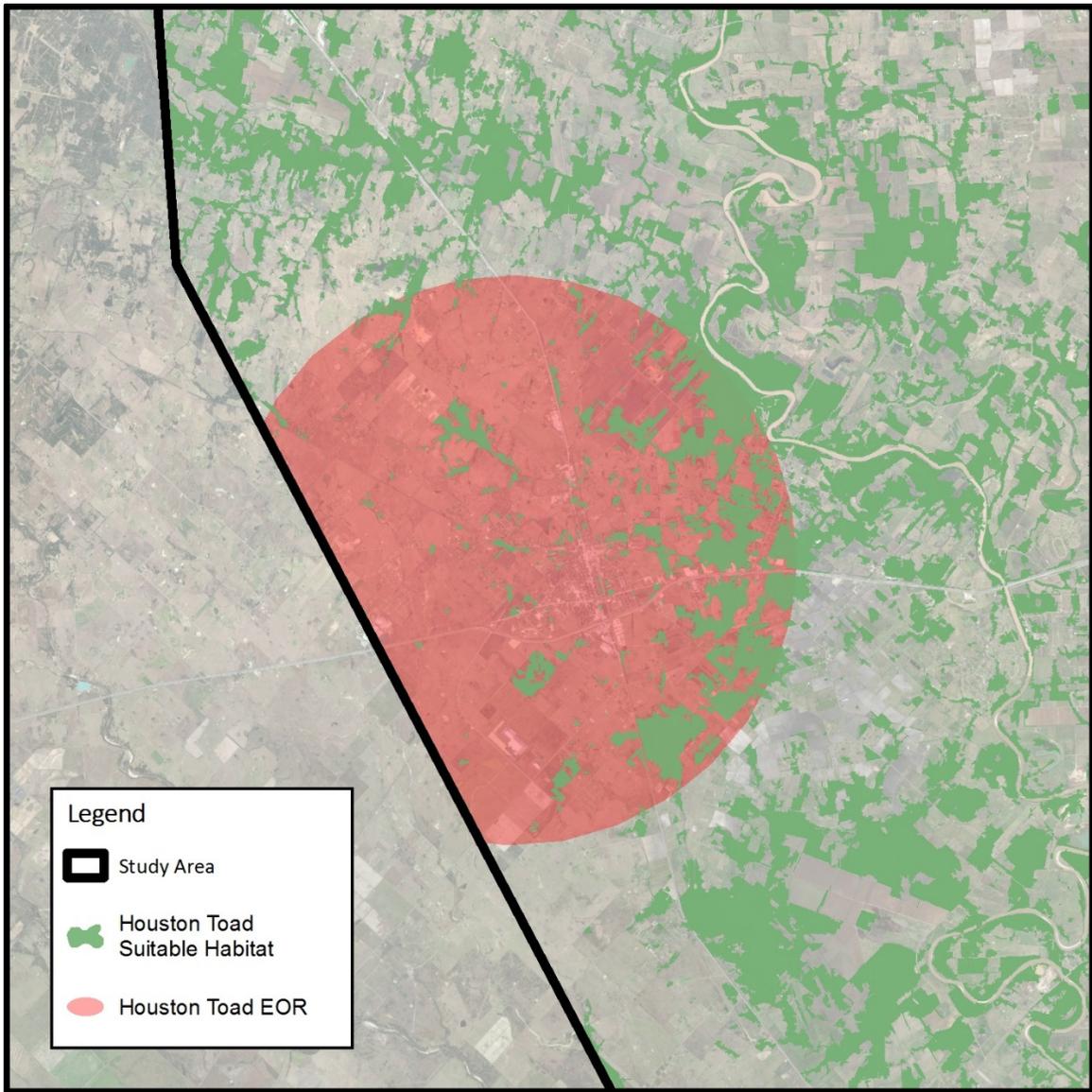


Figure F-4.3 – Houston Toad EOR and Potentially Suitable Habitat

F.5.0 Cultural Resources

F.5.1 Introduction and Regulatory Review

Cultural resources may include historic and archaeological resources such as districts, sites, buildings, structures, and objects listed in or eligible for listing in the National Register of Historic Places (NRHP)⁸⁰. Federal regulations providing legislative protection to cultural resources include the NHPA, NEPA, the Rivers and Harbors Act of 1899 (RHA), the Archaeological and Historical Preservation Act of 1974 (AHPA), Executive Order No. 11593 – *Protection and Enhancement of the*

⁸⁰ <https://www.epa.gov/sites/production/files/2015-08/documents/r1-nhpa-cultural-resources-manual.pdf>

Cultural Environment, and Protection of Historic Properties (36 CFR 800). In Texas, the Texas Historical Commission (THC) serves as the State Historic Preservation Office (SHPO) as required by the NHPA. Under the NHPA, the THC is required to:

- survey and inventory historic resources;
- nominate significant historic resources to the NRHP;
- identify and mitigate resources potentially affected by federally controlled projects (Section 106);
- facilitate the federal Historic Preservation Tax Credit Program;
- administer the Certified Local Government Programs;
- prepare and implement a comprehensive statewide preservation plan;
- provide public information, education, training, and technical assistance in historic preservation;
- provide funds to the public for preservation activities.

THC houses an online GIS database for cultural resources within Texas. This database includes cemeteries⁸¹, historic highways⁸², state historic sites⁸³, historical markers⁸⁴, and NRHP data⁸⁵. THC also maintains the Texas Archaeological Sites Atlas (TASA), however this information is restricted and confidential under Section 191.004 of the Texas Natural Resources Code (TNRC) and the Archaeological Resources Protection Act of 1979 (ARPA) and cannot be included in this database review. However, THC does provide locations of known archaeological projects and the archaeologists and/or firms that conducted the work. These locations⁸⁶ have been provided in the LBRED. The following sections detail the available cultural resources information within the study area.

F.5.2 Cemeteries

Cemeteries are considered among the most valuable of historic resources, providing insight into historic events, religions, lifestyles, and genealogy⁸⁷. According to the THC...

"It is estimated that there are roughly 50,000 cemeteries in Texas. These range from single, isolated and often unmarked graves to expansive cemeteries spanning hundreds of acres and reaching up to hundreds-of-thousands of burials. Many of these cemeteries are endangered due to lack of historic context and knowledge of their presence or exact location. Efforts to identify, locate, protect, and preserve these endangered cemeteries remains a goal of the THC and our many partners around the state."⁸⁸

Cemeteries that have received the Texas Cemetery designation or have been located during surveys by the THC are included in the LBRED. Figure F-5.2 depicts the location of cemeteries within the study area.

⁸¹ LBRED.gdb\Cultural_Resources\Cemeteries

⁸² LBRED.gdb\Cultural_Resources\HistoricHighways

⁸³ LBRED.gdb\Cultural_Resources\State_Historic_Sites

⁸⁴ LBRED.gdb\Cultural_Resources\Historic_Markers

⁸⁵ LBRED.gdb\Cultural_Resources\NRHP_Districts; LBRED.gdb\Cultural_Resources\NRHP_Properties

⁸⁶ LBRED.gdb\Cultural_Resources\THC_ArchaeologicalProjects_Polygon;

LBRED.gdb\Cultural_Resources\THC_ArchaeologicalProjects_Polyline

⁸⁷ <http://www.thc.texas.gov/preserve/projects-and-programs/cemetery-preservation/importance-cemeteries>

⁸⁸ <http://www.thc.texas.gov/preserve/projects-and-programs/cemetery-preservation>

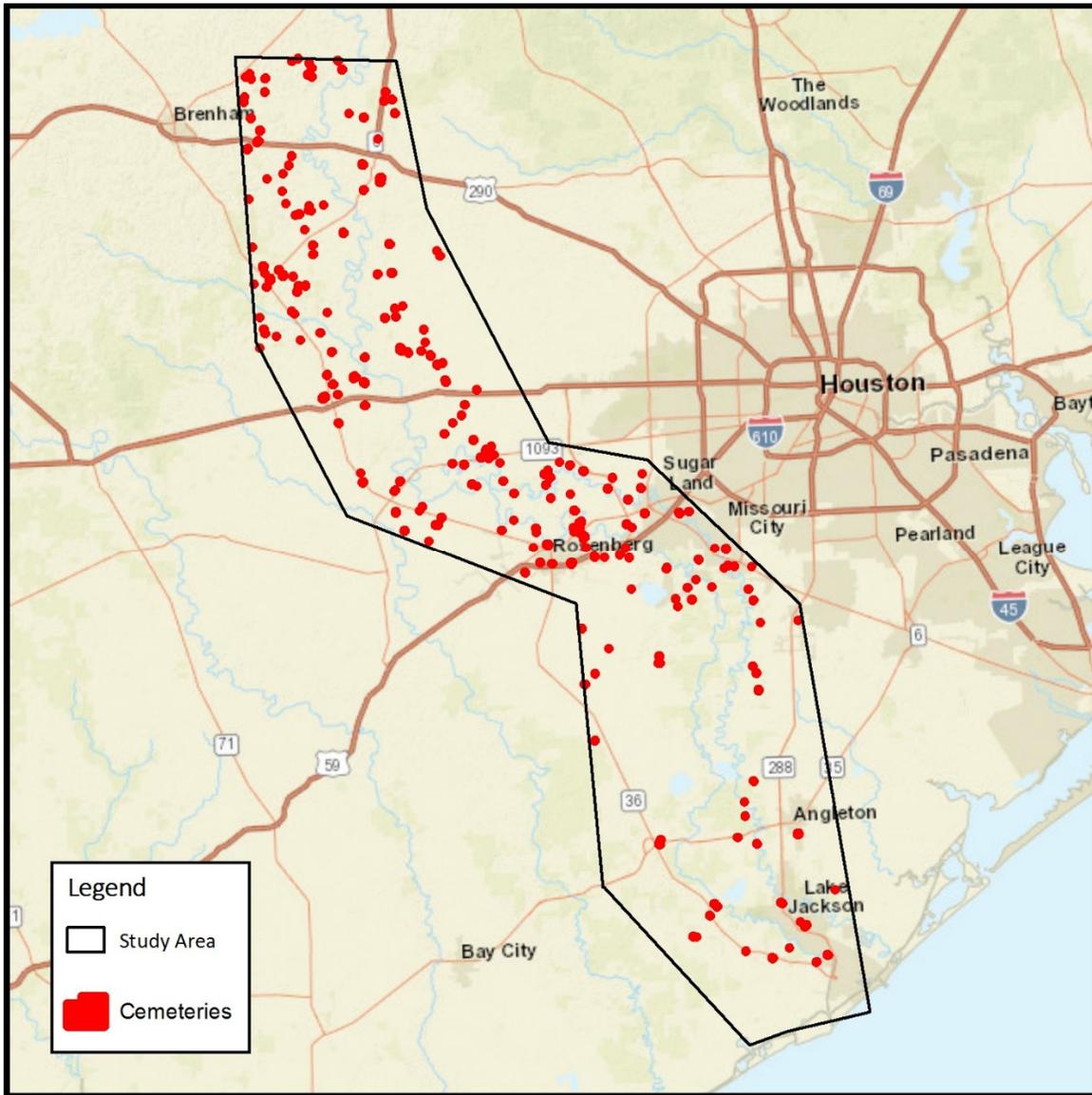


Figure F-5.2 – Cemeteries found within the Study Area

F.5.3 Historic Sites, Historical Markers, and Historic Highways

- State Historic Sites

THC State Historic Sites are overseen by the agency’s Historic Sites Division. There are 21 historic properties scattered throughout the State⁸⁹, three of which occur within the study area: the Varner-Hogg Plantation, the Levi Jordan Plantation, and the San Felipe de Austin Colonial Establishment. Figure F-5.3 depicts the location of these features within the study area.

⁸⁹ <http://www.thc.texas.gov/preserve/projects-and-programs/thc-state-historic-sites> (accessed 8/1/2017)

- **Historical Markers**

Historical Markers can be found in all 254 Texas Counties and commemorate diverse topics in Texas history including: the history and architecture of houses, commercial and public buildings, religious congregations, military sites, events that changed the course of local and state history, and individuals who have made lasting contributions to Texas⁹⁰. There are 249 historical markers within the limits of the study area. Figure F-5.3 depicts the location⁹¹ of these features within the study area.

- **Historic Highways**

In 2009, House Bill 2642 established the Texas Historic Roads and Highways Program, after which the THC and the Texas Department of Transportation (TxDOT) entered into a partnership to administer programs related to the identification, designation, interpretation, and marketing of historic roads and highways in Texas⁹². The Meridian Highway, considered the foundation of one of the busiest and most significant transportation corridors in the nation⁹³, crosses through the northeast corner of the study area. Figure F-5.3 depicts the location of this feature within the study area.

⁹⁰ <http://www.thc.texas.gov/preserve/projects-and-programs/state-historical-markers>(accessed 8/1/2017)

⁹¹ Historical Markers are frequently not in the exact geographic location as the resource that they are marking. More database research may be required to determine potential impacts to these resources.

⁹² <http://www.thc.texas.gov/preserve/projects-and-programs/historic-texas-highways>(accessed 8/1/2017)

⁹³ <http://www.thc.texas.gov/preserve/projects-and-programs/historic-texas-highways/meridian-highway-under-construction/meridia-3>
(accessed 8/1/2017)

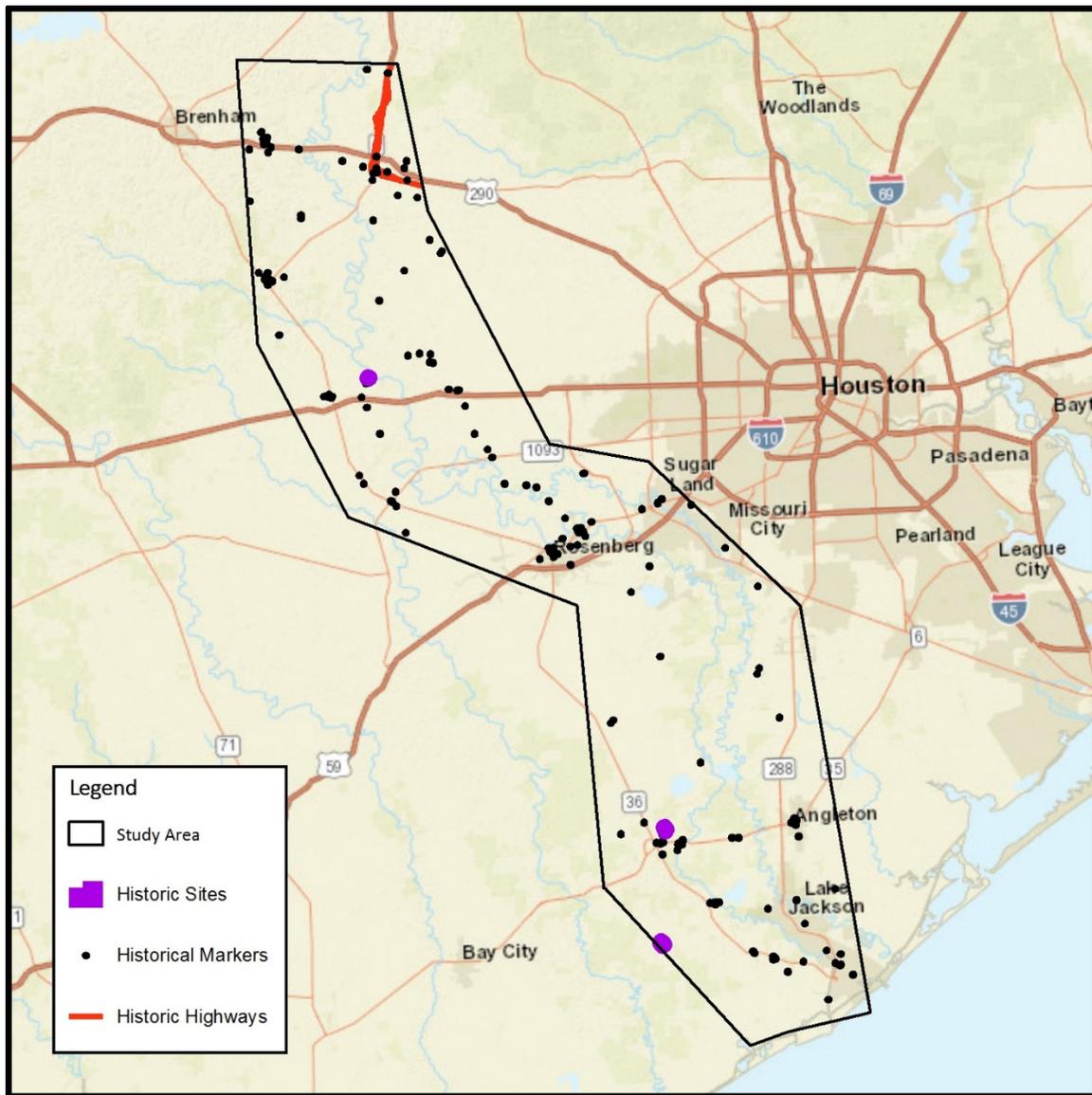


Figure F-5.3 – Historic Sites, Historical Markers, and Historic Highways

F.5.4 National Register of Historic Places

In coordination with the National Park Service (NPS), the THC administers the NRHP which formally recognizes buildings, sites, objects, structures, and districts whose historical or architectural significance denotes that it is worthy of preservation. While the NRHP imposes no restrictions on property owners, those projects receiving grant assistance or other federal funding must adhere to certain standards⁹⁴. There are 24 NRHP designated sites within the study area and Figure F-5.4 depicts their location.

⁹⁴ <http://www.thc.texas.gov/preserve/projects-and-programs/national-register-historic-places> (accessed 08/01/2017)

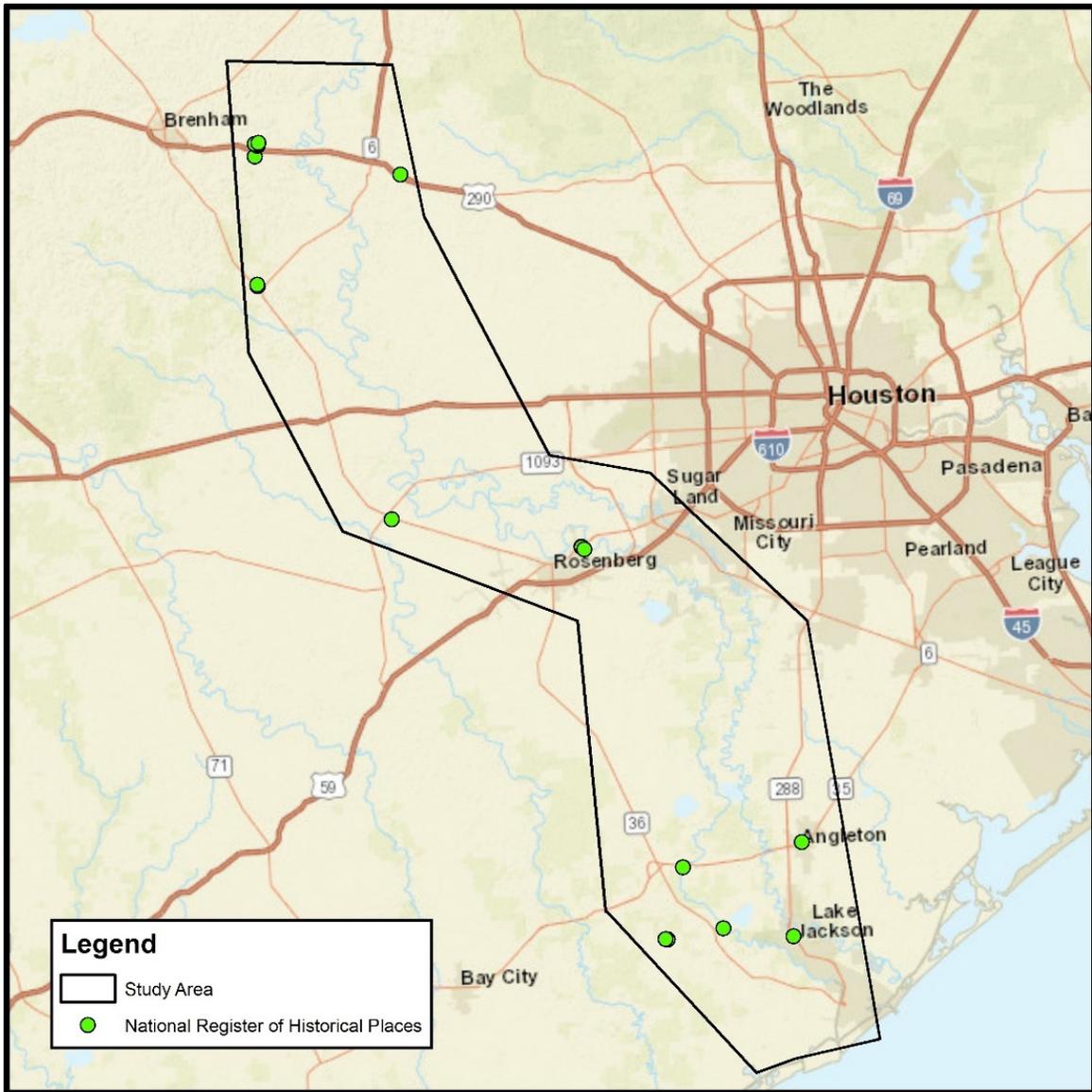


Figure F-5.4 – National Register of Historic Places

F.5.5 Archaeological Project Sites

The THC GIS database contains location records for archaeological surveys that have been permitted through the Antiquities Permit program, or sites surveyed on private land where significant resources were uncovered and recorded. While these records do not contain detailed information regarding the type and extent of the resources surveyed, they do provide a location for existing survey data, as well as the name of the archaeologist and/or firm that completed the work. This could be valuable information for BRA in terms of scoping for archaeological due diligence for future projects in the lower Brazos River corridor. Figure F-5.5 depicts the location of these surveys within the study area.

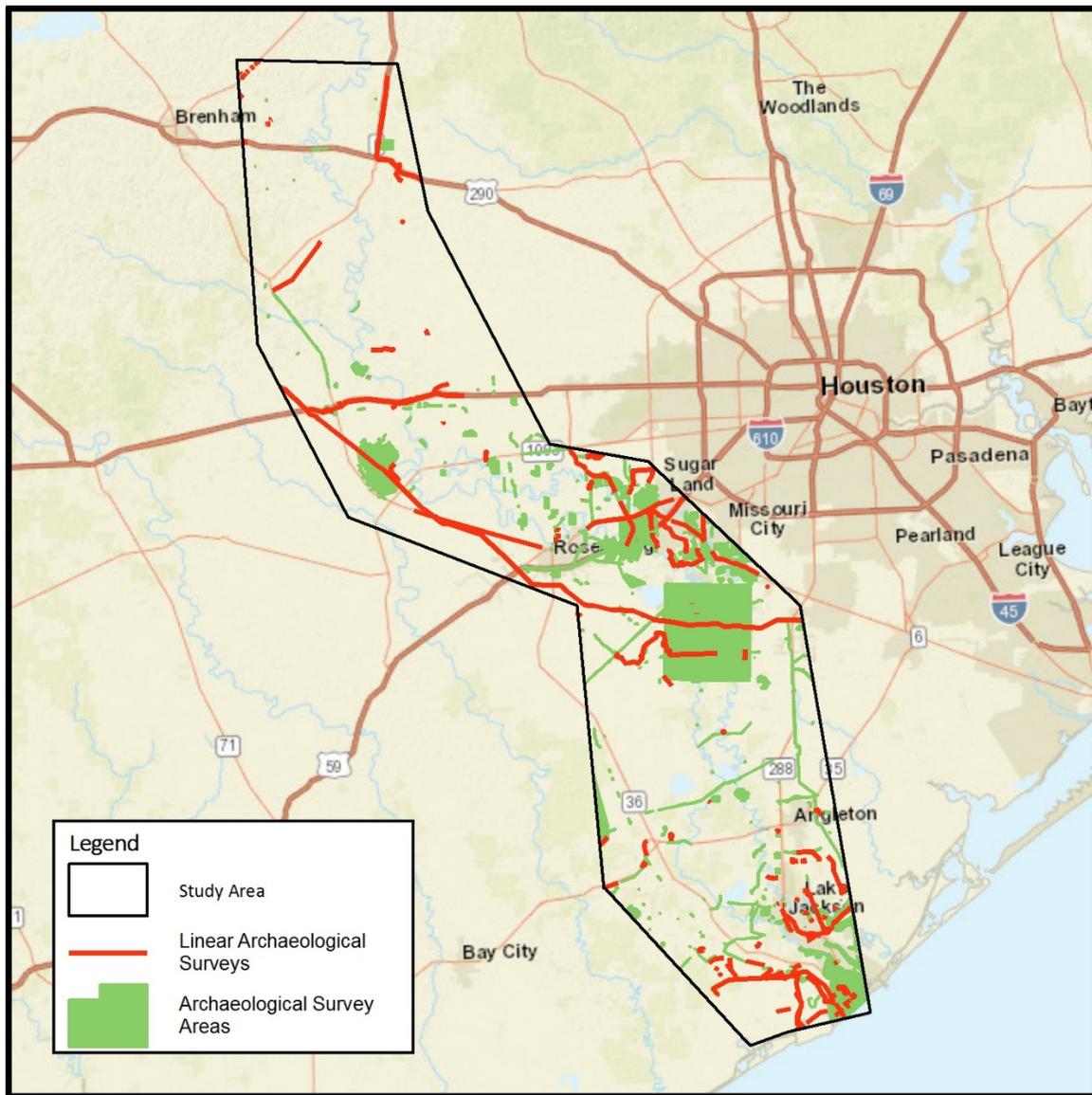


Figure F-5.5 – THC Archaeological Surveys

F.6.0 Other Potential Environmental Constraints

F.6.1 Oil and Gas

The Texas Railroad Commission (TXRRC), through its Oil and Gas Division, regulates the exploration, production, and transportation of oil and natural gas in Texas. Its statutory role is to (1) prevent waste of the state's natural resources, (2) to protect the correlative rights of different interest owners, (3) to prevent pollution, and (4) to provide safety in matters such as hydrogen sulfide. As part of the permitting program, the TXRRC maintains and updates a GIS database of oil and gas

infrastructure within the state⁹⁵. Because BRA's future flood mitigation projects have the potential to occur in proximity to existing or planned oil and gas infrastructure, thus necessitating coordination with operators, landowners, and the TXRRC, these datasets were requested from the TXRRC and included in the LBRED. Figure F-6.1a depicts the location of surface oil and/or gas wells⁹⁶ within the study area. Figure F-6.1b depicts the location of oil and/or gas pipelines⁹⁷ within the study area.

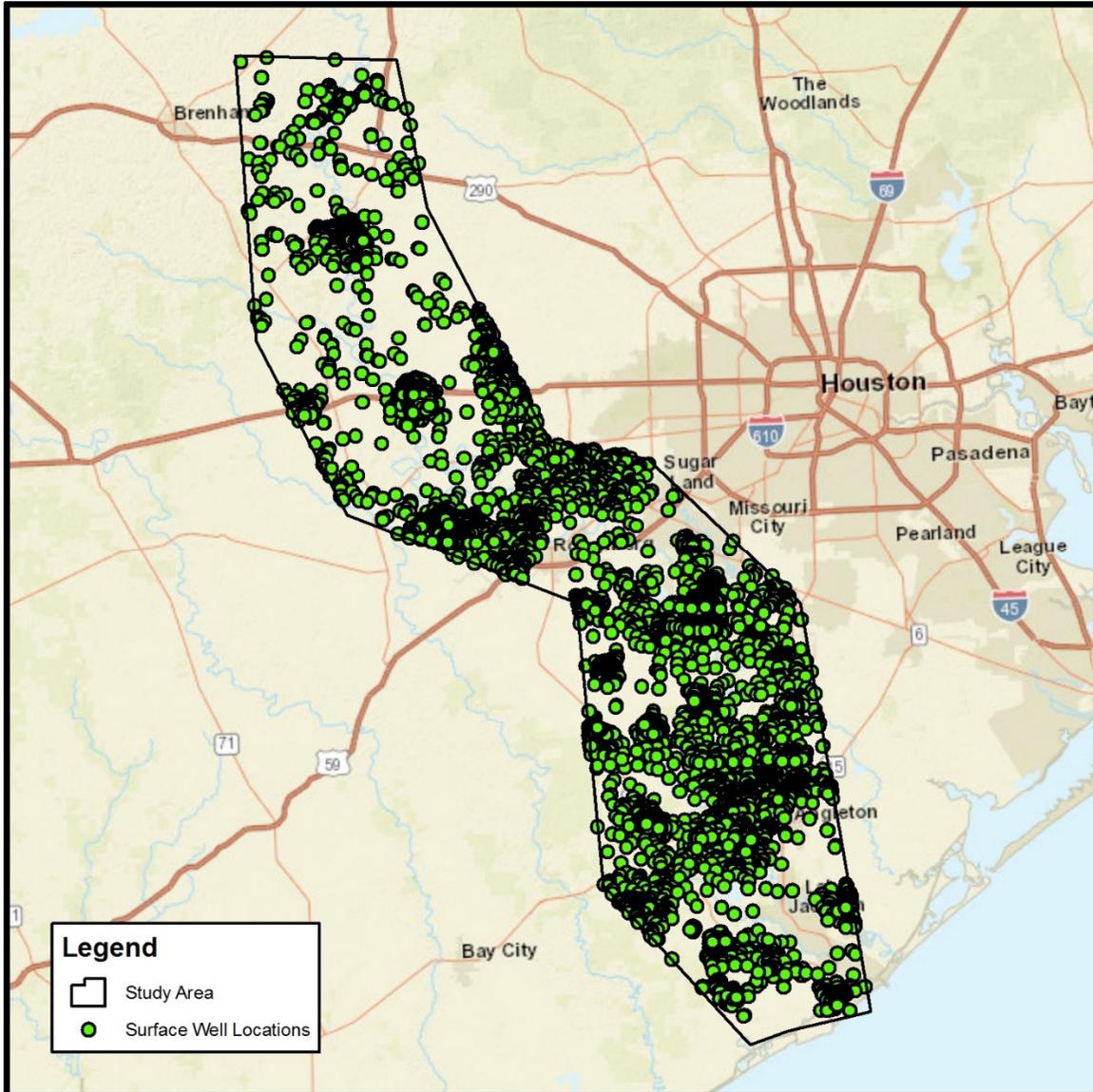


Figure F-6.1a – TXRRC Surface Wells

⁹⁵ <http://www.rrc.state.tx.us/oil-gas/>

⁹⁶ LBRED.gdb\Oil_and_Gas\TXRRC_Surface_Well_Locations

⁹⁷ LBRED.gdb\Oil_and_Gas\TXRRC_Pipelines

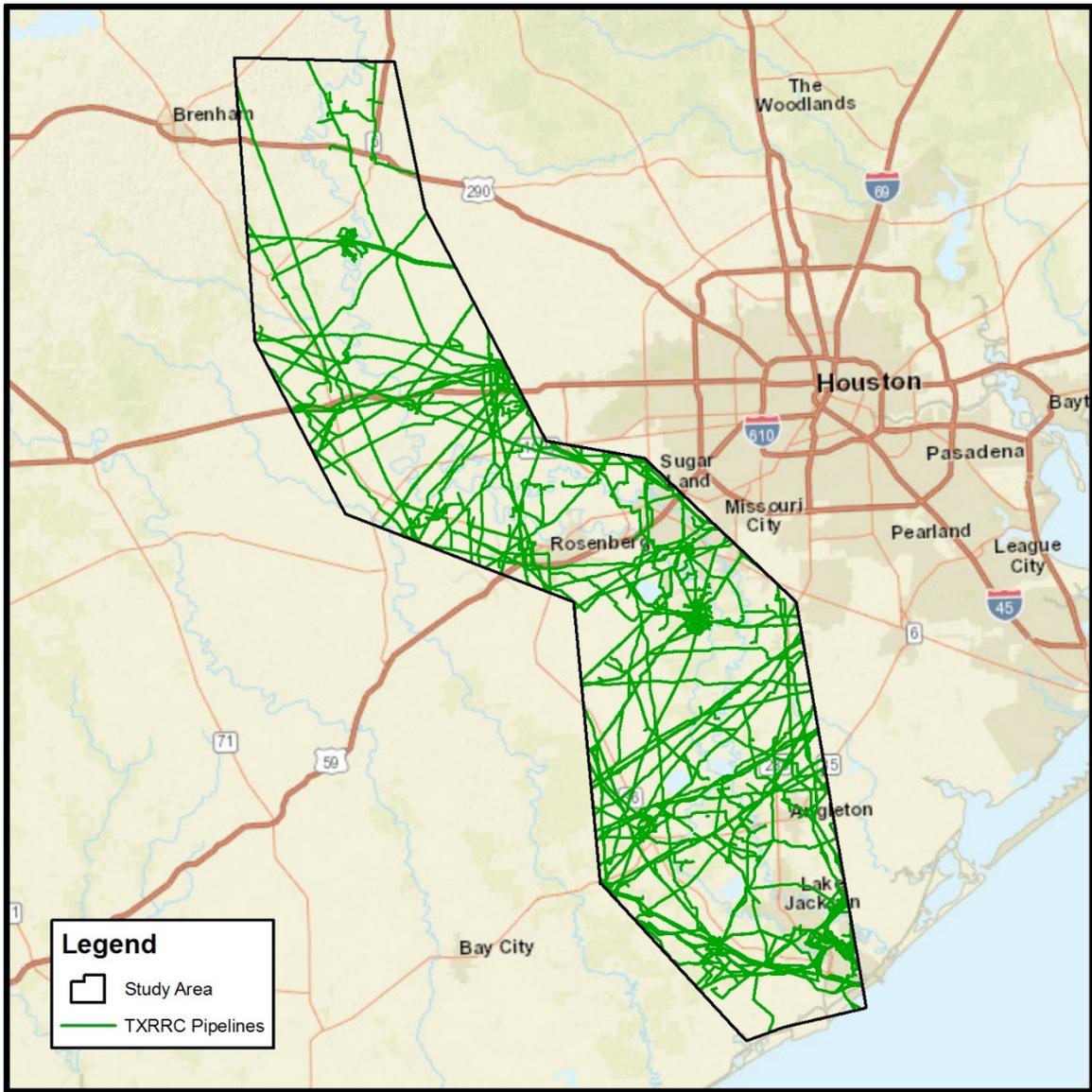


Figure F-6.1b – TXRRC Pipelines

F.6.2 Prime Farmland

The Federal Farmland Protection Policy Act (FPPA) 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, ...”⁹⁸. Such lands have the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed, including water management, according to acceptable farming methods. Federal projects, or federally funded projects, must evaluate potential adverse impacts to prime farmland using a land evaluation and site assessment (LESA) scoring system and determine if the potential impacts exceed the recommended allowable level⁹⁹. Because BRA’s future flood mitigation projects in the lower

⁹⁸ 7 CFR Section 4201(c)(1)(A)

⁹⁹ This is a component of the NEPA process

Brazos River Corridor may include federal funding, or authorization from a federal agency (e.g. USACE or FEMA), Halff has included a feature class¹⁰⁰ representing areas of prime farmland¹⁰¹ in the LBRED. Figure 6.2 depicts prime farmland within the study area.

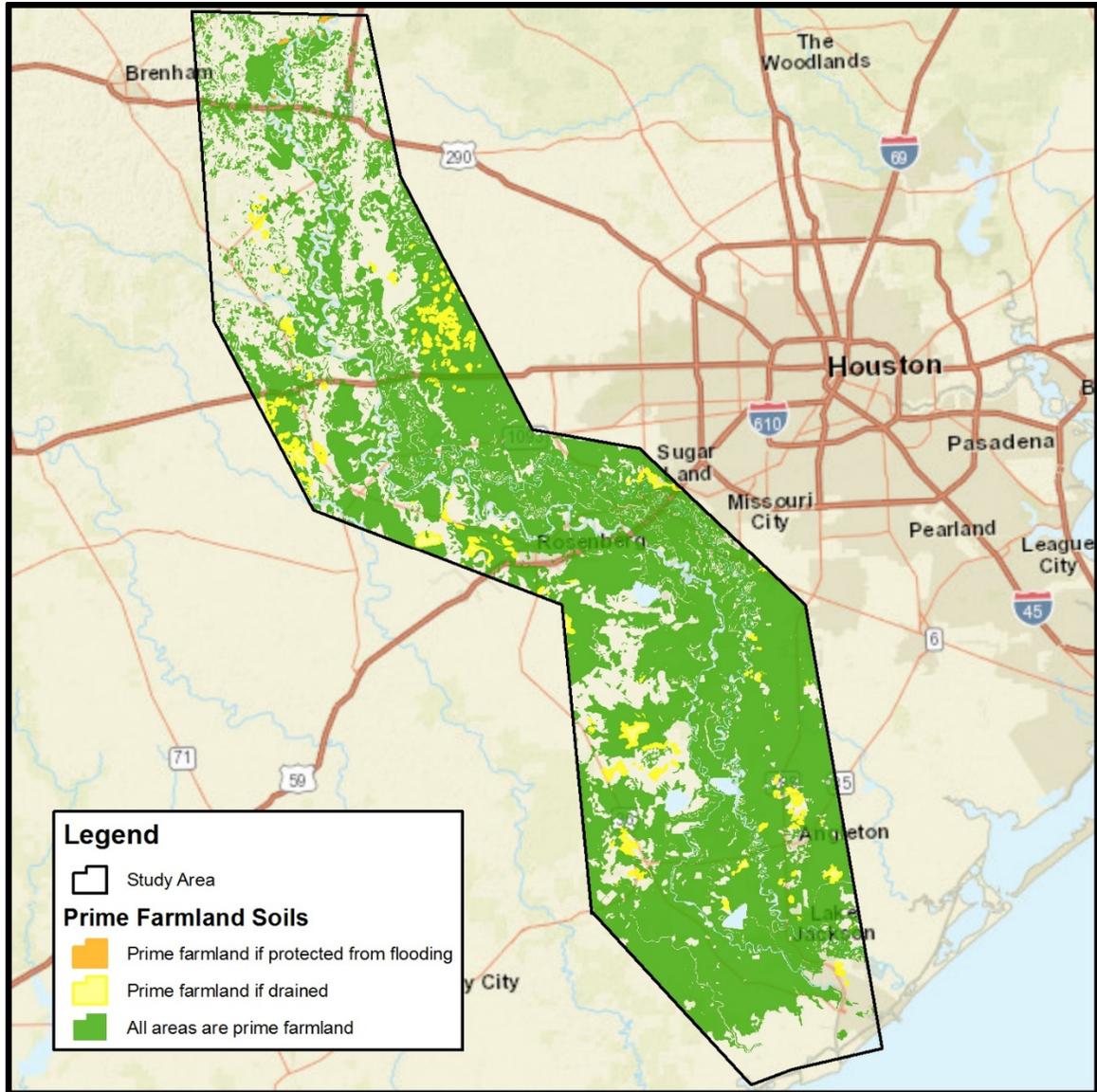


Figure F-6.2 – Prime Farmland

F.6.3 USACE Galveston District – Nationwide Permit Regional Conditions

As discussed in Section 2.0, flood mitigation projects have the potential to impact waters of the United States and would therefore be subject to regulation under Section 404. Under Section 404, the USACE can issue general permits to authorize activities that have only minimal individual and cumulative adverse environmental effects. General permits can only be authorized for five years.

¹⁰⁰ LBRED.gdb\Soils\Prime_Farmland

¹⁰¹ As indicated in the USDA soil survey data downloaded for the study area.

The nationwide permit (NWP) program authorizes activities across the country utilizing 50 general permits, each of which was reissued on March 19, 2017¹⁰². While these permits can be utilized across the country, there are regional conditions (including variances at the state and district level) that may alter or disallow the use of NWPs.

For most of the study area (excepting the portions in Washington and Grimes Counties) the USACE Galveston District is the Section 404 permitting authority. Regional conditions within the Galveston District disallow the use of NWPs (except NWP 3 – *Maintenance*) for activities occurring within waters of the United States classified as mangrove marshes, coastal dune swales, or columbia bottomlands¹⁰³. Therefore, in areas classified as such, flood mitigation project could potentially be subject to the individual permit process rather than utilizing NWP 43 – *Stormwater Management Facilities*. The individual permit process can be considerably costlier and time consuming than a NWP and therefore should be considered a significant constraint in terms of planning a flood mitigation project. As such, Halff has identified areas with the potential to contain these protected resources from the TPWD EMST data and created a feature class¹⁰⁴ within the LBRED. Figure F-6.3 depicts these habitat types within the study area.

¹⁰² <http://www.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/1043655/nationwide-permit-reissuance/>

¹⁰³ <http://www.swg.usace.army.mil/Portals/26/docs/regulatory/PN%20January/2017%20NWP%20RC.pdf?ver=2017-01-12-140117-117>

¹⁰⁴ LBRED.gdb\Vegetation\USACE_Galveston_Protected_Habitat_Classes

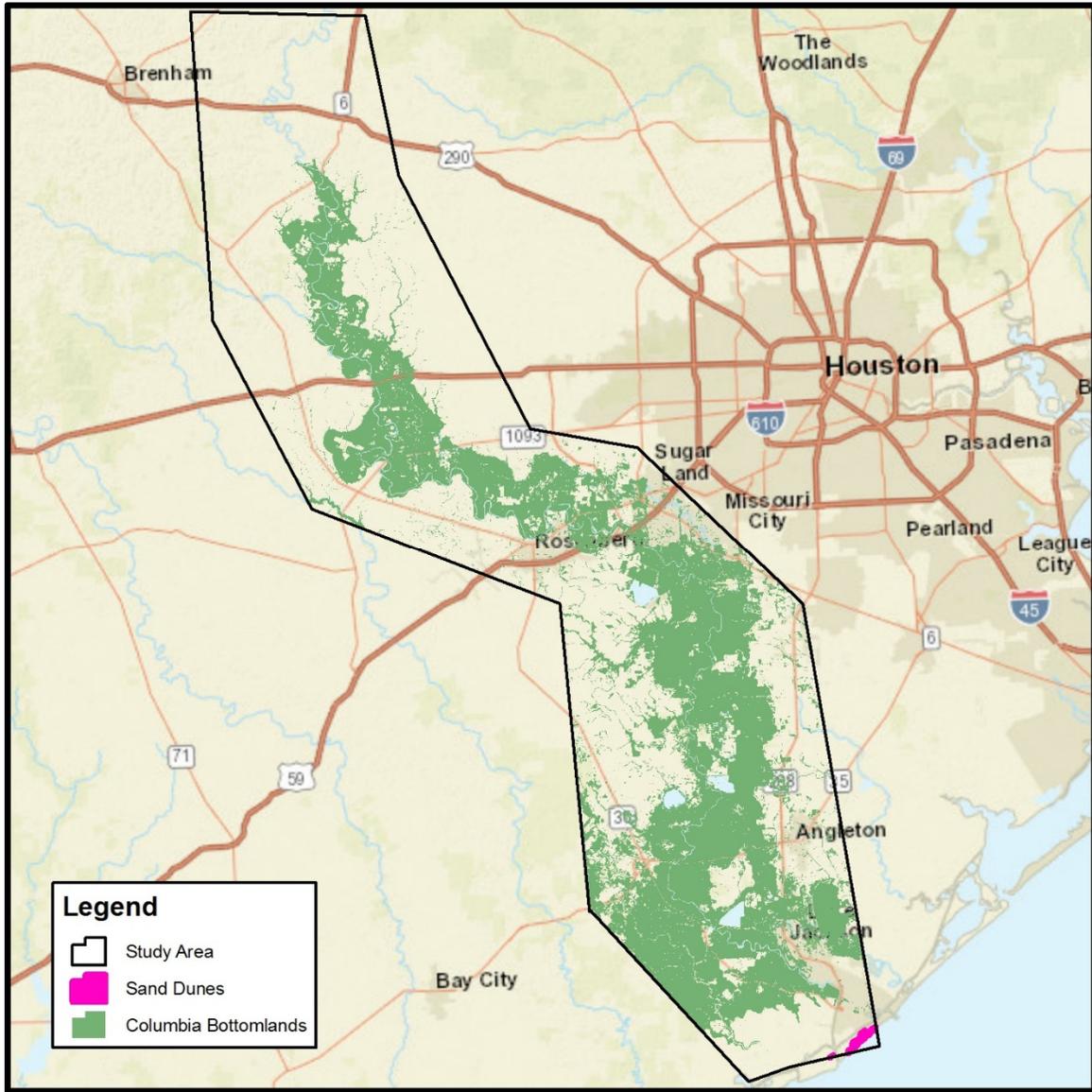


Figure F-6.3 – Protected Cover Classes within the Study Area

Appendix F: Desktop Environmental Review

EMST Vegetation Descriptions

TABLE A1 – AGRICULTURAL AND OTHER HUMAN-RELATED MAPPED TYPES

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
n/a			by <i>Cynodon dactylon</i> (Bermudagrass) and consist of golf course fairways and greens that are fertilized and irrigated. This type also includes areas of moist soil and fast-growing, highly productive grassland. <i>Cynodon dactylon</i> (FACU)			
		1 to 3 meters tall	common within this type, which is mapped over moist soils where natural pine stands are not expected to occur. Other species such as <i>Liquidambar styraciflua</i> (sweetgum), <i>Quercus nigra</i> (water oak), <i>Ulmus alata</i> (winged elm), <i>Ilex vomitoria</i> (yaupon), and <i>Rubus trivialis</i> (southern dewberry) may also be components. Some sites mapped as this type contain sparse or short <i>Quercus virginiana</i> (coastal live oak), <i>Juniperus virginiana</i> (eastern redcedar), or <i>Ilex vomitoria</i> (yaupon). <i>Pinus taeda</i> (FAC), <i>Pinus echinata</i> (NI/UPL), <i>Liquidambar styraciflua</i> (FAC), <i>Quercus nigra</i> (FAC), <i>Rubus trivialis</i> (FACU), <i>Ilex vomitoria</i> (FAC)			
		3 meters tall	<i>taeda</i> (loblolly pine) and <i>Pinus echinata</i> (shortleaf pine) characterize this type that is mapped over moist soils where natural pine stands are not expected to occur. Plantations of <i>Pinus elliottii</i> (slash pine) may also be present. Important components may include <i>Liquidambar styraciflua</i> (sweetgum), <i>Quercus nigra</i> (water oak), <i>Nyssa sylvatica</i> (blackgum), <i>Quercus falcata</i> (southern red oak), <i>Quercus stellata</i> (post oak), and <i>Quercus alba</i> (white oak). Some sites mapped as this type contain <i>Quercus fusiformis</i> (plateau live oak), <i>Quercus virginiana</i> (coastal live oak), <i>Juniperus virginiana</i> (eastern redcedar), or <i>Ilex vomitoria</i> (yaupon). <i>Pinus taeda</i> (FAC), <i>Pinus echinata</i> (NI/UPL), <i>Liquidambar styraciflua</i> (FAC), <i>Quercus nigra</i> (FAC), <i>Nyssa sylvatica</i> (FAC), <i>Quercus falcata</i> (FACU), <i>Quercus stellata</i> (UPL), <i>Quercus alba</i> (FACU)			
			some portion of the year. Some fields may rotate into and out of cultivation frequently, and year-round cover crops are generally mapped as grassland.			
	9411	Urban Low Intensity	This type includes areas that are built-up but not entirely covered by impervious cover, including most of the area within cities and towns.	NI/UPL	0.01	1945
	9410	Urban High Intensity	This type consists of built-up areas and wide transportation corridors that are dominated by impervious cover.	NI/UPL	0.01	91

TABLE A2 – MAINLY NATURAL AZONAL MAPPED TYPES

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
Azonal types are those types that are widespread and not particularly characteristic of any region or naturally occurring vegetation type. This may be due to disturbance, where wide ranging species adapted to disturbed conditions predominate. In other areas, land management may have resulted in invasion of widespread species such as juniper or mesquite. Azonal types may also be used to refer to general physiognomic types that are not ascribable to particular naturally occurring systems.	9000	Barren	This type includes areas where little or no vegetative cover existed at the time of image data collection. Large areas cleared for development are included, as well as rural roads and buildings and associated clearing in primarily rural areas. Stream beds with exposed gravel or bedrock, rock outcrops, quarries, and mines may be mapped as this type. Fallow fields or areas within cropland blocks that remain barren throughout one growing season or heavily grazed pastures where bare soils are dominant may also be mapped as barren. Impervious.	NI/UPL	0.01	44
	9007	Marsh	Areas mapped as marsh are small, and consist of wet or alternately wet and dry soils with herbaceous vegetation. These are often near tanks or ponds, and may contain <i>Typha</i> spp. (cattails), <i>Eleocharis</i> spp. (spikerushes), <i>Schoenoplectus</i> spp. (bulrushes), other sedges, <i>Polygonum</i> spp. (smartweeds) and grasses such as <i>Sorghum halepense</i> (Johnsongrass) or <i>Cynodon dactylon</i> (bermudagrass) as important species. Some shrubs such as <i>Cephalanthus occidentalis</i> (common buttonbush) and <i>Salix nigra</i> (black willow) may be important in this mapped type. <i>Typha</i> spp. (OBL), <i>Eleocharis</i> spp. (OBL), <i>Schoenoplectus</i> spp. (OBL), <i>Persicaria</i> spp. (OBL)	OBL	9.95	94
	9116	Native Invasive: Baccharis Shrubland	This type is mapped on salty or sandy soils and <i>Baccharis</i> spp. (baccharis), <i>Prosopis glandulosa</i> (honey mesquite), <i>Tamarix</i> spp. (salt cedars), and <i>Iva frutescens</i> (shrubby sumpweed) are the most common dominants. Other shrubs may include <i>Triadica sebifera</i> (Chinese tallow), <i>Borrchia frutescens</i> (sea ox-eye daisy), <i>Rosa bracteata</i> (Macartney rose), <i>Forestiera acuminata</i> (swamp privet), and <i>Zanthoxylum fagara</i> (tella), and grasses	FAC+	4.5	33

TABLE A2 – MAINLY NATURAL AZONAL MAPPED TYPES

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
			may include <i>Spartina spartinae</i> (Gulf cordgrass), <i>Distichlis spicata</i> (saltgrass), <i>Cynodon dactylon</i> (bermudagrass), and <i>Sporobolus indicus</i> (rat-tail smutgrass). <i>Baccharis</i> spp. (FAC/FACW), <i>Tamarix</i> spp. (FACW), <i>Prosopis glandulosa</i> (UPL), <i>Iva frutescens</i> (FACW),			
	9107	Native Invasive: Common Reed	Areas mapped within this type are often dominated by nearly pure stands of <i>Phragmites australis</i> (common reed) on formerly disturbed soils. <i>Phragmites australis</i> (FACW)	FACW	7.32	6
	9126	Native Invasive: Deciduous Shrubland	A variety of shrubs and generally small or sparse deciduous trees may be important in this successional type that was mapped on non-prairie soils. Important species may include <i>Celtis laevigata</i> (sugar hackberry), <i>Quercus nigra</i> (water oak), <i>Prosopis glandulosa</i> (honey mesquite), <i>Triadica sebifera</i> (Chinese tallow, south), <i>Ilex vomitoria</i> (yaupon), <i>Baccharis</i> spp. (baccharis), <i>Rubus trivialis</i> (southern dewberry), <i>Liquidambar styraciflua</i> (sweetgum), <i>Quercus tellat</i> (southern red oak), <i>Ulmus alata</i> (winged elm), or <i>Ulmus crassifolia</i> (cedar elm). Small pine trees may be present in young, managed plantations. <i>Celtis laevigata</i> (FACW), <i>Quercus nigra</i> (FAC), <i>Prosopis glandulosa</i> (UPL), <i>Triadica sebifera</i> (FAC), <i>Ilex vomitoria</i> (FAC), <i>Rubus trivialis</i> (FACU), <i>Liquidambar styraciflua</i> (FAC)	FAC-	1.5	24
	9104	Native Invasive: Deciduous Woodland	This broadly-defined type may have <i>Celtis laevigata</i> (sugar hackberry), <i>Quercus nigra</i> (water oak), <i>Ulmus crassifolia</i> (cedar elm), <i>Liquidambar styraciflua</i> (sweetgum), <i>Ulmus alata</i> (winged elm), <i>Ilex vomitoria</i> (yaupon), <i>Acacia farnesiana</i> (huisache), <i>Fraxinus</i> spp. (ashes), or <i>Prosopis glandulosa</i> (honey mesquite) among the dominants. To the south and west, species such as <i>Celtis ehrenbergiana</i> (granjeno), <i>Zanthoxylum fagara</i> (tella), and <i>Diospyros texana</i> (Texas	FAC-	1.5	380

TABLE A2 – MAINLY NATURAL AZONAL MAPPED TYPES

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
			persimmon) are more common. <i>Quercus tellata</i> (post oak), <i>Quercus virginiana</i> (coastal live oak), and <i>Quercus fusiformis</i> (plateau live oak) may be important. <i>Juniperus virginiana</i> (eastern redcedar) and <i>Pinus taeda</i> (loblolly pine) may also be present. <i>Celtis laevigata</i> (FACW), <i>Quercus nigra</i> (FAC), <i>Ulmus crassifolia</i> (FAC), <i>Liquidambar styraciflua</i> (FAC), <i>Ulmus alata</i> (FACU), <i>Ilex vomitoria</i> (FAC)			
	9124	Native Invasive: Huisache Woodland or Shrubland	This broadly-defined type often has invasive shrubs or small trees such as <i>Acacia farnesiana</i> (huisache), <i>Prosopis glandulosa</i> (honey mesquite), <i>Celtis laevigata</i> (sugar hackberry), <i>Ulmus crassifolia</i> (cedar elm), <i>Sideroxylon lanuginosum</i> (gum bumelia), <i>Quercus nigra</i> (water oak), or <i>Triadica sebifera</i> (Chinese tallow) among the dominants. <i>Quercus fusiformis</i> (plateau live oak) or <i>Quercus virginiana</i> (coastal live oak) may be present in the tree layer and other common species include <i>Celtis ehrenbergiana</i> (granjeno), <i>Forestiera angustifolia</i> (elbow bush), <i>Acacia berlandieri</i> (guajillo), <i>Opuntia engelmannii</i> var. <i>lindheimeri</i> (Lindheimer pricklypear), <i>Diospyros texana</i> (Texas persimmon), and <i>Rosa bracteata</i> (Macartney rose). <i>Acacia farnesiana</i> (NI/UPL), <i>Prosopis glandulosa</i> (UPL), <i>Celtis laevigata</i> (FACW), <i>Ulmus crassifolia</i> (FAC), <i>Sideroxylon lanuginosum</i> (FACU)	UPL	0.01	793

TABLE A2 – MAINLY NATURAL AZONAL MAPPED TYPES

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
Azonal types are those types that are widespread and not particularly characteristic of any region or naturally occurring vegetation type. This may be due to disturbance, where wide ranging species adapted to disturbed conditions predominate. In other areas, land management may have resulted in invasion of widespread species such as juniper or mesquite. Azonal types may also be used to refer to general physiognomic types that are not ascribable to particular naturally occurring systems.	9105	Native Invasive: Juniper Shrubland	Various species of Juniperus (juniper) dominate these shrublands. Juniperus virginiana (eastern redcedar) is the primary dominant of these shrublands or low woodlands in the Blackland Prairie, Post Oak Savanna, and far northern Crosstimbers ecoregions. To the west, on the Rolling Plains, Juniperus pinchotii (redberry juniper) may be the dominant. In other areas, Juniperus ashei (Ashe juniper) may dominate these shrublands. Other sites mapped as this type may be dominated by Ilex vomitoria (yaupon). A variety of deciduous species may also be present, including Ulmus crassifolia (cedar elm), Ulmus alata (winged elm), Celtis laevigata (sugar hackberry), Liquidambar styraciflua (sweetgum), Quercus nigra (water oak), and Prosopis glandulosa (honey mesquite). To the east, sites dominated by young Pinus taeda (loblolly pine) may be mapped as this type. Juniperus virginiana (FACU), Ulmus crassifolia (FAC), Ulmus alata (FACU), Pinus taeda (FAC)	FACU	0.34	129
	9101	Native Invasive: Juniper Woodland	This type may be dominated either by Juniperus ashei (Ashe juniper) in the northwest, over Edwards Plateau limestones, or by Juniperus virginiana (eastern redcedar) in the northeast and east, or Juniperus pinchotii (redberry juniper) to the northwest. Quercus fusiformis (plateau live oak) is a common component, and species such as Celtis laevigata (sugar hackberry) and Ulmus crassifolia (cedar elm) occur throughout. Quercus stellata (post oak) and Ilex vomitoria (yaupon) are commonly associated with Juniperus virginiana (eastern redcedar). Juniperus virginiana (FACU), Ulmus crassifolia (FAC), Ulmus alata (FACU), Pinus taeda (FAC)	FACU	0.34	6

TABLE A2 – MAINLY NATURAL AZONAL MAPPED TYPES

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
	9106	Native Invasive: Mesquite Shrubland	Prosopis glandulosa (honey mesquite) is often the dominant species of this broadly-defined type, but species such as Acacia farnesiana (huisache), Celtis laevigata (sugar hackberry), Juniperus ashei (Ashe juniper), Ulmus crassifolia (cedar elm), Ziziphus obtusifolia (lotebush), Mahonia trifoliolata (agarito), Ulmus alata (winged elm), Rhus spp. (sumacs), Condalia hookeri (brasil), Diospyros virginiana (common persimmon), Diospyros texana (Texas persimmon), Celtis ehrenbergiana (granjeno), and Opuntia engelmannii var. lindheimeri (Lindheimer pricklypear) may also be important. Trees such as Quercus fusiformis (plateau live oak), Quercus virginiana (coastal live oak), or Quercus stellata (post oak) may form a sparse canopy. Prosopis glandulosa (UPL), Acacia farnesiana (NI/UPL), Celtis laevigata (FACW), Ulmus crassifolia (FAC), Rhus spp. (UPL)	FACU	0.34	62
	9214	Non-Native Invasive: Chinese Tallow Forest, Woodland, or Shrubland	More or less dense stands of Triadica sebifera (Chinese tallow) characterize this type, which is generally mapped over prairie soils, but a diversity of mainly invasive deciduous shrublands and sparse woodlands are circumscribed. Other component species may include Prosopis glandulosa (honey mesquite), Acacia farnesiana (huisache), Baccharis spp. (baccharis), Rosa bracteata (Macartney rose), Ulmus crassifolia (cedar elm), Quercus nigra (water oak), Ligustrum sinense (Chinese privet), and Ilex vomitoria (yaupon). Sparse tree cover with Celtis laevigata (sugar hackberry), Quercus nigra (water oak), Quercus phellos (willow oak), Quercus fusiformis (plateau live oak), Quercus virginiana (coastal live oak), Pinus taeda (loblolly pine), and Liquidambar styraciflua (sweetgum) may be present. Triadica sebifera (FAC)	FAC	3	28

TABLE A2 – MAINLY NATURAL AZONAL MAPPED TYPES

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
	9205	Non-native Invasive: Rose Shrubland	Rosa bracteata (Macartney rose) is the most common dominant of this type, but a variety of mainly invasive shrub types may occur, including species such as Acacia farnesiana (huisache), Baccharis spp. (baccharis), Triadica sebifera (Chinese tallow), Celtis laevigata (sugar hackberry), Ulmus crassifolia (cedar elm), and Ilex vomitoria (yaupon). Sparse tree cover with species such as Quercus fusiformis (plateau live oak), Quercus virginiana (coastal live oak), Quercus nigra (water oak), Celtis laevigata (sugar hackberry), and Fraxinus pennsylvanica (green ash) may also occur. Rosa bracteata (UPL), Acacia farnesiana (NI/UPL), Baccharis spp. (FAC/FACW), Triadica sebifera (FAC)	FACU	0.34	255
Azonal types are those types that are widespread and not particularly characteristic of any region or naturally occurring vegetation type. This may be due to disturbance, where wide ranging species adapted to disturbed conditions predominate. In other areas, land management may have resulted in invasion of widespread species such as juniper or mesquite. Azonal types may also be used to refer to general physiognomic types that are not ascribable to particular naturally occurring systems.	9204	Non-native Invasive: Saltcedar Shrubland	Mainly invasive shrublands are characteristic of this type and Tamarix spp. (salt cedars) is the most common dominant. Species such as Iva frutescens (shrubby sumpweed), Baccharis spp. (baccharis), Prosopis glandulosa (honey mesquite), Acacia farnesiana (huisache), Celtis laevigata (sugar hackberry), and Borrichia frutescens (sea ox-eye daisy) may also be present. Tamarix spp. (FACW), Iva frutescens (FACW)	FACW	7.32	93
	9600	Open Water	In addition to large lakes, rivers, and marine water, ephemeral ponds may be mapped as open water. Some mapped areas may support vegetation with pioneering species such as Salix nigra (black willow), Populus deltoides (eastern cottonwood), Triadica sebifera (Chinese tallow), Suaeda spp. (seepweeds), Borrichia frutescens (sea ox-eye daisy), Batis maritima (saltwort), Juncus spp. (rushes), sedges, Typha spp. (cattails), and Eleocharis spp. (spikerushes). Salix nigra (OBL), Populus deltoides (FAC), Triadica sebifera (FAC), Borrichia frutescens (OBL), Batis maritima (OBL)	OBL	9.95	4

TABLE A2 – MAINLY NATURAL AZONAL MAPPED TYPES

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
	9197	Pineywoods: Disturbance or Tame Grassland	This grass dominated vegetation type occurs within a landscape that would naturally be dominated by forest or woodland. Natural occurrences would be short-lived following natural disturbances, such as fire. The predominant cover often consists of non-native grass species such as <i>Cynodon dactylon</i> (bermudagrass), <i>Paspalum notatum</i> (Bahia grass), <i>Lolium perenne</i> (Italian ryegrass), <i>Schedonorus phoenix</i> (tall fescue), and/or <i>Bromus catharticus</i> (rescuegrass). However, native grasses such as <i>Schizachyrium scoparium</i> (little bluestem) and <i>Andropogon virginicus</i> (broomsedge bluestem) may also have significant cover. Various forbs and some woody species may also be present. These sites will develop significant woody cover in the absence of active management. <i>Cynodon dactylon</i> (FACU), <i>Paspalum notatum</i> (FACU), <i>Lolium perenne</i> (FACU), <i>Schedonorus phoenix</i> (NI/UPL), <i>Bromus catharticus</i> (NI/UPL), <i>Schizachyrium scoparium</i> (FACU), <i>Andropogon virginicus</i> (FAC)	FACU	0.34	490
	9004	Swamp	Typically forested, wet or alternately wet and dry soils at the upper ends of reservoirs, or on stock tanks or ponds. A variety of species, including <i>Taxodium distichum</i> (baldcypress), <i>Ulmus americana</i> (American elm), <i>Ulmus crassifolia</i> (cedar elm), <i>Salix nigra</i> (black willow), <i>Quercus macrocarpa</i> (bur oak), and <i>Quercus nigra</i> (water oak), <i>Liquidambar styraciflua</i> (sweetgum), or <i>Cephalanthus occidentalis</i> (common buttonbush) may be present. <i>Taxodium distichum</i> (OBL), <i>Ulmus americana</i> (FAC), <i>Ulmus crassifolia</i> (FAC), <i>Salix nigra</i> (OBL), <i>Quercus macrocarpa</i> (FACU)	OBL	9.95	2287

TABLE A3 – TEXAS COAST DUNE AND COASTAL GRASSLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
This system includes upland, grass-dominated vegetation on deep sands. Dunes are often dominated by <i>Uniola paniculata</i> (sea oats), with other species such as <i>Croton punctatus</i> (Gulf croton), <i>Panicum amarum</i> (bitter panicum), <i>Ipomoea pes-caprae</i> (goat-foot morning-glory), <i>Ipomoea imperati</i> (beach morning-glory), <i>Tidestromia lanuginosa</i> (wooly tidestromia), <i>Cakile</i> spp. (searocket), and <i>Sesuvium portulacastrum</i> (shoreline seapurslane) also present. Upland grasslands are often dominated by <i>Schizachyrium littorale</i> (seacoast bluestem) and <i>Paspalum monostachyum</i> (gulfdune paspalum). Numerous other species, such as <i>Sorghastrum nutans</i> (Indiangrass), <i>Paspalum plicatulum</i> (brownseed paspalum), <i>Muhlenbergia capillaris</i> (Gulf muhly), <i>Cenchrus spinifex</i> (common sandbur), <i>Elionurus tripsacoides</i> (Pan American balsamscale), <i>Eragrostis secundiflora</i> (red lovegrass), <i>Bothriochloa laguroides</i> ssp. <i>torreyana</i> (silver bluestem), <i>Heteropogon contortus</i> (tanglehead), <i>Andropogon glomeratus</i> (bushy bluestem), <i>Spartina patens</i> (marshhay cordgrass), and <i>Dichanthelium</i> spp. (rosette grasses) may also be common. Numerous forbs, including such species as <i>Heterotheca subaxillaris</i> (camphor weed), <i>Croton</i> spp. (crotons), <i>Chamaecrista fasciculata</i> (partridge pea), <i>Rayjacksonia phyllocephala</i> (camphor daisy), <i>Physalis</i> spp. (groundcherries), <i>Helianthus argophyllus</i> (silverleaf sunflower), <i>Gaillardia pulchella</i> (Indian blanket), <i>Solidago sempervirens</i> (seaside goldenrod), <i>Baptisia</i> spp. (wild-indigos), <i>Indigofera miniata</i> (scarlet-pea), <i>Eriogonum multiflorum</i> (heartsepal wildbuckwheat), <i>Conoclinium betonicifolium</i> (betonyleaf thoroughwort), and <i>Rudbeckia hirta</i> (blackeyed Susan) are also commonly encountered. Some woody species are found in the system, but typically make up very little cover. Cover of woody species is limited, but may include <i>Baccharis</i> spp. (<i>baccharis</i>), <i>Opuntia engelmannii</i> var. <i>lindheimeri</i> (Lindheimer pricklypear), <i>Morella cerifera</i> (wax-myrtle), <i>Quercus fusiformis</i> (plateau live oak), <i>Quercus virginiana</i> (coastal live oak), and stunted <i>Prosopis glandulosa</i> (honey mesquite). Non-native woody species such as <i>Tamarix</i> spp. (salt cedars), <i>Schinus terebinthifolius</i> (Brazilian peppertree), and <i>Triadica sebifera</i> (Chinese tallow) may be present to dominant. Small areas may have sufficient woody cover to be mapped as a shrubland.	6200	Active Sand Dune	These are barren to sparsely vegetated deep sands where active sand movement is occurring. These sites may sometimes be 15 m or more in height and offer the greatest degree of topographic relief in the region. <i>Uniola paniculata</i> (FACU), <i>Croton punctatus</i> (NI/UPL), <i>Panicum amarum</i> (FAC), <i>Ipomoea pes-caprae</i> (FAC), <i>Ipomoea imperati</i> (FACU), <i>Tidestromia lanuginosa</i> (NI/UPL)	FACU	0.34	12313
	6307	Coastal and Sandsheet: Deep Sand Grassland	As described for herbaceous portions of the system. <i>Cyperus</i> spp. (OBL/FACW), <i>Eleocharis</i> spp. (OBL/FACW), <i>Fimbristylis</i> spp. (OBL/FACW), <i>Fuirena</i> spp. (OBL), <i>Rhynchospora</i> spp. (OBL/FACW), <i>Schoenoplectus</i> spp. (OBL)	FAC-	1.5	3186
	6507	Coastal and Sandsheet: Deep Sand Grassland Swale Marsh	Small areas within deep coastal sands may be dominated by shrub species such as <i>Baccharis</i> spp. (<i>baccharis</i>), <i>Opuntia engelmannii</i> var. <i>lindheimeri</i> (Lindheimer pricklypear), <i>Prosopis glandulosa</i> (honey mesquite), <i>Morella cerifera</i> (wax-myrtle), <i>Iva frutescens</i> (shrubby sumpweed), or the non-native <i>Schinus terebinthifolius</i> (Brazilian peppertree). <i>Schizachyrium littorale</i> (FAC), <i>Paspalum monostachyum</i> (FACW), <i>Uniola paniculata</i> (FACU), <i>Croton punctatus</i> (NI/UPL), <i>Panicum amarum</i> (FAC), <i>Ipomoea pes-caprae</i> (FAC), <i>Ipomoea imperati</i> (FACU), <i>Tidestromia lanuginosa</i> (NI/UPL)	OBL	9.95	221

TABLE A4 – TEXAS BLACKLAND TALLGRASS PRAIRIE

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
Currently, only remnants of this system exist, with most of the historical distribution replaced by crop production or improved pasture. <i>Schizachyrium scoparium</i> (little bluestem) is the most ubiquitous component of occurrences of this system. <i>Andropogon gerardii</i> (big bluestem) and <i>Sorghastrum nutans</i> (Indiangrass) are also common dominants. Other species commonly encountered include <i>Bouteloua curtipendula</i> (sideoats grama), <i>Carex microdonta</i> (smalltooth sedge), <i>Sporobolus compositus</i> (tall dropseed), <i>Nassella leucotricha</i> (Texas wintergrass), <i>Bothriochloa laguroides</i> spp. <i>torreyana</i> (silver bluestem), <i>Eriochloa sericea</i> (silky cupgrass), <i>Paspalum floridanum</i> (Florida paspalum), and <i>Tridens strictus</i> (longspike tridens). Forbs commonly encountered in this system include <i>Symphotrichum ericoides</i> (heath aster), <i>Stenaria nigricans</i> var. <i>nigricans</i> (prairie bluets), <i>Helianthus maximiliani</i> (Maximilian sunflower), <i>Rudbeckia hirta</i> (blackeyed Susan), <i>Bifora americana</i> (prairie bishop), <i>Acacia angustissima</i> var. <i>hirta</i> (prairie acacia), <i>Desmanthus illinoensis</i> (Illinois bundleflower), and many more. Perhaps more commonly encountered species include <i>Croton monanthogynus</i> (doveweed), <i>Amphiachyris dracunculoides</i> (annual broomweed), and <i>Asclepias</i> spp. (milkweeds). Lowland sites and swales are often dominated by <i>Tripsacum dactyloides</i> (eastern gamagrass) and <i>Panicum virgatum</i> (switchgrass).	207	Blackland Prairie: Disturbance or Tame Grassland	Very little intact Blackland prairie remains within the region, so grasslands that are mapped in the region are assumed to primarily consist of disturbance or tame grasslands. Non-native grasses such as <i>Cynodon dactylon</i> (bermudagrass), <i>Panicum coloratum</i> (kleingrass), <i>Bothriochloa ischaemum</i> var. <i>songarica</i> (King Ranch bluestem) and <i>Sorghum halepense</i> (Johnsongrass) are frequently encountered. Weedy forbs such as <i>Ambrosia psilostachya</i> (western ragweed) and <i>Amphiachyris dracunculoides</i> (common broomweed) are often present. <i>Prosopis glandulosa</i> (honey mesquite) or <i>Acacia farnesiana</i> (huisache) are often present and may be fairly dense. Important native grasses may include <i>Schizachyrium scoparium</i> (little bluestem), <i>Bothriochloa laguroides</i> spp. <i>torreyana</i> (silver bluestem), <i>Sorghastrum nutans</i> (Indiangrass), <i>Nassella leucotricha</i> (Texas wintergrass), <i>Bouteloua hirsuta</i> (hairy grama), and <i>Aristida</i> spp. (threeawn species). <i>Cynodon dactylon</i> (FACU), <i>Panicum coloratum</i> (FACW), <i>Bothriochloa ischaemum</i> var. <i>songarica</i> (NI/UPL), <i>Sorghum halepense</i> (FACU), <i>Ambrosia psilostachya</i> (FAC), <i>Amphiachyris dracunculoides</i> (NI/UPL)	FACU	0.34	1532

TABLE A5 – SOUTHEASTERN GREAT PLAINS FLOODPLAIN FOREST

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
Dominant communities within this system range from floodplain forests to wet meadows to gravel/sand flats; however, they are linked by underlying soils and the flooding regime. Canopy dominants may include <i>Carya illinoensis</i> (pecan), <i>Fraxinus americana</i> (white ash), <i>Quercus nigra</i> (water oak), <i>Ulmus crassifolia</i> (cedar elm), <i>Celtis laevigata</i> (sugar hackberry), <i>Ulmus americana</i> (American elm), <i>Quercus fusiformis</i> or <i>Q. virginiana</i> (plateau or coastal live oak), <i>Platanus occidentalis</i> (American sycamore), <i>Acer negundo</i> (boxelder), <i>Gleditsia triacanthos</i> (common honeylocust), <i>Quercus macrocarpa</i> (bur oak), <i>Morus rubra</i> (red mulberry), <i>Fraxinus pennsylvanica</i> (green ash), and <i>Sapindus saponaria</i> var. <i>drummondii</i> (western soapberry). Especially along river margins, species such as <i>Platanus occidentalis</i> (American sycamore), <i>Populus deltoides</i> (eastern cottonwood), and <i>Salix nigra</i> (black willow) may dominate. In this eastern part of the range of the system, <i>Liquidambar styraciflua</i> (sweetgum), <i>Quercus phellos</i> (willow oak), and <i>Betula nigra</i> (river birch) may also be commonly encountered. Seasonally flooded sites, especially within the Trinity River basin, may have <i>Quercus lyrata</i> (overcup oak) as an overstory component. Overgrazing and/or overbrowsing may influence recruitment of overstory species and composition of the understory and herbaceous layers. Shrub species may include	1801	Central Texas: Floodplain Evergreen Forest	As described for the system, but the canopy is dominated by <i>Juniper virginiana</i> (eastern redcedar). In some cases, this mapped type may have <i>Pinus taeda</i> (loblolly pine) as the canopy dominant. <i>Juniperus virginiana</i> (FACU), <i>Pinus taeda</i> (FAC), <i>Callicarpa americana</i> (FACU), <i>Cephalanthus occidentalis</i> (OBL), <i>Ilex decidua</i> (FACW), <i>Ilex vomitoria</i> (FAC), <i>Viburnum rufidulum</i> (UPL), <i>Toxicodendron radicans</i> (FAC), <i>Parthenocissus quinquefolia</i> (FACU), <i>Campsis</i>	FAC	3	11
	1802	Central Texas: Floodplain Live Oak Forest	As described for the system, but dominated by <i>Quercus fusiformis</i> (plateau live oak) or <i>Quercus virginiana</i> (coastal live oak). Deciduous species can be, and frequently are, common in the canopy, but <i>Quercus fusiformis</i> (plateau live oak) or <i>Quercus virginiana</i> (coastal live oak) clearly dominates. <i>Juniperus virginiana</i> (eastern redcedar) may also be present. <i>Quercus fusiformis</i> (NI/UPL), <i>Quercus virginiana</i> (FACU), <i>Juniperus virginiana</i> (FACU), <i>Callicarpa americana</i> (FACU), <i>Cephalanthus occidentalis</i> (OBL), <i>Ilex decidua</i> (FACW), <i>Ilex vomitoria</i> (FAC), <i>Viburnum rufidulum</i> (UPL), <i>Toxicodendron radicans</i> (FAC), <i>Partheno</i>	FACU	0.34	4
	1803	Central Texas: Floodplain Hardwood - Evergreen Forest	As described for the system with a mix of evergreen and deciduous species in the canopy, with <i>Quercus fusiformis</i> (plateau live oak) representing the most common evergreen component. <i>Juniperus virginiana</i> (FACU), <i>Quercus fusiformis</i> (NI/UPL), <i>Carya illinoensis</i> (FACU), <i>Fraxinus americana</i> (FACU), <i>Quercus nigra</i> (FAC), <i>Ulmus crassifolia</i> (FAC), <i>Celtis laevigata</i> (FACW), <i>Ulmus americana</i> (FAC), <i>Platanus occidentalis</i> (FACW), <i>Acer negundo</i> (F	FAC	3	1210

TABLE A5 – SOUTHEASTERN GREAT PLAINS FLOODPLAIN FOREST

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
Callicarpa americana (American beautyberry), Cephalanthus occidentalis (common buttonbush), Ilex decidua (possumhaw), Ilex vomitoria (yaupon), Sideroxylon lanuginosum (gum bumelia), Diospyros virginiana (common persimmon), Vaccinium arboreum (farkleberry), Juniperus virginiana (eastern redcedar), Cornus drummondii (roughleaf dogwood), and Viburnum rufidulum (rusty blackhaw), which may occur as dense patches following disturbance, but are otherwise generally fairly sparse. In the southern expressions of the system, other shrubs such as Prosopis glandulosa (honey mesquite), Acacia farnesiana (huisache), Diospyros texana (Texas persimmon), and Condalia hookeri (brasil) may be commonly encountered. Vines such as Berchemia scandens (Alabama supplejack), Campsis radicans (common trumpet creeper), Vitis spp. (grape), Parthenocissus quinquefolia (Virginia creeper), Toxicodendron radicans (poison ivy), Smilax bona-nox (saw greenbrier), and Ampelopsis arborea (peppervine) may be conspicuous. Herbaceous cover includes Elymus virginicus (Virginia wildrye), Verbesina virginica (frostweed), Chasmanthium latifolium (creek oats), Chasmanthium sessiliflorum (narrowleaf woodoats), Carex cherokeensis (Cherokee sedge), Tripsacum dactyloides (eastern gamagrass),	1804	Central Texas: Floodplain Hardwood Forest	As described for the system, but deciduous species dominating the canopy. <i>Carya illinoensis (FACU)</i>, <i>Fraxinus americana (FACU)</i>, <i>Quercus nigra (FAC)</i>, <i>Ulmus crassifolia (FAC)</i>, <i>Celtis laevigata (FACW)</i>, <i>Ulmus americana (FAC)</i>, <i>Platanus occidentalis (FACW)</i>, <i>Acer negundo (FAC)</i>, <i>Gleditsia triacanthos (FAC)</i>, <i>Quercus macrocarpa (FACU)</i>	FAC+	4.5	31
	1805	Central Texas: Floodplain Evergreen Shrubland	Shrublands of the floodplains of the region that are dominated by Juniperus spp. (juniper) occurring as shrubs, or other evergreen shrubs, such as Ilex vomitoria (yaupon) or the non-native Rosa bracteata (Macartney rose). This type may also represent young Pinus taeda (loblolly pine) stands. <i>Juniperus virginiana (FACU)</i>, <i>Ilex vomitoria (FAC)</i>, <i>Rosa bracteata (UPL)</i>, <i>Pinus taeda (FAC)</i>	FAC-	1.5	822
	1806	Central Texas: Floodplain Deciduous Shrubland	Shrublands of the floodplains of the region that are dominated by deciduous shrubs such as Ilex decidua (possumhaw), Prosopis glandulosa (honey mesquite), Salix nigra (black willow), Cornus drummondii (roughleaf dogwood), and/or Cephalanthus occidentalis (common buttonbush). This mapped type may also include areas with sparse woodlands composed of typical deciduous overstory species as described above, or sites in early succession dominated by species such as Prosopis glandulosa (honey mesquite), Acacia farnesiana (huisache), Celtis laevigata (sugar hackberry), or Triadica sebifera (Chinese tallow). <i>Ilex decidua (FACW)</i>, <i>Prosopis glandulosa (UPL)</i>, <i>Salix nigra (OBL)</i>, <i>Cornus drummondii (FAC)</i>, <i>Cephalanthus occidentalis (OBL)</i>	FACW	7.32	9

TABLE A5 – SOUTHEASTERN GREAT PLAINS FLOODPLAIN FOREST

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
Symphytotrichum drummondii var. texanum (Drummond's aster), Calyptocarpus vialis (straggler daisy), Geum canadense (white avens), Sanicula canadensis (Canada snakeroot), Ambrosia trifida (giant ragweed), Panicum virgatum (switchgrass), Galium spp. (bedstraw), Teucrium canadense (American germander), and Carex spp. (caric sedges). Wetter sites may contain species such as Zizaniopsis miliacea (marshmillet), Rhynchospora spp. (beaksedges), Eleocharis spp. (spikerushes), Nymphaea odorata (American waterlily), and Peltandra virginica (Virginia peltandra). Non-native grasses that may dominate these sites include Cynodon dactylon (bermudagrass), Bothriochloa ischaemum var. songarica (King Ranch bluestem), and Sorghum halepense (Johnsongrass).	1807	Central Texas: Floodplain Herbaceous Vegetation	Floodplains of the region that lack a significant overstory or shrub canopy, but retain cover in the herbaceous layer. Non-native grass species such as Cynodon dactylon (bermudagrass), Bothriochloa ischaemum var. songarica (King Ranch bluestem), and Sorghum halepense (Johnsongrass) may frequently dominate this vegetation type. Tripsacum dactyloides (eastern gamagrass) – Panicum virgatum (switchgrass) dominated prairies on lowlands, like those that occur at Knight Prairie and Mill Creek Bottom, may also be mapped as this vegetation type. Cynodon dactylon (FACU), Bothriochloa ischaemum var. songarica (NI/UPL), Sorghum halepense (FACU), Tripsacum dactyloides (FAC), Panicum virgatum (FAC)	FAC-	1.5	8126
Herbaceous cover may be quite high, especially in situations where shrub cover is low. The non-native trees Triadica sebifera (Chinese tallow) and Melia azedarach (chinaberry) may be present.	1824	Central Texas: Floodplain Baldcypress Swamp	In the eastern portion of the range of the system, baldcypress swamps are more commonly encountered, particularly in the eastern part of the upper Trinity River basin. These sites are dominated by Taxodium distichum (baldcypress). Some mapped occurrences may be dominated by Planera aquatica (water elm). Taxodium distichum (OBL), Planera aquatica (OBL)	OBL	9.95	5167

TABLE A6 – SOUTHEASTERN GREAT PLAINS RIPARIAN FOREST

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
Trees that may be present in stands of this system include <i>Celtis laevigata</i> (sugar hackberry), <i>Ulmus crassifolia</i> (cedar elm), <i>Platanus occidentalis</i> (American sycamore), <i>Populus deltoides</i> (eastern cottonwood), <i>Quercus fusiformis</i> (plateau live oak), <i>Quercus nigra</i> (water oak), <i>Quercus phellos</i> (willow oak), <i>Sapindus saponaria</i> var. <i>drummondii</i> (western soapberry), <i>Salix nigra</i> (black willow), <i>Fraxinus americana</i> (white ash), <i>Fraxinus pennsylvanica</i> (green ash), <i>Gleditsia triacanthos</i> (common honeylocust), <i>Prosopis glandulosa</i> (honey mesquite), and <i>Carya illinoensis</i> (pecan). To the east, <i>Quercus falcata</i> (southern red oak) and <i>Liquidambar styraciflua</i> (sweetgum) may become important components of the overstory. To the east, evergreen dominated occurrences may contain <i>Pinus taeda</i> (loblolly pine) or <i>Pinus echinata</i> (shortleaf pine), as well as <i>Juniperus virginiana</i> (eastern redcedar). The shrub layer development is variable, sometimes with species such as <i>Amorpha fruticosa</i> (indigobush), <i>Forestiera acuminata</i> (swamp privet), <i>Ilex decidua</i> (possumhaw), <i>Ilex vomitoria</i> (yaupon), <i>Sideroxylon lanuginosum</i> (gum bumelia), <i>Juniperus virginiana</i> (eastern redcedar), <i>Diospyros virginiana</i> (common persimmon), <i>Cornus drummondii</i> (roughleaf dogwood), <i>Condalia hookeri</i> (brasil), <i>Acacia farnesiana</i> (huisache), and/or <i>Viburnum rufidulum</i> (rusty blackhaw). A few sites may be shrub dominated without an overstory canopy, containing species such as <i>Forestiera acuminata</i> (swamp privet), <i>Cephalanthus occidentalis</i> (common buttonbush), <i>Acacia farnesiana</i> (huisache), or	1902	Central Texas: Riparian Live Oak Forest	As described for the system, with <i>Quercus fusiformis</i> (plateau live oak) or <i>Quercus virginiana</i> (coastal live oak) dominating the canopy. Deciduous species can be, and frequently are, common in the canopy, but <i>Q. fusiformis</i> (plateau live oak) or <i>Quercus virginiana</i> (coastal live oak) clearly dominates. <i>Juniperus virginiana</i> (eastern redcedar) may also be present. <i>Quercus fusiformis</i> (NI/UPL), <i>Quercus virginiana</i> (FACU), <i>Juniperus virginiana</i> (FACU), <i>Amorpha fruticosa</i> (FACW), <i>Forestiera acuminata</i> (OBL), <i>Ilex decidua</i> (FACW), <i>Ilex vomitoria</i> (FAC), <i>Cornus drummondii</i> (FAC), <i>Juniperus virginiana</i> (FACU), <i>Smilax bona-nox</i>	FACU	0.34	1254
	1903	Central Texas: Riparian Hardwood - Evergreen Forest	As described for the system, with a mix of evergreen species, including <i>Juniperus virginiana</i> (eastern redcedar), <i>Pinus</i> spp. (pines) (to the east), <i>Quercus fusiformis</i> (plateau live oak) and/or <i>Quercus virginiana</i> (coastal live oak) and deciduous species in the canopy. <i>Juniperus virginiana</i> (FACU), <i>Pinus taeda</i> (FAC), <i>Quercus fusiformis</i> (NI/UPL), <i>Quercus virginiana</i> (FACU), <i>Ilex vomitoria</i> (FAC)	FAC-	1.5	109
	1904	Central Texas: Riparian Hardwood Forest	As described for the system, with deciduous species dominating the canopy. <i>Celtis laevigata</i> (FACW), <i>Ulmus crassifolia</i> (FAC), <i>Platanus occidentalis</i> (FACW), <i>Populus deltoides</i> (FAC), <i>Amorpha fruticosa</i> (FACW), <i>Forestiera acuminata</i> (OBL), <i>Ilex decidua</i> (FACW), <i>Ilex vomitoria</i> (FAC), <i>Cornus drummondii</i> (FAC), <i>Juniperus virginiana</i> (FA	FAC+	4.5	98
	1906	Central Texas: Riparian Deciduous Shrubland	Shrublands in riparian sites that may be dominated by deciduous shrubs such as <i>Ilex decidua</i> (possumhaw), <i>Prosopis glandulosa</i> (honey mesquite), <i>Salix nigra</i> (black willow), <i>Cornus drummondii</i> (roughleaf dogwood), <i>Forestiera acuminata</i> (swamp privet), and/or <i>Cephalanthus occidentalis</i> (common buttonbush). This mapped type may also represent relatively sparse	FACW	7.32	8121

TABLE A6 – SOUTHEASTERN GREAT PLAINS RIPARIAN FOREST

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>Herbaceous cover is also variable, depending on overstory and shrub canopies and recent flooding history. Herbaceous species may include <i>Elymus virginicus</i> (Virginia wildrye), <i>Verbesina virginica</i> (frostweed), <i>Chasmanthium latifolium</i> (creek oats), <i>Chasmanthium sessiliflorum</i> (narrowleaf woodoats), <i>Tripsacum dactyloides</i> (eastern gamagrass), <i>Symphotrichum drummondii</i> var. <i>texanum</i> (Drummond's aster), <i>Amphiachyris dracunculoides</i> (common broomweed), <i>Ambrosia psilostachya</i> (western ragweed), <i>Geum canadense</i> (white avens), <i>Sanicula canadensis</i> (Canada snakeroot), <i>Panicum virgatum</i> (switchgrass), <i>Galium</i> spp. (bedstraw), and <i>Carex</i> spp. (caric sedges). Upland species such as <i>Schizachyrium scoparium</i> (little bluestem), <i>Nassella leucotricha</i> (Texas wintergrass), and <i>Sorghastrum nutans</i> (Indiangrass) may be common. Woody vines such as <i>Smilax bona-nox</i> (saw greenbrier), <i>Toxicodendron radicans</i> (poison ivy), <i>Ampelopsis arborea</i> (peppervine), and <i>Vitis</i> spp. (grapes) may be common. The environment and characteristics of the vegetation of this system become drier from east to west, with moister representatives (such as communities containing <i>Quercus nigra</i> (water oak)) occurring in the eastern parts of the range. Non-native grass species that may be common to dominant on these sites include <i>Arundo donax</i> (giant reed) and <i>Cynodon dactylon</i> (bermudagrass) and <i>Sorghum halepense</i> (Johnsongrass). The non-native species, such as <i>Ligustrum</i> spp. (privets) and <i>Triadica sebifera</i> (Chinese tallow), may be commonly encountered.</p>			woodlands dominated by overstory species typical of the system. <i>Ilex decidua</i> (FACW), <i>Prosopis glandulosa</i> (UPL), <i>Salix nigra</i> (OBL), <i>Cornus drummondii</i> (FAC), <i>Cephalantus occidentalis</i> (OBL)			
	1907	Central Texas: Riparian Herbaceous Vegetation	Riparian sites lacking overstory or shrub canopy but retaining herbaceous cover. Some sites may be dominated by species such as <i>Schizachyrium scoparium</i> (little bluestem) or <i>Sorghastrum nutans</i> (Indiangrass), that are more commonly encountered in surrounding uplands. Other sites may be dominated by the non-natives like <i>Arundo donax</i> (giant reed), <i>Bothriochloa ischaemum</i> var. <i>songarica</i> (King Ranch bluestem), or <i>Cynodon dactylon</i> (bermudagrass). <i>Schizachyrium scoparium</i> (FACU), <i>Sorghastrum nutans</i> (FACU), <i>Arundo donax</i> (FAC), <i>Bothriochloa ischaemum</i> var. <i>songarica</i> (NI/UPL), <i>Cynodon dactylon</i> (FACU)	FACU	0.34	259

TABLE A7 – TEXAS COAST SALT AND BRACKISH TIDAL MARSH

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>These marshes occupy relatively low-lying, coastal situations on level landforms influenced by tidal fluctuations. Some sites are only influenced by storm tides, or tides resulting from extreme wind events. The composition of these marshes is primarily influenced by the frequency and duration of tidal inundation. Salinity on some marshes, particularly in the south, is maintained by salt spray from prevailing southeasterly winds. Low marshes are regularly flooded and representative examples are dominated by <i>Spartina alterniflora</i> (smooth cordgrass), <i>Juncus roemerianus</i> (blackrush), or <i>Avicennia germinans</i> (black mangrove). Significant areas of <i>Avicennia germinans</i> (black mangrove) become more frequent towards the south, while extensive areas of <i>Spartina alterniflora</i> (smooth cordgrass) become rare south of Corpus Christi Bay. Areas of decreased frequency and/or duration of tidal inundation are often referred to as high, or irregularly flooded, marsh. These marshes may be dominated by species such as <i>Spartina patens</i> (marshhay cordgrass), <i>Distichlis spicata</i> (saltgrass), <i>Schoenoplectus robustus</i> (sturdy bulrush), <i>Schoenoplectus americanus</i> (three-square bulrush), <i>Sporobolus virginicus</i> (seashore dropseed), <i>Monanthochloe littoralis</i> (shoregrass), and <i>Spartina spartinae</i> (Gulf cordgrass). Shrubs, subshrubs, and forbs, such as <i>Batis maritima</i> (saltwort), <i>Borrichia frutescens</i> (sea ox-eye daisy), <i>Sesuvium portulacastrum</i> (shoreline seapurslane), <i>Salicornia</i> spp. (glassworts), <i>Suaeda linearis</i> (annual seepweed), <i>Limonium</i> spp. (sea-lavenders), and <i>Lycium carolinianum</i> (Carolina wolfberry) are commonly encountered in these marshes. Some irregularly flooded sites may become shrub-dominated with species such as <i>Iva frutescens</i> (shrubby sumpweed) or <i>Baccharis halimifolia</i> (eastern baccharis). In the south, extensive areas are dominated by <i>Borrichia frutescens</i> (sea ox-eye daisy) and these often occur at very slightly lower elevations and higher salinities than nearby <i>Spartina spartinae</i> (Gulf cordgrass) salty prairie. These <i>Borrichia</i> flats may be very infrequently flooded, perhaps only under extreme storm tide conditions. Other species that may be encountered in these situations include <i>Maytenus phyllanthoides</i> (guttapercha), <i>Prosopis reptans</i> (tornillo), <i>Monanthochloe littoralis</i> (shoregrass), <i>Distichlis spicata</i> (saltgrass), and <i>Batis maritima</i> (saltwort). The aspect dominant on these sites is clearly <i>Borrichia frutescens</i> (sea ox-eye daisy).</p>	5600	Coastal: Tidal Flat	Unvegetated or very sparsely vegetated flats affected by tidal fluctuations. Unvegetated flats	OBL	9.95	834
	5605	Coastal: Sea Ox-eye Daisy Flats	<i>Borrichia frutescens</i> (sea ox-eye daisy) is the clear aspect dominant of these irregularly flooded sites. These flats become very extensive from Corpus Christi Bay, southward. <i>Borrichia frutescens</i> (OBL), <i>Spartina alterniflora</i> (OBL), <i>Juncus roemerianus</i> (OBL), <i>Avicennia germinans</i> (OBL)	OBL	9.95	35
	5607	Coastal: Salt and Brackish Low Tidal Marsh	Marshes frequently inundated by tides and often dominated by <i>Spartina alterniflora</i> (smooth cordgrass). <i>Spartina patens</i> (FACW), <i>Distichlis spicata</i> (OBL), <i>Schoenoplectus</i> spp. (OBL), <i>Spartina alterniflora</i> (OBL), <i>Juncus roemerianus</i> (OBL), <i>Avicennia germinans</i> (OBL)	OBL	9.95	2225
	5616	Coastal: Salt and Brackish High Tidal Shrub Wetland	These sites may be dominated by species such as <i>Iva frutescens</i> (shrubby sumpweed) or <i>Baccharis halimifolia</i> (eastern baccharis). <i>Iva frutescens</i> (FACW), <i>Baccharis halimifolia</i> (FAC), <i>Spartina alterniflora</i> (OBL), <i>Juncus roemerianus</i> (OBL), <i>Avicennia germinans</i> (OBL)	OBL	9.95	484
	5617	Coastal: Salt and Brackish High Tidal Marsh	Irregularly flooded marsh dominated by graminoids such as <i>Spartina patens</i> (marshhay cordgrass), <i>Distichlis spicata</i> (saltgrass), and <i>Schoenoplectus</i> spp. (bulrushes). <i>Spartina patens</i> (FACW), <i>Distichlis spicata</i> (OBL), <i>Schoenoplectus</i> spp. (OBL)	OBL	9.95	4832

TABLE A9 – COLUMBIA BOTTOMLANDS FOREST AND WOODLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
This system occurs on Quaternary alluvium and adjacent Pleistocene terraces (Beaumont and Lissie Formations) along the Brazos, San Bernard, and Colorado Rivers (as they pass through these Pleistocene formations), and adjacent streams such as Oyster Creek, Caney Creek, and Linnville Bayou. Chocolate Bayou represents the eastern extent of this system as the forest grades into systems more closely resembling the West Gulf Coastal Plain Small Stream and River Forest system to the northeast. Tres Palacios Creek represents the southwestern limit of this system, as floodplains further south and west share closer affinity to coastal rivers such as the Mission and Aransas. This system occupies a generally level landscape, punctuated by a series of swales, depressions, and natural levees. Much of the flooding experienced by this system results from seasonal precipitation and tropical storms, not from over-bank flooding. Over-bank flooding is infrequent, occurring about every 15 to 25 years (M. Lange, Pers. Comm.). Soils are frequently clayey bottomlands (such as Pledger or Brazoria clays) or loamy bottomlands (such as those of the Asa or Norwood series). This system expresses a range of communities along a moisture gradient ranging from the wettest sites along stream margins and depressions, to somewhat drier sites on ridges and natural levees. Herbaceous communities and open water typically characterize the wettest sites, with species such as Eleocharis quadrangulata (squarestem spikesedge), Sagittaria graminea (grassy arrowhead),	4702	Columbia Bottomlands: Live Oak Forest and Woodland	This type typically occupies slightly drier sites on levees and ridges and is dominated by <i>Quercus virginiana</i> (coastal live oak). This is the region of transition between <i>Quercus virginiana</i> (coastal live oak) and <i>Quercus fusiformis</i> (plateau live oak). We refer to live oaks in this section of the coast as <i>Quercus virginiana</i> (coastal live oak), though the true taxon, or taxa, is not known. <i>Quercus virginiana</i> (FACU), <i>Quercus fusiformis</i> (NI/UPL)	FACU	0.34	120
	4703	Columbia Bottomlands: Mixed Evergreen - Hardwood Forest and Woodland	Forest and woodland with the canopy shared between <i>Quercus virginiana</i> (coastal live oak) and hardwood species described for the system. <i>Quercus virginiana</i> (FACU), <i>Carya illinoensis</i> (FACU), <i>Quercus nigra</i> (FAC), <i>Celtis laevigata</i> (FACW), <i>Ulmus crassifolia</i> (FAC), <i>Fraxinus pennsylvanica</i> (FACW), <i>Ilex vomitoria</i> (FAC), <i>Sabal minor</i> (FACW), <i>Cornus drummondii</i> (FAC), <i>Chasmanthium sessiliflorum</i> (F)	FAC+	4.5	211
	4704	Columbia Bottomlands: Hardwood Forest and Woodland	About 47% of the system is represented by this forest and woodland characterized by a deciduous canopy of species described for the system. <i>Quercus virginiana</i> (FACU), <i>Carya illinoensis</i> (FACU), <i>Quercus nigra</i> (FAC), <i>Celtis laevigata</i> (FACW), <i>Ulmus crassifolia</i> (FAC), <i>Fraxinus pennsylvanica</i> (FACW), <i>Ilex vomitoria</i> (FAC), <i>Sabal minor</i> (FACW), <i>Cornus drummondii</i> (FAC), <i>Chasmanthium sessiliflorum</i> (F)	FAC+	4.5	3137
	4705	Columbia Bottomlands: Evergreen Shrubland	Shrublands or sparse woodlands with a well-developed shrub layer with species such as <i>Ilex vomitoria</i> (yaupon), <i>Sabal minor</i> (dwarf palmetto), <i>Quercus virginiana</i> (coastal live oak), <i>Rosa bracteata</i> (Macartney rose), or <i>Baccharis</i> spp. (baccharis). These shrublands are often the result of disturbance. <i>Ilex vomitoria</i> (FAC), <i>Sabal minor</i> (FACW), <i>Quercus virginiana</i> (FACU), <i>Rosa bracteata</i> (UPL), <i>Baccharis</i> spp. (FAC/FACW), <i>Triadica sebifera</i> (FAC), <i>Celtis laevigata</i> (FACW), <i>Salix nigra</i> (OBL)	FAC+	4.5	187

TABLE A9 – COLUMBIA BOTTOMLANDS FOREST AND WOODLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
Sagittaria platyphylla (delta arrowhead), Ludwigia spp. (water-primroses), Saururus cernuus (lizard’s tail), Azolla caroliniana (Carolina mosquito-fern), and Lemna obscura (little duckweed). Such very wet sites may have Taxodium distichum (baldcypress) and Salix nigra (black willow) in the overstory, or may be shrub swamps dominated by Cephalanthus occidentalis (common buttonbush) and/or Forestiera acuminata (swamp privet). Sites inundated somewhat less frequently, such as meander scars, abandoned oxbows, and channels, are often dominated in the overstory by species including Fraxinus pennsylvanica (green ash), Ulmus americana (American elm), and Carya aquatica (water hickory), while the woody understory of these sites are typically open and may be dominated by Cephalanthus occidentalis (common buttonbush) and/or Forestiera acuminata (swamp privet). Rarely, Leitneria floridana (corkwood) may be a conspicuous component of the shrub layer. Herbaceous cover is often patchy and can include species such as Phanopyrum gymnocarpon (savannah panicum), Echinodorus cordifolius (heartleaf burhead), Carex spp. (carices), Rhynchospora corniculata (horned beakrush), Saururus cernuus (lizard’s tail), Polygonum punctatum (water smartweed), Hygrophila lacustris (Gulf swampweed), Boehmeria cylindrica (false nettle), Mikania scandens (climbing hempweed), and Lemna obscura (little duckweed). Flats and ridges that are only occasionally flooded are often dominated by Celtis	4706	Columbia Bottomlands: Deciduous Shrubland	Shrub dominated sites that may have a sparse woody overstory with species in the shrub layer such as Cephalanthus occidentalis (common buttonbush), Salix nigra (black willow), Forestiera acuminata (swamp privet), and/or Cornus drummondii (roughleaf dogwood). Triadica sebifera (Chinese tallow) may be a conspicuous component of these shrublands, which often result from disturbance. Cephalanthus occidentalis (OBL), Salix nigra (OBL), Forestiera acuminata (OBL), Cornus drummondii (FAC),	OBL	9.95	10
	4707	Columbia Bottomlands: Grassland	These are herbaceous dominated sites occupying bottomland soils and lacking significant shrub or overstory canopy cover. They are mostly managed grasslands dominated by grasses such as Cynodon dactylon (bermudagrass), Paspalum notatum (bahiagrass), and Lolium perenne (Italian ryegrass). Cynodon dactylon (FACU), Paspalum notatum (FACU), Lolium perenne (FACU)	FACU	0.34	2071
	4717	Columbia Bottomlands: Herbaceous Wetland	Wetlands dominated by herbaceous species such as Carex crus-corvi (crowfoot sedge), other Carex spp. (carices), Eleocharis quadrangulata (squarestem spikesedge), Rhynchospora spp. (beaksedges), Juncus spp. (rushes), Sagittaria spp. (arrowheads), Saururus cernuus (lizard’s tail), Echinodorus cordifolius (heartleaf burhead), Typha spp. (cattails), and/or Polygonum spp. (smartweeds). Carex crus-corvi (OBL), Carex spp. (OBL/FACW), Eleocharis quadrangulata (OBL), Rhynchospora spp. (OBL/FACW), Juncus spp. (OBL/FACW), Sagittaria spp. (OBL), Saururus cernuus (OBL), Echinodorus cordifolius (OBL), Typha spp. (OBL), Persicaria spp.	OBL	9.95	78

TABLE A9 – COLUMBIA BOTTOMLANDS FOREST AND WOODLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>laevigata (sugar hackberry), Ulmus crassifolia (cedar elm), Quercus nigra (water oak), and Quercus shumardii (Shumard oak). Shrubs on these sites include Ilex vomitoria (yaupon), Sapindus saponaria var. drummondii (western soapberry), Malvaviscus arboreus var. drummondii (Drummond Turk's cap), Symphoricarpos orbiculatus (coralberry), and Callicarpa americana (American beautyberry). Sabal minor (dwarf palmetto) and Carex cherokeensis (Cherokee sedge) are more abundant on these sites, and other species such as Toxicodendron radicans (poison ivy), Chasmanthium sessiliflorum (narrowleaf woodoats), Chasmanthium latifolium (creek oats), Calyptocarpus vialis (straggler daisy), Oplismenus hirtellus ssp. setarius (basketgrass), and Polygonum virginianum (jump seed) may be present. Clay backflats in this landscape may be dominated by Quercus virginiana (coastal live oak) and Carya illinoensis (pecan), and Quercus virginiana (coastal live oak) may also share dominance with other canopy species on natural levees of these river systems. Blackland soils on the Pleistocene surface (such as those of the Lake Charles series) are often occupied by a forest dominated or co-dominated by Quercus nigra (water oak), Celtis laevigata (sugar hackberry), Ulmus crassifolia (cedar elm), Fraxinus pennsylvanica (green ash), and less frequently Quercus virginiana (coastal live oak). The shrub layer on these sites is often well-developed and typically dominated by Ilex vomitoria (yaupon), sometimes with Sabal minor (dwarf palmetto), Cornus drummondii (roughleaf dogwood), and Prunus caroliniana (Carolina</p>	4712	<p>Columbia Bottomlands: Riparian Live Oak Forest and Woodland</p>	<p>Forests or woodlands along drainages outside of bottomland soils, but within the Columbia Bottomlands landscape, where the canopy is dominated by Quercus virginiana (coastal live oak). Quercus virginiana (FACU), Quercus fusiformis (NI/UPL)</p>	FACU	0.34	3

TABLE A9 – COLUMBIA BOTTOMLANDS FOREST AND WOODLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>laurelcherry) also present. Vines are commonly encountered including species such as <i>Vitis mustangensis</i> (mustang grape), <i>Toxicodendron radicans</i> (poison ivy), <i>Ampelopsis arborea</i> (peppervine), and <i>Berchemia scandens</i> (Alabama supplejack). <i>Chasmanthium sessiliflorum</i> (narrowleaf woodoats), <i>Carex cherokeensis</i> (Cherokee sedge), <i>Carex crus-corvi</i> (crowfoot sedge), <i>Urochloa platyphylla</i> (broadleaf signalgrass), and <i>Juncus</i> spp. (rushes) and numerous other species are commonly found in the herbaceous layer. It is unclear whether these typically prairie dominated surfaces are now occupied by woodland and forest due to a disruption in natural fire cycle and disturbance, or whether the unique hydrology or other environmental factors of the Columbia Bottomlands leads to this incongruity. <i>Tillandsia usneoides</i> (Spanish moss) is a frequently encountered epiphyte in these forests. Riverside woodlands, along major rivers, have <i>Platanus occidentalis</i> (American sycamore) and <i>Populus deltoides</i> (eastern cottonwood) in the canopy (David Rosen, Pers. Comm.). The non-native tree <i>Triadica sebifera</i> (Chinese tallow) may often be encountered, sometimes as a significant or dominant component of the canopy.</p>						
<p>See above</p>	4713	<p>Columbia Bottomlands: Riparian Mixed Evergreen - Hardwood Forest and Woodland</p>	<p>Forests or woodlands along drainages outside of bottomland soils, but within the Columbia Bottomlands landscape, where the canopy is co-dominated by <i>Quercus virginiana</i> (coastal live oak) and deciduous species. <i>Quercus virginiana</i> (FACU), <i>Carya illinoensis</i> (FACU), <i>Quercus nigra</i> (FAC), <i>Celtis laevigata</i> (FACW), <i>Ulmus crassifolia</i> (FAC), <i>Fraxinus pennsylvanica</i> (FACW), <i>Ilex vomitoria</i> (FAC), <i>Sabal minor</i> (FACW), <i>Cornus drummondii</i> (FAC), <i>Chasmanthium sessiliflorum</i> (FAC)</p>	FAC	3	35

TABLE A9 – COLUMBIA BOTTOMLANDS FOREST AND WOODLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
See above	4714	Columbia Bottomlands: Riparian Hardwood Forest and Woodland	Forests and woodlands with a deciduous canopy that occupy sites along drainages but outside of bottomland soils. <i>Quercus virginiana</i> (FACU), <i>Carya illinoensis</i> (FACU), <i>Quercus nigra</i> (FAC), <i>Celtis laevigata</i> (FACW), <i>Ulmus crassifolia</i> (FAC), <i>Fraxinus pennsylvanica</i> (FACW), <i>Ilex vomitoria</i> (FAC), <i>Sabal minor</i> (FACW), <i>Cornus drummondii</i> (FAC), <i>Chasmanthium sessiliflorum</i> (F)	FAC	3	105
	4715	Columbia Bottomlands: Riparian Evergreen Shrubland	Evergreen shrublands, often resulting from disturbance, that occupy sites along drainages but outside of bottomland soils. Species such as <i>Baccharis</i> spp. (<i>baccharis</i>), <i>Rosa bracteata</i> (<i>Macartney rose</i>), <i>Ilex vomitoria</i> (<i>yaupon</i>), or small <i>Quercus virginiana</i> (<i>coastal live oak</i>) sometimes dominate this type. Some sites dominated by <i>Triadica sebifera</i> (<i>Chinese tallow</i>) may be mapped as this type. <i>Baccharis</i> spp. (FAC/FACW), <i>Rosa bracteata</i> (UPL), <i>Ilex vomitoria</i> (FAC), <i>Quercus virginiana</i> (FACU)	FAC-	1.5	17
	4716	Columbia Bottomlands: Riparian Deciduous Shrubland	Shrublands dominated by deciduous species along drainages that are outside of bottomland soils and are often the result of disturbance. Species such as <i>Sapindus saponaria</i> var. <i>drummondii</i> (<i>western soapberry</i>), <i>Cephalanthus occidentalis</i> (<i>common buttonbush</i>), <i>Cornus drummondii</i> (<i>roughleaf dogwood</i>), or <i>Sesbania drummondii</i> (<i>rattlebox sesbania</i>) may be dominant. Disturbed sites may be dominated by <i>Prosopis glandulosa</i> (<i>honey mesquite</i>), <i>Acacia farnesiana</i> (<i>huisache</i>), or <i>Triadica sebifera</i> (<i>Chinese tallow</i>). <i>Sapindus saponaria</i> var. <i>drummondii</i> (FACU), <i>Cephalanthus occidentalis</i> (OBL), <i>Cornus drummondii</i> (FAC), <i>Sesbania drummondii</i> (FACW)	FAC+	4.5	1601

TABLE A9 – COLUMBIA BOTTOMLANDS FOREST AND WOODLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
	4724	Columbia Bottomlands: Baldcypress Swamp	<i>Taxodium distichum (OBL)</i> , <i>Planera aquatica (OBL)</i>	OBL	9.95	1048
	4727	Columbia Bottomlands: Riparian Grassland	These are typically managed grasslands on upland drainages. Most are dominated by non-native species such as <i>Bothriochloa ischaemum</i> var. <i>songarica</i> (King Ranch bluestem), <i>Cynodon dactylon</i> (bermudagrass), <i>Paspalum notatum</i> (bahiagrass), and <i>Lolium perenne</i> (Egyptian ryegrass). <i>Bothriochloa ischaemum</i> var. <i>songarica (NI/UPL)</i> , <i>Cynodon dactylon (FACU)</i> , <i>Paspalum notatum (FACU)</i> , <i>Lolium perenne (FACU)</i>	FACU	0.34	9
	4737	Columbia Bottomlands: Riparian Herbaceous Wetland	Herbaceous wetlands along upland drainages outside of bottomland soils. These wetlands are often dominated by sedges, rushes, and forbs such as <i>Polygonum</i> spp. (smartweeds). <i>Carex crus-corvi (OBL)</i> , <i>Carex</i> spp. (OBL/FACW), <i>Eleocharis quadrangulata (OBL)</i> , <i>Rhynchospora</i> spp. (OBL/FACW), <i>Juncus</i> spp. (OBL/FACW), <i>Sagittaria</i> spp. (OBL), <i>Saururus cernuus (OBL)</i> , <i>Echinodorus cordifolius (OBL)</i> , <i>Typha</i> spp. (OBL), <i>Persicaria</i> spp.	OBL	9.95	46

TABLE A10 – TEXAS-LOUISIANA COASTAL PRAIRIE

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>This mid- to tallgrass prairie occupies Pleistocene surfaces of the Texas and Louisiana coast, on non-saline soils of level to gently rolling topography. It is dominated by graminoid species, such as <i>Schizachyrium scoparium</i> (little bluestem), <i>Sorghastrum nutans</i> (Indiangrass), <i>Paspalum plicatulum</i> (brownseed paspalum), <i>Panicum virgatum</i> (switchgrass), <i>Andropogon gerardii</i> (big bluestem), <i>Sporobolus compositus</i> (tall dropseed), <i>Paspalum setaceum</i> (thin paspalum), <i>Fimbristylis puberula</i> (hairy fimbry), <i>Dichanthelium oligosanthes</i> (fewflower panicgrass), <i>Rhynchospora</i> spp. (beaksedges), <i>Paspalum floridanum</i> (Florida paspalum), <i>Muhlenbergia capillaris</i> (Gulf muhly), <i>Tridens strictus</i> (longspike tridens), <i>Bouteloua curtipendula</i> (sideoats grama), <i>Andropogon glomeratus</i> (bushy bluestem), and <i>Tripsacum dactyloides</i> (eastern gamagrass). <i>Axonopus</i> spp. (carpetgrasses), <i>Sporobolus indicus</i> (rat-tail smutgrass), <i>Andropogon virginicus</i> (broomsedge bluestem), <i>Bothriochloa laguroides</i> ssp. <i>torreyana</i> (silver bluestem), and <i>Nassella leucotricha</i> (Texas wintergrass) may be particularly noticeable on over-grazed sites. Non-native graminoids that may be conspicuous to dominant components include <i>Cynodon dactylon</i> (bermudagrass), <i>Cyperus entrerianus</i> (deep-rooted sedge), <i>Bothriochloa ischaemum</i> var. <i>songarica</i> (King Ranch bluestem), <i>Dichanthium</i> spp. (old world bluestems), <i>Lolium perenne</i> (Italian ryegrass), <i>Schedonorus phoenix</i> (tall fescue), <i>Paspalum notatum</i> (bahiagrass), and <i>Paspalum dilatatum</i> (dallisgrass). Forbs that may often be encountered include <i>Liatris</i> spp. (gayfeathers), <i>Sabatia campestris</i> (meadow pink), <i>Ambrosia psilostachya</i> (western ragweed), <i>Euphorbia bicolor</i> (snow-on-the-prairie), <i>Solidago</i> spp. (goldenrods), <i>Rudbeckia hirta</i> (blackeyed Susan), <i>Ruellia humilis</i> (low wild petunia), <i>Asclepias viridis</i> (green milkweed), <i>Chamaecrista fasciculata</i> (partridge pea), <i>Helianthus angustifolius</i> (narrowleaf sunflower), <i>Euthamia</i> spp. (goldentops), <i>Ratibida columnifera</i> (Mexican hat), <i>Symphotrichum ericoides</i> (heath aster), <i>Silphium laciniatum</i> (compassplant), <i>Baptisia</i> spp. (wild indigos), <i>Iva angustifolia</i> (narrowleaf sumpweed), <i>Eryngium yuccifolium</i> (button snakeroot), <i>Boltonia diffusa</i> (smallhead doll's daisy), and <i>Neptunia lutea</i> (yellow neptunia). Woody species may invade this typically herbaceous vegetation, including <i>Rosa bracteata</i> (Macartney rose), <i>Acacia farnesiana</i> (huisache), <i>Triadica sebifera</i> (Chinese tallow), <i>Baccharis halimifolia</i> (baccharis), <i>Celtis laevigata</i> (sugar hackberry), and <i>Prosopis glandulosa</i> (honey mesquite).</p>	5207	Gulf Coast: Coastal Prairie	As described for system. <i>Schizachyrium scoparium</i> (FACU), <i>Sorghastrum nutans</i> (FACU), <i>Bouteloua curtipendula</i> (NI/UPL), <i>Andropogon gerardii</i> (FAC), <i>Nassella leucotricha</i> (NI/UPL)	FACU	0.34	695

TABLE A11 – TEXAS-LOUISIANA COASTAL PRAIRIE PONDSHORE

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>coastal prairie matrix. Soils are poorly-drained, and surface water from rainfall and local runoff is retained for much of the year (except for periods of high evapotranspiration). Occurrences are wetter than the <i>Tripsacum dactyloides</i> (eastern gamagrass) or <i>Panicum virgatum</i> (switchgrass) dominated prairie sites of the Texas-Louisiana Coastal Prairie. These wetlands are primarily herbaceous, sometimes with sparse woody cover, and are composed of various species, such as <i>Eleocharis quadrangulata</i> (squarestem spikedge), <i>Fuirena squarrosa</i> (hairy umbrellasedge), <i>Cyperus haspan</i> (sheathed umbrellasedge), <i>Cyperus virens</i> (green flatsedge), <i>Rhynchospora</i> spp. (beaksedges), <i>Leersia hexandra</i> (clubhead cutgrass), <i>Steinchisma hians</i> (gaping panicum), <i>Panicum virgatum</i> (switchgrass), <i>Andropogon glomeratus</i> (bushy bluestem), <i>Xyris jupicai</i> (Richard’s yellow-eyed grass), <i>Centella erecta</i> (erect centella), <i>Sagittaria papillosa</i> (nipplebract arrowhead), <i>Sagittaria longiloba</i> (longlobe arrowhead), <i>Ludwigia glandulosa</i> (Torrey water-primrose), <i>Ludwigia linearis</i> (narrowleaf water-primrose), <i>Bacopa</i> spp. (waterhyssops), <i>Hydrocotyle</i> spp. (pennyworts), <i>Symphyotrichum subulatum</i> (hierba del marrano), and <i>Sesbania</i> spp. (rattleboxes). Large areas of some of the occurrences may be relatively homogeneous, dominated by one or a few species. Areas of open water within the ponds may contain floating and submerged aquatic species, including <i>Stuckenia pectinata</i> (sago pondweed), <i>Ceratophyllum demersum</i> (coontail), <i>Brasenia schreberi</i> Schreber watershield), <i>Nymphoides aquatica</i> (largeleaf floating heart), and <i>Nelumbo lutea</i> (yellow lotus).</p>	5307	Gulf Coast: Coastal Prairie Pondshore	As described for the system. <i>Eleocharis quadrangulata</i> (OBL), <i>Fuirena squarrosa</i> (OBL), <i>Cyperus haspan</i> (OBL), <i>Cyperus virens</i> (FACW), <i>Andropogon glomeratus</i> (FACW)	OBL	9.95	103

TABLE A11 – TEXAS SALINE COASTAL PRAIRIE

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
This system occupies saline soils, generally near-coast, on level topography of the Beaumont Formation. Sites may be nearly monotypic stands of <i>Spartina spartinae</i> (Gulf cordgrass). Other gramimoids that may be present to abundant include <i>Schizachyrium scoparium</i> (little bluestem), <i>Andropogon glomeratus</i> (bushy bluestem), <i>Panicum virgatum</i> (switchgrass), <i>Muhlenbergia capillaris</i> (Gulf muhly), or <i>Sporobolus indicus</i> (rat-tail smutgrass). <i>Spartina patens</i> (marshhay cordgrass), <i>Aristida oligantha</i> (oldfield threeawn), <i>Paspalum hartwegianum</i> (Hartweg paspalum), <i>Sporobolus virginicus</i> (seashore dropseed), <i>Paspalum vaginatum</i> (seashore paspalum), and <i>Distichlis spicata</i> (saltgrass) may be common, particularly on lower, somewhat wetter sites. Forbs are generally uncommon, but may include species such as <i>Borrichia frutescens</i> (sea ox-eye daisy), <i>Solidago sempervirens</i> (seaside goldenrod), <i>Iva angustifolia</i> (narrowleaf sumpweed), <i>Euthamia</i> spp. (goldentops), or other species more common to the non-saline soils nearby, or the salt marsh that may also be nearby. Microtopographic highs in the form of pimple mounds often have species more characteristic of less saline adjacent habitats. Shrubby species may invade the prairie, commonly including species such as <i>Iva frutescens</i> (shrubby sumpweed), <i>Prosopis glandulosa</i> (honey mesquite), <i>Acacia farnesiana</i> (huisache), <i>Lycium carolinianum</i> (Carolina wolfberry), <i>Tamarix</i> spp. (salt cedar), and <i>Baccharis halimifolia</i> (baccharis).	2207	Gulf Coast: Salty Prairie	Occurrences of the system lacking significant shrub cover. <i>Spartina spartinae</i> (OBL), <i>Schizachyrium scoparium</i> (FACU), <i>Andropogon glomeratus</i> (FACW), <i>Panicum virgatum</i> (FAC), <i>Muhlenbergia capillaris</i> (FAC), <i>Sporobolus indicus</i> (FACU)	FACW	7.32	1836
	2206	Gulf Coast: Salty Prairie Shrubland	Occurrences of the system where shrubs, such as those listed above, have dominated the site. <i>Prosopis glandulosa</i> (UPL), <i>Chloracantha spinosa</i> (FACW), <i>Isocoma drummondii</i> (NI/UPL), <i>Borrichia frutescens</i> (OBL)	FAC+	4.5	48

TABLE A12 – WEST GULF COASTAL PLAIN PINE-HARDWOOD FOREST

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>This upland system forms the matrix over much of the West Gulf Coastal Plain. This is particularly the case outside of the range of <i>Pinus palustris</i> (longleaf pine). Within the range of <i>Pinus palustris</i> (longleaf pine), the historical matrix was often dominated by that species and should be mapped as West Gulf Coastal Plain Upland Longleaf Pine Forest and Woodland (CES203.293). However, given the current patchy distribution of <i>Pinus palustris</i> (longleaf pine), the prevalence of plantings of <i>Pinus taeda</i> (loblolly pine) and <i>Pinus elliottii</i> (slash pine), and the difficulty in identifying the system on the basis of remote-sensing data, we chose to include occurrences of this more restricted system within the West Gulf Coastal Plain Pine-Hardwood Forest. The system occupies a range of topographic and edaphic conditions, replaced by other systems in areas where unique abiotic conditions result in occurrences of other, more restricted, systems. Typical pines that dominate these sites are <i>Pinus taeda</i> (loblolly pine) and <i>Pinus echinata</i> (shortleaf pine), though <i>Pinus palustris</i> (longleaf pine) may also be present to dominant, within its range. Historically, <i>Pinus echinata</i> (shortleaf pine) dominated drier sites, especially to the north. <i>Pinus taeda</i> (loblolly pine) was less dominant than in the current landscape, and occupied less dry sites and became more conspicuous to the south. Seventy-five percent or more of the canopy of some occurrences may be occupied by pines, often <i>Pinus taeda</i> (loblolly pine). Typical deciduous hardwoods conspicuous in this system include <i>Liquidambar styraciflua</i> (sweetgum), <i>Carya texana</i> (black hickory), <i>Quercus stellata</i> (post oak), <i>Quercus falcata</i> (southern red oak), <i>Quercus alba</i> (white oak), <i>Quercus nigra</i> (water oak), <i>Ulmus alata</i> (winged elm), <i>Ulmus crassifolia</i> (cedar elm), and <i>Nyssa sylvatica</i> (blackgum). Some sites may be primarily deciduous, with 75% or more of the canopy cover occupied by hardwoods. <i>Ilex vomitoria</i> (yaupon), saplings and seedlings of overstory species, <i>Callicarpa americana</i> (American beautyberry), <i>Morella cerifera</i> (wax-myrtle), <i>Vaccinium arboreum</i> (farkleberry), and <i>Cornus florida</i> (flowering dogwood) commonly occupy the shrub layer, which may be well-developed, with understory canopy cover to 40% or more. Woody vines in this system may be conspicuous and often include <i>Smilax bona-nox</i> (saw greenbrier), <i>Vitis</i> spp. (grape, often <i>Vitis rotundifolia</i> (muscadine grape)), <i>Parthenocissus quinquefolia</i> (Virginia creeper), and <i>Toxicodendron radicans</i> (poison ivy). The herbaceous layer is generally sparse (often < 20% cover), with <i>Schizachyrium scoparium</i> (little bluestem), <i>Chasmanthium laxum</i> (slender woodoats), <i>Chasmanthium sessiliflorum</i> (narrowleaf woodoats), and <i>Pteridium aquilinum</i> (brackenfern) often present to dominant. Forests with dense tree cover (especially evergreen cover), have reduced shrub and herbaceous cover. Herbaceous cover may be additionally limited by dense litter accumulation. Few occurrences of this system can be considered old growth.</p>	3001	Pineywoods: Pine Forest or Plantation	<p>This represents the typical type for the system where the canopy is dominated by pines. Many sites actually represent pine plantations and managed forests, and discriminating between natural pine forest and plantation is problematic using our mapping methods. More than half of the area mapped for this system is represented by this vegetation type, and <i>Pinus taeda</i> (loblolly pine) predominates. <i>Pinus taeda</i> (FAC)</p>	FAC	3	106

TABLE A13 – EAST-CENTRAL TEXAS PLAINS POST OAK SAVANNA AND WOODLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>This system represents a transition from the woodlands and forests of East Texas to the prairies to the west, specifically the Blackland Prairie. Savannas and woodlands are typically dominated by <i>Quercus stellata</i> (post oak), <i>Quercus marilandica</i> (blackjack oak), and <i>Carya texana</i> (black hickory). Large areas of woodland, particularly in the south and east, are dominated or co-dominated by <i>Quercus fusiformis</i> (plateau live oak) or <i>Quercus virginiana</i> (coastal live oak, east of the Brazos River). Other species, such as <i>Quercus incana</i> (bluejack oak) (on more xeric sites), <i>Ulmus alata</i> (winged elm), <i>Ulmus crassifolia</i> (cedar elm), <i>Quercus nigra</i> (water oak), <i>Juniperus virginiana</i> (eastern redcedar), <i>Celtis laevigata</i> (sugar hackberry), and <i>Prosopis glandulosa</i> (mesquite), can also be present in the overstory. To the east, <i>Quercus falcata</i> (southern red oak), <i>Quercus nigra</i> (water oak), <i>Liquidambar styraciflua</i> (sweetgum), <i>Pinus echinata</i> (shortleaf pine), <i>Pinus taeda</i> (loblolly pine), and <i>Carya alba</i> (mockernut hickory) may be conspicuous in the overstory. Shrubs may attain significant cover in the understory, with species including <i>Ilex vomitoria</i> (yaupon) (often dominant), <i>Callicarpa americana</i> (American beautyberry), <i>Sideroxylon lanuginosum</i> (gum bumelia), <i>Crataegus</i> spp. (hawthorn), <i>Ilex decidua</i> (possumhaw), <i>Toxicodendron radicans</i> (poison ivy), <i>Smilax bona-nox</i> (saw greenbrier), <i>Juniperus virginiana</i> (eastern redcedar), and <i>Symphoricarpos orbiculatus</i> (coral-berry). To the south, this system grades into vegetation more characteristic of south Texas, with</p>	602	Post Oak Savanna: Live Oak Motte and Woodland	<p><i>Quercus fusiformis</i> (plateau live oak) or <i>Quercus virginiana</i> (coastal live oak) may dominate sites within the Post Oak Savanna. <i>Quercus stellata</i> (post oak) may be present in these woodlands, but typically only as a minor component of the canopy, or it may be completely absent. These occurrences become more common and may occupy large areas in the southeastern part of this region, but occur elsewhere as well. In the western portion of the Post Oak Savanna, occurrences tend to occupy Claypan Savannah and Claypan Prairie ecoclasses, though this cover type is less common than others within these soil types. <i>Ilex vomitoria</i> (yaupon), <i>Callicarpa americana</i> (American beautyberry), <i>Smilax bona-nox</i> (saw greenbrier), <i>Sideroxylon lanuginosum</i> (gum bumelia), <i>Toxicodendron radicans</i> (poison ivy), <i>Vitis mustangensis</i> (mustang grape), <i>Diospyros texana</i> (Texas persimmon), and <i>Zanthoxylum clava-herculis</i> (Hercules' club) may be present in the shrub layer. To the south, <i>Acacia rigidula</i> (blackbrush), <i>Colubrina texensis</i> (Texas hogplum), <i>Eysenhardtia texana</i> (Texas kidneywood), <i>Forestiera angustifolia</i> (desert olive), and <i>Zanthoxylum fagara</i> (colima) may form a conspicuous shrub layer. <i>Schizachyrium scoparium</i> (little bluestem), <i>Bothriochloa laguroides</i> spp. <i>torreyana</i> (silver bluestem), and <i>Nassella leucotricha</i> (Texas wintergrass) are among the many species of grass that may be present in the herbaceous layer, though many sites may have <i>Bothriochloa ischaemum</i> var. <i>songarica</i> (King Ranch bluestem), <i>Paspalum notatum</i> (bahiagrass), or <i>Cynodon dactylon</i> (bermudagrass) as herbaceous dominants. <i>Quercus fusiformis</i> (NI/UPL), <i>Quercus virginiana</i> (FACU), <i>Quercus stellata</i> (UPL), <i>Ilex vomitoria</i> (FAC), <i>Callicarpa americana</i> (FACU), <i>Smilax bona-nox</i> (FAC)</p>	FACU	0.34	2349

TABLE A13 – EAST-CENTRAL TEXAS PLAINS POST OAK SAVANNA AND WOODLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>Quercus fusiformis (plateau live oak) and Prosopis glandulosa (honey mesquite) becoming the primary overstory components, and shrubs of south Texas such as Acacia rigidula (blackbrush), Forestiera angustifolia (desert olive), Condalia hookeri (brasil), Colubrina texensis (Texas hogplum), Eysenhardtia texana (Texas kidneywood), Opuntia engelmannii var. lindheimeri (Lindheimer pricklypear), and Diospyros texana (Texas persimmon) becoming increasingly conspicuous understory components. To the east, Vaccinium arboreum (farkleberry), Morella cerifera (wax-myrtle), Diospyros virginiana (common persimmon), and Cornus florida (flowering dogwood) may be common components of the understory. On some sites, Ilex vomitoria (yaupon) can form nearly continuous, sometimes impenetrable, dense shrub layer. Mid- and tallgrass species including Schizachyrium scoparium (little bluestem), Sorghastrum nutans (Indiangrass), and Panicum virgatum (switchgrass) are frequent in the understory where light penetration supports herbaceous cover, and also form prairie patches within the savanna, particularly on tighter soils. Other grasses present include Andropogon gerardii</p>	603	Post Oak Savanna: Post Oak - Redcedar Motte and Woodland	<p>Occurrences of this woodland are dominated by Quercus stellata (post oak) and/or Quercus fusiformis (plateau live oak), with Juniperus virginiana (eastern redcedar) as either a co-dominant of the overstory or as a conspicuous dominant of the shrub layer. This vegetation type is particularly well-represented on disturbed sites, particularly where fire is excluded. Dynamics described in Ecological Site Descriptions for Claypan Savannah, Sandy Loam, and Sandy sites in the Post Oak Savanna include this vegetation type in the Oak Scrub-Shrubland Community or the Post Oak - Elm Woodland Community. These communities result from the lack of fire and the presence of heavy continuous grazing. This vegetation type may sometimes be incorrectly mapped as Post Oak / Yaupon Motte and Woodland. The shrub layer may be dominated by Juniperus virginiana (eastern redcedar), but Ilex vomitoria (yaupon) may also be conspicuous. The herbaceous layer is often poorly developed, due to the closed nature of the canopy, resulting in the reduced potential for the development of fine fuels and the consequent maintenance of the redcedar dominance through lack of fire. Pinus taeda (loblolly pine) may be in the overstory near the Bastrop Lost Pines ecoregion.</p> <p><i>Quercus stellata (UPL), Quercus fusiformis (NI/UPL), Juniperus virginiana (FACU), Ilex vomitoria (FAC)</i></p>	UPL	0.01	45

TABLE A13 – EAST-CENTRAL TEXAS PLAINS POST OAK SAVANNA AND WOODLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>(big bluestem), <i>Bothriochloa laguroides</i> ssp. <i>torreyana</i> (silver bluestem), <i>Paspalum plicatulum</i> (brownseed paspalum) (to the south), <i>Nassella leucotricha</i> (Texas wintergrass), <i>Dichanthelium</i> spp. (rosette grasses), <i>Aristida</i> spp. (threeawn), and <i>Sporobolus cryptandrus</i> (sand dropseed). Non-native grass species such as <i>Bothriochloa ischaemum</i> var. <i>songarica</i> (King Ranch bluestem), <i>Paspalum notatum</i> (bahiagrass), and <i>Cynodon dactylon</i> (bermudagrass) may dominate some sites. Forbs are often conspicuous, and may include species such as <i>Croton capitatus</i> (hog croton), <i>Gaillardia pulchella</i> (Indian blanket), <i>Monarda punctata</i> (spotted beebalm), <i>Rudbeckia hirta</i> (blackeyed Susan), <i>Phlox drummondii</i> (Drummond phlox), <i>Commelina erecta</i> (erect dayflower), <i>Acalypha radians</i> (cardinal's feather), <i>Verbesina virginica</i> (frostweed), <i>Aphanostephus skirrhobasis</i> (lazy daisy), <i>Froelichia gracilis</i> (slender snake cotton), <i>Cnidioscolus texanus</i> (Texas bull-nettle), and many others.</p> <p>Drought, grazing, and fire are the primary natural processes that affect this system. Much of this system has been impacted by conversion to improved pasture or crop production. Overgrazing and fire suppression have led to increased woody cover on most extant occurrences and the invasion of some areas by problematic brush species such as <i>Juniperus virginiana</i> (eastern redcedar) (to the north) and <i>Prosopis glandulosa</i> (honey mesquite) (to the south).</p>	604	Post Oak Savanna: Post Oak Motte and Woodland	<p>woodland component of the system. The typical occurrence is dominated by <i>Quercus stellata</i> (post oak), with <i>Quercus marilandica</i> (blackjack oak) and/or <i>Quercus fusiformis</i> (plateau live oak) (particularly in the south) also present. <i>Carya texana</i> (black hickory) may be a significant component of the overstory, particularly on deep sands. Depending on site history and edaphic conditions, other species may be present in the overstory or may be better represented as shrubs. Such species as <i>Celtis laevigata</i> (sugar hackberry), <i>Prosopis glandulosa</i> (honey mesquite), <i>Quercus nigra</i> (water oak), <i>Diospyros virginiana</i> (eastern persimmon), <i>Juniperus virginiana</i> (eastern redcedar), <i>Ulmus alata</i> (winged elm), and <i>Ulmus crassifolia</i> (cedar elm) are often overstory components, and are often stunted (< 12 m in height). The shrub layer includes species such as <i>Callicarpa americana</i> (American beautyberry), <i>Ilex decidua</i> (possumhaw), <i>Ilex vomitoria</i> (yaupon), <i>Sideroxylon lanuginosum</i> (gum bumelia), <i>Smilax bona-nox</i> (saw greenbrier), <i>Symphoricarpos orbiculatus</i> (coral-berry), <i>Vaccinium arboreum</i> (farkleberry), and <i>Zanthoxylum clava-herculis</i> (Hercules' club). Herbaceous components are often represented by components of the surrounding prairies, primarily <i>Schizachyrium scoparium</i> (little bluestem), but also <i>Sorghastrum nutans</i> (Indiangrass), <i>Andropogon gerardii</i> (big bluestem), and, to the south and east, <i>Paspalum plicatulum</i> (brownseed paspalum). Other grass species may include <i>Bothriochloa laguroides</i> ssp. <i>torreyana</i> (silver bluestem), <i>Elymus canadensis</i> (Canada wildrye), <i>Panicum virgatum</i> (switchgrass), <i>Paspalum floridanum</i> (Florida paspalum), <i>Paspalum setaceum</i> (thin paspalum), <i>Sporobolus compositus</i> (tall dropseed), and <i>Tridens flavus</i> (purpletop). <i>Quercus marilandica</i> (NI/UPL), <i>Quercus fusiformis</i> (NI/UPL), <i>Carya texana</i> (NI/UPL), <i>Celtis laevigata</i> (FACW), <i>Prosopis glandulosa</i> (UPL)</p>	UPL	0.01	4888

TABLE A13 – EAST-CENTRAL TEXAS PLAINS POST OAK SAVANNA AND WOODLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>This system represents a transition from the woodlands and forests of East Texas to the prairies to the west, specifically the Blackland Prairie. Savannas and woodlands are typically dominated by <i>Quercus stellata</i> (post oak), <i>Quercus marilandica</i> (blackjack oak), and <i>Carya texana</i> (black hickory). Large areas of woodland, particularly in the south and east, are dominated or co-dominated by <i>Quercus fusiformis</i> (plateau live oak) or <i>Quercus virginiana</i> (coastal live oak, east of the Brazos River). Other species, such as <i>Quercus incana</i> (bluejack oak) (on more xeric sites), <i>Ulmus alata</i> (winged elm), <i>Ulmus crassifolia</i> (cedar elm), <i>Quercus nigra</i> (water oak), <i>Juniperus virginiana</i> (eastern redcedar), <i>Celtis laevigata</i> (sugar hackberry), and <i>Prosopis glandulosa</i> (mesquite), can also be present in the overstory. To the east, <i>Quercus falcata</i> (southern red oak), <i>Quercus nigra</i> (water oak), <i>Liquidambar styraciflua</i> (sweetgum), <i>Pinus echinata</i> (shortleaf pine), <i>Pinus taeda</i> (loblolly</p>	613	<p>Post Oak Savanna: Post Oak - Yaupon Motte and Woodland</p>	<p>Many occurrences of this common vegetation type may have an exceedingly dense shrub layer dominated by <i>Ilex vomitoria</i> (yaupon). Such occurrences are conspicuous and widespread where lack of fire and heavy continuous grazing have allowed this woody species to dominate. The overstory is dominated by <i>Quercus stellata</i> (post oak). <i>Juniperus virginiana</i> (eastern redcedar) or, in southern occurrences <i>Quercus fusiformis</i> (plateau live oak) may also be present. Dynamics described in Ecological Site Descriptions for Claypan Savannah, Sandy Loam, and Sandy sites in the Post Oak Savanna include this mapping system in the Oak Scrub-Shrubland Community. The dense shrub layer is generally dominated by <i>Ilex vomitoria</i> (yaupon), almost to the exclusion of other shrub species, and the closed shrub canopy limits the development of a significant herbaceous layer. Near the Bastrop Lost Pines region, <i>Pinus taeda</i> (loblolly pine) may be an important overstory tree. <i>Quercus stellata</i> (UPL), <i>Juniperus virginiana</i> (FACU), <i>Quercus fusiformis</i> (NI/UPL), <i>Ilex vomitoria</i> (FAC)</p>	FACU	0.34	2138

TABLE A13 – EAST-CENTRAL TEXAS PLAINS POST OAK SAVANNA AND WOODLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>pine), and <i>Carya alba</i> (mockernut hickory) may be conspicuous in the overstory. Shrubs may attain significant cover in the understory, with species including <i>Ilex vomitoria</i> (yaupon) (often dominant), <i>Callicarpa americana</i> (American beautyberry), <i>Sideroxylon lanuginosum</i> (gum bumelia), <i>Crataegus</i> spp. (hawthorn), <i>Ilex decidua</i> (possumhaw), <i>Toxicodendron radicans</i> (poison ivy), <i>Smilax bona-nox</i> (saw greenbrier), <i>Juniperus virginiana</i> (eastern redcedar), and <i>Symphoricarpos orbiculatus</i> (coral-berry). To the south, this system grades into vegetation more characteristic of south Texas, with <i>Quercus fusiformis</i> (plateau live oak) and <i>Prosopis glandulosa</i> (honey mesquite) becoming the primary overstory components, and shrubs of south Texas such as <i>Acacia rigidula</i> (blackbrush), <i>Forestiera angustifolia</i> (desert olive), <i>Condalia hookeri</i> (brasil), <i>Colubrina texensis</i> (Texas hogplum), <i>Eysenhardtia texana</i> (Texas kidneywood), <i>Opuntia engelmannii</i> var. <i>lindheimeri</i> (Lindheimer pricklypear), and <i>Diospyros texana</i> (Texas persimmon) becoming increasingly conspicuous understory components. To the east, <i>Vaccinium arboreum</i> (farkleberry), <i>Morella cerifera</i> (wax-myrtle), <i>Diospyros virginiana</i> (common persimmon), and <i>Cornus florida</i> (flowering dogwood) may be common components of the understory. On</p>	607	Post Oak Savanna: Savanna Grassland	<p>This vegetation type represents the herbaceous expression of the overall system, which is a mosaic of woody and herbaceous cover types as suggested by reference to a savanna. These grasslands are often dominated by mid- and tallgrass species often present in the understory of woody expressions of the system. Dominant species include <i>Schizachyrium scoparium</i> (little bluestem), <i>Sorghastrum nutans</i> (Indiangrass), and <i>Panicum virgatum</i> (switchgrass). Other grasses present include <i>Andropogon gerardii</i> (big bluestem), <i>Bothriochloa laguroides</i> ssp. <i>torreyana</i> (silver bluestem), <i>Paspalum plicatulum</i> (brownseed paspalum) (to the south), <i>Nassella leucotricha</i> (Texas wintergrass), and <i>Sporobolus cryptandrus</i> (sand dropseed). Non-native grass species such as <i>Bothriochloa ischaemum</i> var. <i>songarica</i> (King Ranch bluestem), <i>Paspalum notatum</i> (bahiagrass), <i>Panicum coloratum</i> (kleingrass), <i>Dichanthium annulatum</i> (Kleberg bluestem), and <i>Cynodon dactylon</i> (bermudagrass) may dominate some sites. These grasslands may be difficult to differentiate in areas of transition to Blackland Prairie or Coastal Prairie. Claypan Savannah and Claypan Prairie ecoclasses may support occurrences of this vegetation type, particularly where land management practices including prescribed fire and other forms of brush management are implemented. <i>Schizachyrium scoparium</i> (FACU), <i>Sorghastrum nutans</i> (FACU), <i>Panicum virgatum</i> (FAC),</p>	FACU	0.34	3872

TABLE A13 – EAST-CENTRAL TEXAS PLAINS POST OAK SAVANNA AND WOODLAND

System Description	MoRAP Code	Common Name	Description (Dominant plants in bold)	Community Indicator Status	Rank	Count
<p>continuous, sometimes impenetrable, dense shrub layer. Mid- and tallgrass species including <i>Schizachyrium scoparium</i> (little bluestem), <i>Sorghastrum nutans</i> (Indiangrass), and <i>Panicum virgatum</i> (switchgrass) are frequent in the understory where light penetration supports herbaceous cover, and also form prairie patches within the savanna, particularly on tighter soils. Other grasses present include <i>Andropogon gerardii</i> (big bluestem), <i>Bothriochloa laguroides</i> ssp. <i>torreyana</i> (silver bluestem), <i>Paspalum plicatulum</i> (brownseed paspalum) (to the south), <i>Nassella leucotricha</i> (Texas wintergrass), <i>Dichanthelium</i> spp. (rosette grasses), <i>Aristida</i> spp. (threeawn), and <i>Sporobolus cryptandrus</i> (sand dropseed). Non-native grass species such as <i>Bothriochloa ischaemum</i> var. <i>songarica</i> (King Ranch bluestem), <i>Paspalum notatum</i> (bahia grass), and <i>Cynodon dactylon</i> (bermudagrass) may dominate some sites. Forbs are often conspicuous, and may include species such as <i>Croton capitatus</i> (hog croton), <i>Gaillardia pulchella</i> (Indian blanket), <i>Monarda punctata</i> (spotted beebalm), <i>Rudbeckia hirta</i> (blackeyed Susan), <i>Phlox drummondii</i> (Drummond phlox), <i>Commelina erecta</i> (erect dayflower), <i>Acalypha radians</i> (cardinal's feather), <i>Verbesina virginica</i> (frostweed), <i>Aphanostephus skirrhobasis</i> (lazy daisy), <i>Froelichia gracilis</i> (slender snake cotton), <i>Cnidoscolus texanus</i> (Texas bull-nettle), and many others.</p> <p>Drought, grazing, and fire are the primary natural processes that affect this system. Much of this system has been impacted by conversion to improved pasture or crop production. Overgrazing and fire suppression have led to increased woody cover on most extant occurrences and the invasion of some areas by problematic brush species such as <i>Juniperus virginiana</i> (eastern redcedar) (to the north) and <i>Prosopis glandulosa</i> (honey mesquite) (to the south).</p>	624	Post Oak Savanna: Oak - Hardwood Slope Forest	<p>This deciduous forest vegetation type is found on slopes greater than twenty percent along the Red River and its tributaries, as well as on slopes from Milam to Gonzales counties and elsewhere. Slopes on calcareous substrates along the Red River may be dominated by species such as <i>Quercus muehlenbergii</i> (chinkapin oak), <i>Quercus shumardii</i> (Shumard oak), <i>Ulmus americana</i> (American elm), and <i>Ulmus crassifolia</i> (cedar elm). In the south, slopes are generally not on calcareous substrate and <i>Quercus muehlenbergii</i> (chinkapin oak) is lacking. On these sites, slopes may be dominated by <i>Quercus stellata</i> (post oak), <i>Ulmus crassifolia</i> (cedar elm), <i>Ulmus americana</i> (American elm), <i>Quercus marilandica</i> (blackjack oak) and <i>Celtis laevigata</i> (sugar hackberry) and less commonly <i>Quercus shumardii</i> (Shumard oak). This vegetation type is poorly understood, and may be compositionally quite similar to surrounding woodlands. The greater topographic relief associated with this system results in more mesic conditions leading to the development of denser overstory canopy. <i>Quercus stellata</i> (UPL), <i>Quercus muehlenbergii</i> (UPL)</p>	UPL	0.01	6262

Appendix F: Desktop Environmental Review

Environmental Constraint Analysis Geodatabase Description

TABLE B1 – BASEMAP_FEATURES

Feature Class Name	Description	Source
Major_Roads	HGAC Major Roads Feature Class	http://h-gac.com/rds/gis-data/gis-datasets.aspx
Study_Area_Counties	County boundaries that intersect the study area.	https://tnris.org/data-catalog/
Study_Area	Polygon surrounding the lower Brazos River corridor. Limits of the environmental constraints analysis.	BRA
USGS_Quad_Boundaries	Boundaries of the USGS 7.5' Topographic Quadrangle maps that intersect the study area	https://datagateway.nrcs.usda.gov/
Railroads	Railroads within the study area	https://tnris.org/data-catalog/
StratMap_Roads	TNRIS StratMap Roadways	https://tnris.org/data-catalog/

TABLE B2 – HISTORIC SITES

Feature Class Name	Description	Source
Cemeteries	Represents polygons of cemeteries that received the Historic Texas Cemetery designation or have been located during surveys by the THC. This layer is clipped to the counties of the study area.	THC GIS Database (https://atlas.thc.state.tx.us/Data/GISData)
Historic_Markers	Point features of Texas Historical Markers clipped to the study area. Markers represent places of historical importance to Texas, including military sites, commercial and public buildings, and events that changed local or state history.	THC GIS Database (https://atlas.thc.state.tx.us/Data/GISData)
NRHP_Properties	Point feature of places listed on the National Park Service’s National Register of Historical places clipped to the study area. These places are historic places worthy of preservation.	THC GIS Database (https://atlas.thc.state.tx.us/Data/GISData)
NRHP_Districts	Polygon feature of places listed on the National Park Service’s National Register of Historical places found within the study area, which have been labelled as historic places worthy of preservation.	THC GIS Database (https://atlas.thc.state.tx.us/Data/GISData)
State_Historic_Sites	Historical sites within the state of Texas managed by the THC clipped to the study area.	THC GIS Database (https://atlas.thc.state.tx.us/Data/GISData)
THC_Archaeological_Properties_Polygon	Polygons representing archaeological survey areas	THC GIS Database (https://atlas.thc.state.tx.us/Data/GISData)
THC_Archaeological_Properties_Polygon	Lines representing archaeological survey areas associated with linear projects	THC GIS Database (https://atlas.thc.state.tx.us/Data/GISData)

TABLE B3 – HYDROLOGY

Feature Class Name	Description	Source
FEMA_Floodplains	FEMA 100-year floodplains for the counties of the study area.	Halff Internal Database
Groundwater_Well_Locations	Well locations within the study area submitted to the Submitted Drillers Reports Dataset of the TWDB. Data includes owner, location, and type of well. Layer is updated nightly on the TWDB website. Downloaded on July 7, 2017.	TWDB GIS Database (http://www.twdb.texas.gov/mapping/gisdata.asp)
Major_Aquifers	Major aquifers within the study area. Major aquifers are aquifers that produce large amounts of water over large areas.	TWDB GIS Database (http://www.twdb.texas.gov/mapping/gisdata.asp)
Minor_Aquifers	Minor aquifers within the study area. Minor aquifers are those that produce minor amounts of water over large areas or large amounts of water over small areas.	TWDB GIS Database (http://www.twdb.texas.gov/mapping/gisdata.asp)
NHD_Stream_Centerlines	This layer represents drainage networks, including rivers, streams, canals, etc. clipped to the study area. This layer includes an "Impaired" field with labels as YES or NO representing those features that when overlaid with TCEQ Assessment Units matched with impaired segments were labelled as YES.	NHD Dataset (https://nhd.usgs.gov/data.html)
NHD_Waterbodies	lakes, ponds, and other open water features.	NHD Dataset (https://nhd.usgs.gov/data.html)
NWI_Features	Dataset with wetland features found through the NWI clipped to the counties of the study area.	USFWS National Wetlands Inventory (https://www.fws.gov/wetlands/Data/State-Downloads.html)
TCEQ_Assessment_Units_2014_Polylines	TCEQ Assessment Units Lines clipped to the study area counties. Assessment units are sub-areas of water bodies used in the assessment of water quality by the TCEQ.	TCEQ GIS Database (https://www.tceq.texas.gov/gis/download-tceq-gis-data)
TCEQ_Assessment_Units_2014_Polygons	TCEQ Assessment Units Polygons clipped to study area counties. Assessment units are sub-areas of water bodies used in assessment of water quality by the TCEQ.	TCEQ GIS Database (https://www.tceq.texas.gov/gis/download-tceq-gis-data)

TABLE B3 – HYDROLOGY

Feature Class Name	Description	Source
TCEQ_Impaired_Segments	TCEQ Assessment Units that are listed as impaired per the <i>2014 Texas Integrated Report</i> . Layer includes information on the category of impairment, parameter, category, and sources. Those segments listed as a Category 5 waterbody were the only Impaired Segments in this layer.	TCEQ GIS Database (https://www.tceq.texas.gov/gis/download-tceq-gis-data)
Potential_Wetland_Areas	Polygons extracted from the “Wetland Mapper” raster analysis that represent areas of moderate to high wetland potential.	Halff generated data

TABLE B4 – OIL AND GAS

Feature Class Name	Description	Source
TXRRC_Pipelines	Pipelines located within the counties of the study area. Information in the layer include various identification features, commodity being transported and latitude and longitude of the well.	RRC Data Download
TXRRC_Surface_Well_Locations	Surface well locations for counties within the study area. Information in the layer include various identification features and latitude and longitude of the well.	RRC Data Download

TABLE B5 – PARKS

Feature Class Name	Description	Source
HGAC_Park_Areas	Polygon representing parks in the HGAC region, clipped to the study area	http://h-gac.com/rds/gis-data/gis-datasets.aspx
HGAC_State_Parks	Polygon representing state parks in the HGAC region, clipped to the study area	http://h-gac.com/rds/gis-data/gis-datasets.aspx
HGAC_Park_Points	Points representing parks in the HGAC region, clipped to the study area	http://h-gac.com/rds/gis-data/gis-datasets.aspx
TPWD_State_Parks	Polygons representing TPWD State Parks in the study area	http://h-gac.com/rds/gis-data/gis-datasets.aspx

TABLE B6 – SOILS

Feature Class Name	Description	Source
Prime_Farmland	USDA soil survey layer with "Prime_Farm" field, attributed as either YES or NO. This field was created by labelling those areas as YES if the field "PrimeFarm1" is labelled as "All areas are prime farmland", "Prime farmland if drained", or "Prime farmland if protected from flooding or not frequently flooding during the growing season". If labeled as NO, "PrimeFarm1" is labelled as "Not prime farmland" or "Farmland of statewide importance".	USDA Soil Survey https://datagateway.nrcs.usda.gov/
USDA_Soil_Survey	Soil survey of study area counties from the USDA.	USDA Soil Survey https://datagateway.nrcs.usda.gov/

TABLE B7 – 2013 DEM

Feature Class Name	Description	Source
Algoa_DEM Brenham_DEM FreeP_DEM Waller_DEM Sealy_DEM	2013 National Elevation Datasets for the study area	https://datagateway.nrcs.usda.gov/

TABLE B8 – THREATENED_ENDANGERED_SPECIES

Feature Class Name	Description	Source
USFWS_Critical_Habitat	USFWS Critical Habitat boundaries (downloaded 6/14/2017)	https://ecos.fws.gov/ecp/report/table/critical-habitat.html
NDD_EORs	Polygon representing element occurrence records within the study area from the Texas Natural Diversity Database.	TPWD TXNDD (http://tpwd.texas.gov/huntwild/wild/wildlife_diversity/txnnd/about.phtml)
Ammodramus_henslowii_SH Anaxyrus_houstonensis_SH Anguilla_rostrata_SH Anthus_spragueii_SH Athene_cunicularia_hypugaea_SH Buteo_albicaudatus_SH Calidris_canutus_rufa_SH Cambarellus_texanus_SH Canis_rufus_SH Caretta_caretta_SH Charadrius_alexandrines_SH Charadrius_alexandrinus_nivosus_SH Charadrius_melodus_SH Charadrius_montanus_SH Chelonia_mydas_SH Crotalus_horridus_SH Cycleptus_elongatus_SH Dermochelys_coriacea_SH	Derived from species habitat descriptions and corresponding habitat types from the TPWD EMST vegetation cover class data.	TPWD Ecological Mapping Systems (http://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector)

TABLE B8 – THREATENED_ENDANGERED_SPECIES

Feature Class Name	Description	Source
Egretta_rufescens_SH		
Eretmochelys_imbricata_SH		
Erismyza_oblongus_SH		
Falco_peregrinus_anatum_SH		
Falco_peregrinus_tundrius_SH		
Fusconaia_askewi_SH		
Grus_americanus_SH		
Haliaeetus_leucocephalus_SH		
Herpailurus_yagouaroundi_SH		
Laterallus_jamaicensis_SH		
Leopardus_pardalis_SH		
Lepidochelys_kempii_SH		
Liochlorophis_venalis_SH		
Lithobates_areolatus_areolatus_SH		
Macrochelys_temminckii_SH		
Malaclemys_terrapin_littoralis_SH		
Mycteria_americanus_SH		
Myotis_austroriparius_SH		
Notropis_buccula_SH		
Notropis_oxyrhynchus_SH		
Numenius_borealis_SH		
Pelecanus_occidentalis_SH		
Phrynosoma_cornutum_SH		
Picoides_borealis_SH		
Plegadis_chihi_SH		
Pristis_pectinata_SH		
Procambarus_brazoriensis_SH		
Pseudocentropomus_morihari_SH		
Quadrula_houstonensis_SH		
Quadrula_petrina_SH		
Spilogale_putorius_interrupta_SH		
Spilogale_putorius_SH		
Sterna_antillarum_athalassos_SH		
Sterna_antillarum_SH		
Sterna_fuscata_SH		
Thamnophis_sirtalis_annectens_SH		
Trichechus_manatus_SH		
Trucilla_macrodon_SH		

TABLE B8 – THREATENED_ENDANGERED_SPECIES

Feature Class Name	Description	Source
Tympanuchus_cupido_attwateri_SH Ursus_americanus_luteolus_SH		

TABLE B9 – TOPOGRAPHY

Feature Class Name	Description	Source
HGAC_2ft_Contours	2ft contours derived from 2013 HGAC LIDAR dataset	Halff Internal Database, purchased from HGAC.

TABLE B10 – VEGETATION

Feature Class Name	Description	Source
TPWD_EMST	TPWD EMST dataset for the study area.	TPWD Ecological Mapping Systems (http://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector)
USACE_Galveston_Protected_Habitat_Classes	USACE Galveston District regional NWP conditions disallow the use of NWPs for waters of the United States of the following type: mangrove marshes, coastal dune swales, and Columbia Bottomlands.	Joined featured from TPWD Ecological Mapping Systems Downloads (https://www.epa.gov/eco-research/ecoregion-download-files-state-region-6#pane-41)
TPWD_Ecoregions	Level III Ecoregions of Texas, clipped to the counties of the study area.	EPA Ecoregion Downloads Files by State- Region 6 (https://www.epa.gov/eco-research/ecoregion-download-files-state-region-6#pane-41)

TABLE B11 – WATER_MANAGEMENT_ENTITIES

Feature Class Name	Description	Source
GMA_Boundaries	Represents TWDB Groundwater Management Areas clipped to the study area. Created "in order to provide for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions, consistent with the objectives of Section 59, Article XVI, Texas Constitution, groundwater management areas may be created...".	TWDB GIS Database (http://www.twdb.texas.gov/mapping/gisdata.asp)
GWCD_Boundaries	Represents TWDB's Groundwater Conservation Districts clipped to the study area. These Districts are required to develop and implement management plans for groundwater resources within the District's boundaries. Not all areas have groundwater conservation districts and districts can span more than one county or split counties.	TWDB GIS Database (http://www.twdb.texas.gov/mapping/gisdata.asp)
RWPA_Boundaries	Represents the Texas Water Development Board's Regional Water Planning Areas clipped to the study area. These areas help formulate regional and provide input for Texas State Water Plans.	TWDB GIS Database (http://www.twdb.texas.gov/mapping/gisdata.asp)
RiverAuthorityBoundaries	Represents River Authorities and Special Law Districts clipped to the study area. River Authorities and other Special Law Districts develop and manage waters within a river basin, operate major reservoirs and sell untreated water.	TWDB GIS Database (http://www.twdb.texas.gov/mapping/gisdata.asp)
SWCD_Boundaries	Represents Soil and Water Conservation Districts, as managed by the Texas Soil and Water Conservation Board clipped to the study area.	TWDB GIS Database (http://www.twdb.texas.gov/mapping/gisdata.asp)
TCEQ_Water_District_Boundaries	Represents Water Districts that fall under the supervision of TCEQ. This layer describes the name and type of water district, clipped to the study area.	TCEQ GIS Database (https://www.tceq.texas.gov/gis/download-tceq-gis-data)

TABLE B12 – WETLAND MAPPER

Feature Class Name	Description	Source
Ranked_EMST_Vegetation_Layer	TPWD EMST data ranked according to community wetland indicator status.	Halff derived dataset utilizing the TPWD EMST Data http://tpwd.texas.gov/gis/programs/landscape-ecology/by-ecoregion-vector
Ranked_Floodplain_Layer	FEMA floodplain layers ranked according to wetland mapper methodology	Halff derived dataset
Ranked_NRCS_Hydric_Soil_Layer	USDA soil survey layer ranked according to wetland mapper methodology	Halff derived dataset utilizing the USDA soil survey (https://datagateway.nrcs.usda.gov/)
Ranked_NWI_Layer	NWI data ranked according to wetland mapper methodology	Halff derived dataset utilizing digitized NWI features (https://www.fws.gov/wetlands/data/data-download.html)
Ranked_Topography_Layer	“Sink” raster, derived from 2013 3m DEMs, converted to vector and ranked according to the wetland mapper methodology.	Halff derived dataset utilizing 2013 DEMs (https://datagateway.nrcs.usda.gov/)
WetlandMapperRasters: Floodplain_Rank Hydric_Soil_Rank Hydrology_Linear_Rank Hydrology_Squared_Rank Hydrophytic_Vegetation_Rank NWI_Rank Wetland_Topography_Rank Wetland_Mapper_Final	Raster datasets derived from the wetland mapper methodology and utilized to create potential wetland areas.	Halff derived raster datasets utilizing the various vector datasets described in Table B12.

Appendix F: Desktop Environmental Review

USFWS IPAC Official Species Lists for the Study Area



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Austin Ecological Services Field Office

10711 Burnet Road, Suite 200

Austin, TX 78758-4460

Phone: (512) 490-0057 Fax: (512) 490-0974

<http://www.fws.gov/southwest/es/AustinTexas/>

<http://www.fws.gov/southwest/es/EndangeredSpecies/lists/>

In Reply Refer To:

June 14, 2017

Consultation Code: 02ETAU00-2017-SLI-0994

Event Code: 02ETAU00-2017-E-01853

Project Name: BRA Flood Control Desktop Review

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the county of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

Please note that new information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Also note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of federally listed as threatened or endangered species and to determine whether projects may affect these species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

While a Federal agency may designate a non-Federal representative to conduct informal consultation or prepare a biological assessment, the Federal Agency must notify the Service in writing of any such designation. The Federal agency shall also independently review and evaluate the scope and content of a biological assessment prepared by their designated non-Federal representative before that document is submitted to the Service.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by a federally funded, permitted or authorized activity, the agency is required to consult with the Service pursuant to 50 CFR 402. The following definitions are provided to assist you in reaching a determination:

- No effect - the proposed action will not affect federally listed species or critical habitat. A “no effect” determination does not require section 7 consultation and no coordination or contact with the Service is necessary. However, if the project changes or additional information on the distribution of listed or proposed species becomes available, the project should be reanalyzed for effects not previously considered.
- May affect, but is not likely to adversely affect - the project may affect listed species and/or critical habitat; however, the effects are expected to be discountable, insignificant, or completely beneficial. Certain avoidance and minimization measures may need to be implemented in order to reach this level of effect. The Federal agency or the designated non-Federal representative should consult with the Service to seek written concurrence that adverse effects are not likely. Be sure to include all of the information and documentation used to reach your decision with your request for concurrence. The Service must have this documentation before issuing a concurrence.
- Is likely to adversely affect - adverse effects to listed species may occur as a direct or indirect result of the proposed action. For this determination, the effect of the action is neither discountable nor insignificant. If the overall effect of the proposed action is beneficial to the listed species but the action is also likely to cause some adverse effects to individuals of that species, then the proposed action “is likely to adversely affect” the listed species. The analysis should consider all interrelated and interdependent actions. An “is likely to adversely affect” determination requires the Federal action agency to initiate formal section 7 consultation with our office.

Regardless of the determination, the Service recommends that the Federal agency maintain a complete record of the evaluation, including steps leading to the determination of effect, the qualified personnel conducting the evaluation, habitat conditions, site photographs, and any other related information. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered

Species Consultation Handbook" at:

<http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF>.

Migratory Birds

For projects that may affect migratory birds, the Migratory Bird Treaty Act (MBTA) implements various treaties and conventions for the protection of these species. Under the MBTA, taking, killing, or possessing migratory birds is unlawful. Migratory birds may nest in trees, brushy areas, or other areas of suitable habitat. The Service recommends activities requiring vegetation removal or disturbance avoid the peak nesting period of March through August to avoid destruction of individuals, nests, or eggs. If project activities must be conducted during this time, we recommend surveying for nests prior to conducting work. If a nest is found, and if possible, the Service recommends a buffer of vegetation remain around the nest until the young have fledged or the nest is abandoned.

For additional information concerning the MBTA and recommendations to reduce impacts to migratory birds please contact the U.S. Fish and Wildlife Service Migratory Birds Office, 500 Gold Ave. SW, Albuquerque, NM 87102. A list of migratory birds may be viewed at <https://www.fws.gov/birds/management/managed-species/migratory-bird-treaty-act-protected-species>. Guidance for minimizing impacts to migratory birds for projects including communications towers can be found at:

<https://www.fws.gov/birds/management/project-assessment-tools-and-guidance/guidance-document>. Additionally, wind energy projects should follow the wind energy guidelines

<https://www.fws.gov/birds/management/project-assessment-tools-and-guidance/guidance-document>) for minimizing impacts to migratory birds and bats.

Finally, please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.), and projects affecting these species may require development of an eagle conservation plan

<https://www.fws.gov/birds/management/project-assessment-tools-and-guidance/guidance-document>

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Austin Ecological Services Field Office

10711 Burnet Road, Suite 200

Austin, TX 78758-4460

(512) 490-0057

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office:

Texas Coastal Ecological Services Field Office

17629 El Camino Real #211

Houston, TX 77058

(281) 286-8282

Project Summary

Consultation Code: 02ETAU00-2017-SLI-0994

Event Code: 02ETAU00-2017-E-01853

Project Name: BRA Flood Control Desktop Review

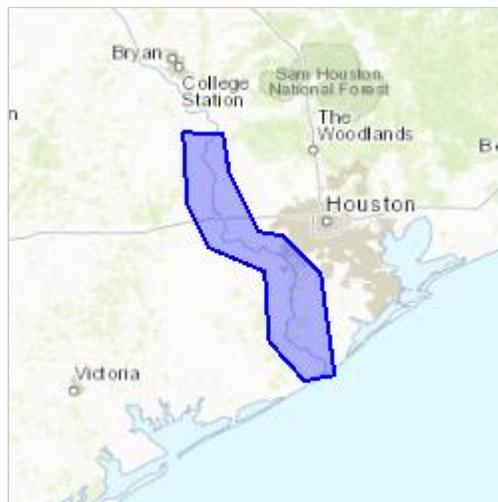
Project Type: STREAM / WATERBODY / CANALS / LEVEES / DIKES

Project Description: Planning level environmental constraints mapping for potential flood control projects along the Lower Brazos River.

Project Location:

Approximate location of the project can be viewed in Google Maps:

<https://www.google.com/maps/place/29.556948791049685N95.74669322425555W>



Counties: Austin, TX | Brazoria, TX | Fort Bend, TX | Grimes, TX | Waller, TX |
Washington, TX | Wharton, TX

Endangered Species Act Species

There is a total of 7 threatened, endangered, or candidate species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 3 of these species should be considered only under certain conditions. See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area. Please contact the designated FWS office if you have questions.

Birds

NAME	STATUS
<p>Least Tern (<i>Sterna antillarum</i>) Population: interior pop. No critical habitat has been designated for this species. This species only needs to be considered under the following conditions:</p> <ul style="list-style-type: none"> ▪ Wind Energy Projects <p>Species profile: https://ecos.fws.gov/ecp/species/8505</p>	Endangered
<p>Piping Plover (<i>Charadrius melodus</i>) Population: except Great Lakes watershed There is a final critical habitat designated for this species. Your location overlaps the designated critical habitat. This species only needs to be considered under the following conditions:</p> <ul style="list-style-type: none"> ▪ Wind Energy Projects <p>Species profile: https://ecos.fws.gov/ecp/species/6039</p>	Threatened
<p>Red Knot (<i>Calidris canutus rufa</i>) No critical habitat has been designated for this species. This species only needs to be considered under the following conditions:</p> <ul style="list-style-type: none"> ▪ Wind Energy Projects <p>Species profile: https://ecos.fws.gov/ecp/species/1864</p>	Threatened
<p>Whooping Crane (<i>Grus americana</i>) Population: Wherever found, except where listed as an experimental population There is a final critical habitat designated for this species. Your location is outside the designated critical habitat. Species profile: https://ecos.fws.gov/ecp/species/758</p>	Endangered

Clams

NAME	STATUS
<p>Smooth Pimpleback (<i>Quadrula houstonensis</i>) No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8967</p>	Candidate
<p>Texas Fawnsfoot (<i>Truncilla macrodon</i>) No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8965</p>	Candidate

Flowering Plants

NAME

STATUS

Navasota Ladies'-tresses (*Spiranthes parksii*)

Endangered

No critical habitat has been designated for this species.

Species profile: <https://ecos.fws.gov/ecp/species/1570>

Critical habitats

There is 1 critical habitat wholly or partially within your project area.

NAME

STATUS

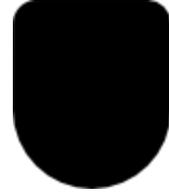
Piping Plover (*Charadrius melodus*)Final
designated



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Texas Coastal Ecological Services Field Office
17629 El Camino Real #211
Houston, TX 77058

Phone: (281) 286-8282 Fax: (281) 488-5882
<http://www.fws.gov/southwest/es/TexasCoastal/>
http://www.fws.gov/southwest/es/ES_Lists_Main2.html



In Reply Refer To:

June 14, 2017

Consultation Code: 02ETTX00-2017-SLI-1349

Event Code: 02ETTX00-2017-E-02636

Project Name: BRA Flood Control Desktop Review

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The U.S. Fish and Wildlife Service (Service) field offices in Clear Lake, Tx, and Corpus Christi, Tx, have combined administratively to form the Texas Coastal Ecological Services Field Office. A map of the Texas Coastal Ecological Services Field Office area of responsibility can be found at: <http://www.fws.gov/southwest/es/TexasCoastal/Map.html>. All project related correspondence should be sent to the field office responsible for the area in which your project occurs. For projects located in southeast Texas please write to: Field Supervisor; U.S. Fish and Wildlife Service; 17629 El Camino Real Ste. 211; Houston, Texas 77058. For projects located in southern Texas please write to: Field Supervisor; U.S. Fish and Wildlife Service; P.O. Box 81468; Corpus Christi, Texas 78468-1468. For projects located in six counties in southern Texas (Cameron, Hidalgo, Starr, Webb, Willacy, and Zapata) please write: Santa Ana NWR, ATTN: Ecological Services Sub Office, 3325 Green Jay Road, Alamo, Texas 78516.

The enclosed species list identifies federally threatened, endangered, and proposed to be listed species; designated critical habitat; and candidate species that may occur within the boundary of your proposed project and/or may be affected by your proposed project.

New information from updated surveys, changes in the abundance and distribution of species, changes in habitat conditions, or other factors could change the list. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. The Service recommends that verification be completed by visiting the ECOS-IPaC website <http://ecos.fws.gov/ipac/> at regular intervals during project planning and implementation for updates to species list and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

Candidate species have no protection under the Act but are included for consideration because they could be listed prior to the completion of your project. The other species information should help you determine if suitable habitat for these listed species exists in any of the proposed project areas or if project activities may affect species on-site, off-site, and/or result in "take" of a federally listed species.

"Take" is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. In addition to the direct take of an individual animal, habitat destruction or modification can be considered take, regardless of whether it has been formally designated as critical habitat, if the activity results in the death or injury of wildlife by removing essential habitat components or significantly alters essential behavior patterns, including breeding, feeding, or sheltering.

Section 7

Section 7 of the Act requires that all Federal agencies consult with the Service to ensure that actions authorized, funded or carried out by such agencies do not jeopardize the continued existence of any listed threatened or endangered species or adversely modify or destroy critical habitat of such species. It is the responsibility of the Federal action agency to determine if the proposed project may affect threatened or endangered species. If a "may affect" determination is made, the Federal agency shall initiate the section 7 consultation process by writing to the office that has responsibility for the area in which your project occurs.

Is not likely to adversely affect - the project may affect listed species and/or critical habitat; however, the effects are expected to be discountable, insignificant, or completely beneficial. Certain avoidance and minimization measures may need to be implemented in order to reach this level of effects. The Federal agency or the designated non-Federal representative should seek written concurrence from the Service that adverse effects have been eliminated. Be sure to include all of the information and documentation used to reach your decision with your request for concurrence. The Service must have this documentation before issuing a concurrence.

Is likely to adversely affect - adverse effects to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial. If the overall effect of the proposed action is beneficial to the listed species but also is likely to cause some adverse effects to individuals of that species, then the proposed action "is likely to adversely affect" the listed species. An "is likely to adversely affect" determination requires the Federal action agency to initiate formal section 7 consultation with this office.

No effect - the proposed action will not affect federally listed species or critical habitat (i.e., suitable habitat for the species occurring in the project county is not present in or adjacent to the action area). No further coordination or contact with the Service is necessary. However, if the project changes or additional information on the distribution of listed or proposed species becomes available, the project should be reanalyzed for effects not previously considered.

Regardless of your determination, the Service recommends that you maintain a complete record

of the evaluation, including steps leading to the determination of affect, the qualified personnel conducting the evaluation, habitat conditions, site photographs, and any other related articles.

Please be advised that while a Federal agency may designate a non-Federal representative to conduct informal consultations with the Service, assess project effects, or prepare a biological assessment, the Federal agency must notify the Service in writing of such a designation. The Federal agency shall also independently review and evaluate the scope and contents of a biological assessment prepared by their designated non-Federal representative before that document is submitted to the Service.

The Service's Consultation Handbook is available online to assist you with further information on definitions, process, and fulfilling Act requirements for your projects at:

http://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf

Section 10

If there is no federal involvement and the proposed project is being funded or carried out by private interests and/or non-federal government agencies, and the project as proposed may affect listed species, a section 10(a)(1)(B) permit is recommended. The Habitat Conservation Planning Handbook is available at:

http://www.fws.gov/endangered/esa-library/pdf/HCP_Handbook.pdf

Service Response

Please note that the Service strives to respond to requests for project review within 30 days of receipt, however, this time period is not mandated by regulation. Responses may be delayed due to workload and lack of staff. Failure to meet the 30-day timeframe does not constitute a concurrence from the Service that the proposed project will not have impacts to threatened and endangered species.

Proposed Species and/or Proposed Critical Habitat

While consultations are required when the proposed action may affect listed species, section 7(a)(4) was added to the ESA to provide a mechanism for identifying and resolving potential conflicts between a proposed action and proposed species or proposed critical habitat at an early planning stage. The action agency should seek concurrence from the Service to assist the action agency in determining effects and to advise the agency on ways to avoid or minimize adverse effect to proposed species or proposed critical habitat.

Candidate Species

Candidate species are species that are being considered for possible addition to the threatened and endangered species list. They currently have no legal protection under the ESA. If you find you have potential project impacts to these species the Service would like to provide technical assistance to help avoid or minimize adverse effects. Addressing potential impacts to these species at this stage could better provide for overall ecosystem health in the local area and avert potential future listing.

Several species of freshwater mussels occur in Texas and four are candidates for listing under the ESA. The Service is also reviewing the status of six other species for potential listing under the ESA. One of the main contributors to mussel die offs is sedimentation, which smothers and suffocates mussels. To reduce sedimentation within rivers, streams, and tributaries crossed by a project, the Service recommends that that you implement the best management practices found at: <http://www.fws.gov/southwest/es/TexasCoastal/FreshwaterMussels.html>.

Candidate Conservation Agreements (CCAs) or Candidate Conservation Agreements with Assurances (CCAAs) are voluntary agreements between the Service and public or private entities to implement conservation measures to address threats to candidate species. Implementing conservation efforts before species are listed increases the likelihood that simpler, flexible, and more cost-effective conservation options are available. A CCAA can provide participants with assurances that if they engage in conservation actions, they will not be required to implement additional conservation measures beyond those in the agreement. For additional information on CCAs/CCAAs please visit the Service's website at <http://www.fws.gov/endangered/what-we-do/cca.html>.

Migratory Birds

The Migratory Bird Treaty Act (MBTA) implements various treaties and conventions for the protection of migratory birds. Under the MBTA, taking, killing, or possessing migratory birds is unlawful. Many may nest in trees, brush areas or other suitable habitat. The Service recommends activities requiring vegetation removal or disturbance avoid the peak nesting period of March through August to avoid destruction of individuals or eggs. If project activities must be conducted during this time, we recommend surveying for active nests prior to commencing work. A list of migratory birds may be viewed at <http://www.fws.gov/migratorybirds/regulationspolicies/mbta/mbtandx.html>.

The bald eagle (*Haliaeetus leucocephalus*) was delisted under the Act on August 9, 2007. Both the bald eagle and the golden eagle (*Aquila chrysaetos*) are still protected under the MBTA and BGEPA. The BGEPA affords both eagles protection in addition to that provided by the MBTA, in particular, by making it unlawful to "disturb" eagles. Under the BGEPA, the Service may issue limited permits to incidentally "take" eagles (e.g., injury, interfering with normal breeding, feeding, or sheltering behavior nest abandonment). For more information on bald and golden eagle management guidelines, we recommend you review information provided at <http://www.fws.gov/midwest/eagle/pdf/NationalBaldEagleManagementGuidelines.pdf>.

The construction of overhead power lines creates threats of avian collision and electrocution. The Service recommends the installation of underground rather than overhead power lines whenever possible. For new overhead lines or retrofitting of old lines, we recommend that project developers implement, to the maximum extent practicable, the Avian Power Line Interaction Committee guidelines found at <http://www.aplic.org/>.

Meteorological and communication towers are estimated to kill millions of birds per year. We recommend following the guidance set forth in the Service Interim Guidelines for

Recommendations on Communications Tower Siting, Constructions, Operation and Decommissioning, found online at:

<http://www.fws.gov/habitatconservation/communicationtowers.html>, to minimize the threat of avian mortality at these towers. Monitoring at these towers would provide insight into the effectiveness of the minimization measures. We request the results of any wildlife mortality monitoring at towers associated with this project.

We request that you provide us with the final location and specifications of your proposed towers, as well as the recommendations implemented. A Tower Site Evaluation Form is also available via the above website; we recommend you complete this form and keep it in your files. If meteorological towers are to be constructed, please forward this completed form to our office.

More information concerning sections 7 and 10 of the Act, migratory birds, candidate species, and landowner tools can be found on our website at:

<http://www.fws.gov/southwest/es/TexasCoastal/ProjectReviews.html>.

Wetlands and Wildlife Habitat

Wetlands and riparian zones provide valuable fish and wildlife habitat as well as contribute to food control, water quality enhancement, and groundwater recharge. Wetland and riparian vegetation provides food and cover for wildlife, stabilizes banks and decreases soil erosion. These areas are inherently dynamic and very sensitive to changes caused by such activities as overgrazing, logging, major construction, or earth disturbance. Executive Order 11990 asserts that each agency shall provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial value of wetlands in carrying out the agency's responsibilities. Construction activities near riparian zones should be carefully designed to minimize impacts. If vegetation clearing is needed in these riparian areas, they should be re-vegetated with native wetland and riparian vegetation to prevent erosion or loss of habitat. We recommend minimizing the area of soil scarification and initiating incremental re-establishment of herbaceous vegetation at the proposed work sites. Denuded and/or disturbed areas should be re-vegetated with a mixture of native legumes and grasses. Species commonly used for soil stabilization are listed in the Texas Department of Agriculture's (TDA) Native Tree and Plant Directory, available from TDA at P.O. Box 12847, Austin, Texas 78711. The Service also urges taking precautions to ensure sediment loading does not occur to any receiving streams in the proposed project area. To prevent and/or minimize soil erosion and compaction associated with construction activities, avoid any unnecessary clearing of vegetation, and follow established rights-of-way whenever possible. All machinery and petroleum products should be stored outside the floodplain and/or wetland area during construction to prevent possible contamination of water and soils.

Wetlands and riparian areas are high priority fish and wildlife habitat, serving as important sources of food, cover, and shelter for numerous species of resident and migratory wildlife. Waterfowl and other migratory birds use wetlands and riparian corridors as stopover, feeding, and nesting areas. We strongly recommend that the selected project site not impact wetlands and riparian areas, and be located as far as practical from these areas. Migratory birds tend to concentrate in or near wetlands and riparian areas and use these areas as migratory yways or

corridors. After every effort has been made to avoid impacting wetlands, you anticipate unavoidable wetland impacts will occur; you should contact the appropriate U.S. Army Corps of Engineers office to determine if a permit is necessary prior to commencement of construction activities.

If your project will involve filling, dredging, or trenching of a wetland or riparian area it may require a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers (COE). For permitting requirements please contact the U.S. Corps of Engineers, District Engineer, P.O. Box 1229, Galveston, Texas 77553-1229, (409) 766-3002.

Beneficial Landscaping

In accordance with Executive Order 13112 on Invasive Species and the Executive Memorandum on Beneficial Landscaping (42 C.F.R. 26961), where possible, any landscaping associated with project plans should be limited to seeding and replanting with native species. A mixture of grasses and forbs appropriate to address potential erosion problems and long-term cover should be planted when seed is reasonably available. Although Bermuda grass is listed in seed mixtures, this species and other introduced species should be avoided as much as possible. The Service also recommends the use of native trees, shrubs, and herbaceous species that are adaptable, drought tolerant and conserve water.

State Listed Species

The State of Texas protects certain species. Please contact the Texas Parks and Wildlife Department (Endangered Resources Branch), 4200 Smith School Road, Austin, Texas 78744 (telephone 512/389-8021) for information concerning fish, wildlife, and plants of State concern or visit their website at:

http://www.tpwd.state.tx.us/huntwild/wild/wildlife_diversity/texas_rare_species/listed_species/.

If we can be of further assistance, or if you have any questions about these comments, please contact 281/286-8282 if your project is in southeast Texas, or 361/994-9005, ext. 246, if your project is in southern Texas. Please refer to the Service consultation number listed above in any future correspondence regarding this project.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Texas Coastal Ecological Services Field Office

17629 El Camino Real #211

Houston, TX 77058

(281) 286-8282

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office:

Austin Ecological Services Field Office

10711 Burnet Road, Suite 200

Austin, TX 78758-4460

(512) 490-0057

Project Summary

Consultation Code: 02ETTX00-2017-SLI-1349

Event Code: 02ETTX00-2017-E-02636

Project Name: BRA Flood Control Desktop Review

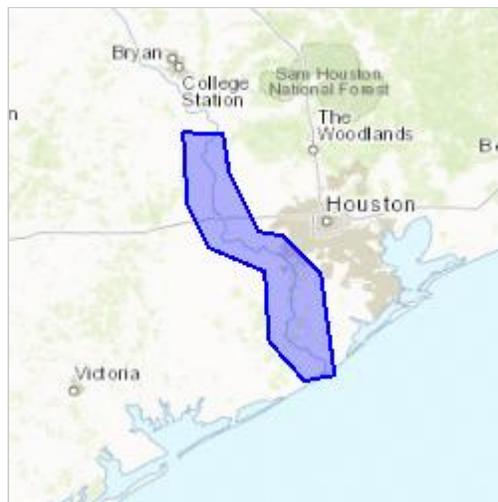
Project Type: STREAM / WATERBODY / CANALS / LEVEES / DIKES

Project Description: Planning level environmental constraints mapping for potential flood control projects along the Lower Brazos River.

Project Location:

Approximate location of the project can be viewed in Google Maps:

<https://www.google.com/maps/place/29.556948791049685N95.74669322425555W>



Counties: Austin, TX | Brazoria, TX | Fort Bend, TX | Grimes, TX | Waller, TX |
Washington, TX | Wharton, TX

Endangered Species Act Species

There is a total of 15 threatened, endangered, or candidate species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 1 of these species should be considered only under certain conditions. See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area. Please contact the designated FWS office if you have questions.

Mammals

NAME	STATUS
<p>West Indian Manatee (<i>Trichechus manatus</i>)</p> <p>There is a final critical habitat designated for this species. Your location is outside the designated critical habitat.</p> <p>Species profile: https://ecos.fws.gov/ecp/species/4469</p>	Threatened

Birds

NAME	STATUS
<p>Attwater's Greater Prairie-chicken (<i>Tympanuchus cupido attwateri</i>)</p> <p>No critical habitat has been designated for this species.</p> <p>Species profile: https://ecos.fws.gov/ecp/species/7259</p>	Endangered
<p>Least Tern (<i>Sterna antillarum</i>)</p> <p>Population: interior pop.</p> <p>No critical habitat has been designated for this species.</p> <p>This species only needs to be considered under the following conditions:</p> <ul style="list-style-type: none"> ▪ Wind related projects within migratory route. <p>Species profile: https://ecos.fws.gov/ecp/species/8505</p>	Endangered
<p>Piping Plover (<i>Charadrius melodus</i>)</p> <p>Population: except Great Lakes watershed</p> <p>There is a final critical habitat designated for this species. Your location overlaps the designated critical habitat.</p> <p>Species profile: https://ecos.fws.gov/ecp/species/6039</p>	Threatened
<p>Red Knot (<i>Calidris canutus rufa</i>)</p> <p>No critical habitat has been designated for this species.</p> <p>Species profile: https://ecos.fws.gov/ecp/species/1864</p>	Threatened
<p>Whooping Crane (<i>Grus americana</i>)</p> <p>Population: Wherever found, except where listed as an experimental population</p> <p>There is a final critical habitat designated for this species. Your location is outside the designated critical habitat.</p> <p>Species profile: https://ecos.fws.gov/ecp/species/758</p>	Endangered

Reptiles

NAME	STATUS
<p>Hawksbill Sea Turtle (<i>Eretmochelys imbricata</i>)</p> <p>There is a final critical habitat designated for this species. Your location is outside the designated critical habitat.</p> <p>Species profile: https://ecos.fws.gov/ecp/species/3656</p>	Endangered
<p>Kemp's Ridley Sea Turtle (<i>Lepidochelys kempii</i>)</p> <p>No critical habitat has been designated for this species.</p> <p>Species profile: https://ecos.fws.gov/ecp/species/5523</p>	Endangered
<p>Leatherback Sea Turtle (<i>Dermochelys coriacea</i>)</p> <p>There is a final critical habitat designated for this species. Your location is outside the designated critical habitat.</p> <p>Species profile: https://ecos.fws.gov/ecp/species/1493</p>	Endangered
<p>Loggerhead Sea Turtle (<i>Caretta caretta</i>)</p> <p>Population: Northwest Atlantic Ocean DPS</p> <p>There is a final critical habitat designated for this species. Your location is outside the designated critical habitat.</p> <p>Species profile: https://ecos.fws.gov/ecp/species/1110</p>	Threatened

Amphibians

NAME	STATUS
<p>Houston Toad (<i>Bufo houstonensis</i>)</p> <p>There is a final critical habitat designated for this species. Your location is outside the designated critical habitat.</p> <p>Species profile: https://ecos.fws.gov/ecp/species/2206</p>	Endangered

Clams

NAME	STATUS
<p>Smooth Pimpleback (<i>Quadrula houstonensis</i>)</p> <p>No critical habitat has been designated for this species.</p> <p>Species profile: https://ecos.fws.gov/ecp/species/8967</p>	Candidate
<p>Texas Fawnsfoot (<i>Truncilla macrodon</i>)</p> <p>No critical habitat has been designated for this species.</p> <p>Species profile: https://ecos.fws.gov/ecp/species/8965</p>	Candidate

Flowering Plants

NAME	STATUS
Navasota Ladies'-tresses (<i>Spiranthes parksii</i>) No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1570	Endangered
Texas Prairie Dawn-flower (<i>Hymenoxys texana</i>) No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6471	Endangered

Critical habitats

There is 1 critical habitat wholly or partially within your project area.

NAME	STATUS
Piping Plover (<i>Charadrius melodus</i>)	Final designated
