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WETLAND MITIGATION BANK PROSPECTUS

BASFORD BAYOU MITIGATION BANK
SWG-2017-00718
Galveston County, Texas

Prepared for Submittal to:
U.S. Army Corps of Engineers, Galveston District

On Behalf of:
HDFI Land Holdings LP

Prepared By:
Wildwood Environmental Credit Company, LLC



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ACRONYMS AND ABBREVIATIONS

GIS	Geographic Information System
NRCS	Natural Resources Conservation Service
PEM	Palustrine Emergent Wetland
SSURGO	Soil Survey Geographic
USGS	U.S. Geological Service
WAA	Wetland Assessment Area

1 INTRODUCTION

1.1 Project Overview

HDFI Land Holdings, LP (the “sponsor”) proposes to develop an approximately 409-acre wetland mitigation bank in Galveston County, Texas known as the Basford Bayou Wetland Mitigation Bank (the “bank”). The site consists of intertidal¹ emergent wetlands, palustrine emergent / scrub-shrub wetlands², and spoil material cast during the construction of the Highland Bayou Diversion Canal between 1969 and 1975. The property is located on the east and west sides of Harbor Drive on the north side of the Highland Bayou Diversion Canal.

Implementation of the mitigation plan would result in the re-establishment, rehabilitation, and enhancement of intertidal emergent wetlands. The bank will be established and operated in accordance to 33 CFR Part 332, *Compensatory Mitigation for Losses of Aquatic Resources*; Final Rule, dated April 10, 2008 (2008 Rule, 2008).

1.2 Ownership / Sponsorship / Long-term Steward

The property is owned by the sponsor, subject to a deed of trust that will be subordinated to the conservation easement and mitigation banking instrument prior to the release of credits. The sponsor would be responsible for establishing and operating the bank. The sponsor would be responsible for the implementation, performance, and long-term management of the project (the long-term manager). Wildwood Environmental Credit Company, LLC is acting as the sponsor’s agent. Contact information is provided below. Please direct all correspondence to the sponsor’s agent.

Sponsor & Property Owner:
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1.3 Project Location

The site is approximately 409 acres located southwest of the community of Bayou Vista in western Galveston County, Texas (**Figure 1**). The attributes of the bank’s location are provided in

¹ Intertidal wetlands are those wetlands that have a substrate exposed and flooded by tides; including the associated splash zone (Cowardin, Carter, Golet, & LaRoe, 1979).

² Palustrine Emergent Wetlands (PEM) are those wetlands characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens that occur in the floodplains of rivers (Cowardin, Carter, Golet, & LaRoe, 1979).

Table 1. Appendix A contains maps of the project area. Appendix B contains photographs of the site. The site is part of a larger tract of land of approximately 747 acres. The remainder of the tract is located south of the Highland Bayou Diversion Canal.

Table 1. Location of the mitigation bank.

Type	Description
Legal Description	West Tract - ABST 194 T TOBY SUR, ABST 195 T TOBY SUR & ABST 196 T TOBY SUR TR 1-1 227.830ACRS (PT OF AUCTION TR 83) East Tract - ABST 175 J SPILLMAN SUR TR 51-6 ACRES 181.015 (AUCTION TR 87)
Longitude/Latitude	-94.98726 / 29.30539
UTM	Zone 15; Easting 306992; Northing: 3243460
USGS Quad	Virginia Point
County	Galveston
Driving Location	2.3 road miles south of Harbor Drive intersection with Highway 6, west of Interstate 45

The bank consists of two tracts, one west of Harbor Drive herein called the “west tract” and one east of Harbor Drive herein called the “east tract” (**Figure 2**). The west tract is approximately 228 acres. The east tract is approximately 181 acres.

Driving Directions to the Bank

Both tracts are located along the north bank of the Highland Bayou Diversion Canal at the canal’s intersection with Harbor Drive, 2.3 miles south of Harbor Drive’s intersection with Highway 6. The intersection being approximately 2.4 miles west of Highway 6’s exits from Interstate 45 (**Figure 1**).

1.4 Project Goals and Objectives

The purpose of the bank would be to sell credits commercially as compensatory mitigation for unavoidable impacts to waters of the United States, including wetlands, which result from activities authorized under Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act of 1899, provided such use has met all applicable requirements and is authorized by the U.S. Army Corps of Engineers.

The goal of the bank would be to replace the functions of the waters of the U.S. that will be lost or degraded due to impacts authorized under Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act of 1899.

The goal of the bank will be achieved by attaining the following objectives:

1. Re-establish³ 80.6 acres of estuarine intertidal emergent wetlands by removing spoil deposited during the construction of the Highland Bayou Diversion Canal, and reestablishing native emergent wetland vegetation;
2. Rehabilitate⁴ 92.1 acres of estuarine intertidal emergent wetlands by filling a former borrow pit on the east tract, removing spoil cast for construction of a containment levee, removing spoil deposits from wetlands within the containment levee on the west tract, and converting low quality

³ Re-establishment is the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a net gain in aquatic resource area and functions (2008 Rule, 2008).

⁴ Rehabilitation means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a former or degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function but does not result in a gain in aquatic resource area (2008 Rule, 2008).

- isolated wetlands back to intertidal emergent wetlands by removing spoil on the east tract, followed by reestablishing native emergent wetland vegetation on all disturbed surfaces;
3. Enhance⁵ 212.1 acres of estuarine intertidal emergent wetlands adjacent to the re-establishment and rehabilitation wetlands by improving the site's hydroperiod and reducing the degree of hydrological modifications within the system;
 4. Ensure long-term viability and sustainability of the site by establishing an approved long-term management plan and long-term funding mechanism to provide for its implementation;
 5. Ensure long-term site protection by executing a perpetual conservation easement on the site.

Figure 17 is a map showing the location of the re-establishment, rehabilitation, and enhancement areas. Table 2 contains a summary of the bank's objectives by resource and activity type.

Table 2. Project objectives by resource type and activity type.

Current Resource Type	Projected Acres			
	Not-Credited	Intertidal Wetland Re-established	Intertidal Wetland Rehabilitated	Intertidal Wetland Enhanced
Non-wetland		80.6		
Wetland			92.1	212.1
State Submerged Land	24.8			
Total Acres	24.8	80.6	92.1	212.1
Total Bank Acres				409.5

⁵ Enhancement means the manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s) but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

2 ECOLOGICAL SUITABILITY

2.1 Site Selection

The site was selected due to its ability to generate functional uplift with minimal risk of failure, and its location in an area of long-term anticipated need for compensatory wetland mitigation credits. Attributes of the site which led to its selection include:

1. The site's location adjacent to existing conservation lands owned by the Galveston Bay Foundation and Scenic Galveston, allowing this project to add 409 acres to a preexisting ~4,700-acre conservation corridor (**Figure 1**);
2. The compatibility of the adjacent land uses (predominately conservation lands and grazing lands) with the purpose and goals of the project.
3. The historic presence of tidal wetlands which were filled by the construction of the adjacent Highland Bayou Diversion Canal, creating a practical opportunity to re-establish those wetlands by removing the spoil (**Figure 5** and **Figure 7**);
4. The presence of spoil piles which impede the movement of tidal waters and/or storm surges, which if removed would improve the function of the adjacent wetlands;
5. The site's location adjacent to the Highland Bayou Diversion Canal, which is a 303d listed stream for bacteria impairments. Establishing a mitigation bank and re-establishing wetlands adjacent to the canal would remove the risk of future excessive bacterial inputs to the waterway from this site;
6. The site's unique location at the ecological transition between the coastal marshes and gulf coastal prairies as mapped by (Griffeth, Bryce, Omernik, & Rogers, 2007) (**Figure 3**).
7. The site's location in terms of its ability to adequately mitigate for losses to aquatic resources within an area of limited options for compensatory tidal wetland mitigation.

2.2 Biophysical Location

The site is located within the historic floodplain of Basford Bayou and straddles the 34a Northern Humid Gulf Coastal Prairies and 34h Mid-Coast Barrier Islands and Coastal Marshes portions of the Western Gulf Coastal Plain Ecoregion (Griffeth, Bryce, Omernik, & Rogers, 2007) (**Figure 3**). **Table 3** and **Table 4** describe these ecoregion in more detail and **Table 5** describes the geographic attributes of the site more specifically.

Table 3. Local ecoregion description from (Griffeth, Bryce, Omernik, & Rogers, 2007).

Level IV Ecoregion	34a. Northern Humid Gulf Coastal Prairies
Level III Ecoregion	34 Western Gulf Coastal Plain
Total Ecoregion Area (sq. mi.)	9,009
Physiography	Low, flat plains, low gradient rivers and streams (some channelized) with sandy, silty, and clayey substrates.
Elevation / Local Relief (feet)	0-300 / 5-35
Surficial Geology; Bedrock Geology	Late Pleistocene marine sand, silt, and clay. Some salt domes.
Soil Order (Great Groups)	Vertisols (Dystraquents, Hapluderts), Mollisols (Argiudolls, Argiaquolls, Hapludolls), Alfisols (Epiqualfs, Hapludalfs, Glossaqualfs, Glossudalfs, Vermaqualfs)
Common Soil Series	Beaumont, Morey, Mocarey, Bernard, Lake Charles, Verland, Edna, Aris, Anahuac, Clodine, Cieno, Nada, Telfemer, Dacosta
Soil Temperature / Soil Moisture Regimes	Hyperthermic, Thermic / Aquic, Udic
Mean Annual Precipitation (in.)	37-58
Mean Annual Frost Free Days	260-300
Mean Temperature (F) (Jan. min/max; July min/max)	42/62; 74/92
Vegetation	Prairie grasslands with little bluestem, yellow Indiangrass, brownseed paspalum, gulf muhly, and switchgrass, with some clusters of southern live oak. Riparian forests of water oak, pecan, southern live oak, American elm, cedar elm, and sugar hackberry, as well as some cane brakes.
Land Use and Land Cover	Cropland with rice, soybeans, grain sorghum, cotton, hay and pastureland, urban and industrial, rangeland, oil and gas production, waterfowl hunting.

Table 4. Local ecoregion description from (Griffeth, Bryce, Omernik, & Rogers, 2007).

Level IV Ecoregion	34h. Mid-Coast Barrier Islands and Coastal Marshes
Level III Ecoregion	34 Western Gulf Coastal Plain
Total Ecoregion Area (sq. mi.)	1,335
Physiography	Barrier islands, dunes, beaches, bays, estuaries, tidal marshes, lakes, and canals.
Elevation / Local Relief (feet)	0-25 / 2-10
Surficial Geology; Bedrock Geology	Holocene beach sand and shell sand, back-island slope sand and silt, lagoon and tidal flat silt, sand, and clay, marsh silt and clay; Late Pleistocene beach and near-shore marine sand, some delta sand, silt, and clay (Beaumont Formation).
Soil Order (Great Groups)	Entisols (Udipsamments, Psammaquents, Fluvaquents), Mollisols (Endoaquolls), Alfisols (Natraqualfs)
Common Soil Series	Galveston, Mustang, Tatton, Veston, Placedo, Ijam, Harris, Surfside, Velasco, Matagorda, Livia, Palacios, Narta
Soil Temperature / Soil Moisture Regimes	Hyperthermic / Aquic
Mean Annual Precipitation (in.)	34-46
Mean Annual Frost Free Days	290-320
Mean Temperature (F) (Jan. min/max; July min/max)	47/62; 75/90
Vegetation	Mostly brackish and saltwater marsh vegetation of grasses, sedges, and rushes. Few to no trees. Smooth cordgrass, marshhay cordgrass, gulf cordgrass, and gulf saltgrass; on islands, seacoast bluestem, sea oats, gulfdune paspalum
Land Use and Land Cover	Marshland, wildlife habitat, recreation, commercial and sport fishing, oil and gas production, some urban and residential.

Table 5. Descriptive geographic information related to the bank site.

Type	Description
<u>Soil Characteristics</u>	
Dominant NRCS Map Units	Ijam clay, 0 - 2 percent slopes, frequently flooded, tidal (44%) Narta fine sandy loam, 0 - 1 percent slopes, rarely flooded (22%)
NRCS Ecological Site & Historic Climax Plant Community	R150BY551TX – Salty Prairie 26-48" PZ (22%) (Narta fine sandy loam) R150BY552TX – Tidal Flats 40+" PZ (31%) (Tracosa and Follet) R151XY673TX – Intermediate Firm Marsh (44%) (Ijam clay) (Soil Survey Staff, n.d.)
<u>Hydrologic Characteristics</u>	
Associated Named Streams	Basford Bayou / Highland Bayou Diversion Canal (adjacent to site)
Local Watershed (HUC 12)	Dickinson Bayou – 120402040200
Local Watershed (HUC 10)	Dickinson Bayou - 1204020402
Sub-basin (HUC 8)	West Galveston Bay - 12040204
Basin (HUC 6)	Galveston Bay – Sabine Lake 120402
<u>Ecoregion Characteristics</u>	
Omernik Level IV	34a: Northern Humid Gulf Coastal Prairies (~13% of site) 34h: Mid-Coast Barrier Islands and Coastal Marshes (~87% of site)
Omernik Level III	34: Western Gulf Coastal Plain (Griffeth, Bryce, Omernik, & Rogers, 2007)
Major Land Resource Area Land Resource Region	150B: Gulf Coast Saline Prairies LRR T: Atlantic and Gulf Coast Lowland Forest and Crop Region
<u>Geologic Characteristics</u>	
USGS 250k Geology Map Types	Qb-Beaumont Formation / Qal-Quaternary alluvium (Army Map Service, 1982)
<u>Annual Precipitation</u> <u>(Galveston Scholes Field)</u> <u>(1946 – 2017)</u>	42.9 inches (average) (three out of ten years less than 35.77 inches to greater than 48.03 inches) (AgACIS, n.d.)

2.3 Site History

The following is an abbreviated history of the site and the surrounding area:

- Prior to 1969 Aerial photography indicates the area prior to 1969 was undisturbed aside from livestock grazing and the two pipeline corridors on the west tract (**Figure 5**)
- 1969 – 1975 Aerial photography indicates the diversion canal was partially completed in 1969 and fully completed in 1974-1975 (**Figure 6**)
- 1975 to present Fencing indicates that the site has periodically been grazed by livestock over the years, including the present. The aerial photography indicates that nearby oil and gas

exploration and production has occurred sporadically since 1969 (**Figure 7, Figure 8, Figure 9, Figure 10**)

2.4 Adjacent Land Uses and Anticipated Future Development

Adjacent and future land uses adjacent to the site are considered compatible with the project. The area east and northeast of the site is conservation land owned by the Galveston Bay Foundation and Scenic Galveston (**Figure 1**). Part of the area east of the site is a Texas Department of Transportation spoil placement area. The operation of the spoil placement area is not expected to have any additional adverse effect on the mitigation bank site since it is already isolated by levees. The area south of the site is the Highland Bayou Diversion Canal. North of the site is the land owned by Scenic Galveston (east tract) and Basford Bayou (west tract). West of the tract is grazing land on wet coastal prairie. No development is expected west of the tract for the foreseeable future due to its isolated nature and wetland status.

2.5 Topography

A map of the topographic relief based on 2006 LiDAR is included as **Figure 11**. Most of the site was historically less than 2.5 feet in elevation (NAVD88). There is a 15-20 acre elevated flat south of Basford Bayou that has elevations ranging from 3 to 4 feet. This flat begins in the southeast corner of the west tract and extends into the southwest and central portion of the east tract. The remainder of the site is either spoil pile or marsh.

The LiDAR data indicates that on the west tract most of the spoil covers an area of marsh that historically ranged from 2 to 2.5 feet in elevation. On the east tract the spoil covers an area that was slightly higher and likely ranging from 2.5 to 3.5 feet. On the east tract this appears to include a portion of the elevated flat mentioned above.

Spoil piles on the west tract are long and linear, perpendicular to the Highland Bayou Diversion Canal. Piles rise above the marsh surface by 8 to 15 feet at their highest. Slopes are greater than 15 percent along the spoil piles. A containment levee on the west tract was partially filled with spoil. This filled area has created a broad gentle (<1 percent) slope on the west side of the containment area.

On the east tract the containment levee was smaller in spatial extent and appears to be filled with more material. The piles are broader and not as tall (generally less than 8 feet tall). On the east tract the containment levee is higher than on the west tract and it appears to be closed off from the surrounding area.

2.6 Vegetation

Historic Vegetation

The NRCS characterizes the site as historically being a mix of salty prairie on the higher elevations with most of the site being tidal flats (low marsh) and intermediate marsh (high marsh). The following description of the historic vegetation on the salty prairie site is from the Ecological Site Assessment obtained from the NRCS Web Soil Survey (Soil Survey Staff, n.d.):

The climax plant community for the Salty Prairie site is an open grassland with gulf cordgrass (*Spartina spartinae*), little bluestem (*Schizachyrium scoparium*), seacoast bluestem (*Schizachyrium littorale*),

switchgrass (*Panicum virgatum*), Hartweg's paspalum (*Paspalum hartwegianum*), seashore saltgrass (*Distichlis spicata*), marshhay cordgrass (*Spartina patens*), and traces of bushy sea oxeye (*Borrchia frutescens*). Variations in salinity and soil moisture cause local variations in the plant community, particularly along streams. Studies have shown that length and amount of inundation, and fresh runoff water or salt water have a controlling influence on the post-inundation plant community. Heavy grazing pressure will quickly depress little/seacoast bluestem and lead to a dominance of gulf cordgrass. Inundation with salt water may also cause little/seacoast bluestem to disappear for 2-3 years' post-inundation. A lengthy inundation with fresh or brackish water may cause the post-inundation community to be dominated by gulf cordgrass.

Low marsh tidal flats community occurs adjacent to saline bays and bayous in areas subject to tidal inundation and lay between the high and low water marks. Average water depth at high tide is between 2 and 12 inches. At low tide the community is not inundated. Smooth cordgrass (*Spartina alterniflora*) dominates the historic plant community on tidal flats. Other plants include inland saltgrass (*Distichlis spicata*), turtleweed (*Batis maritima*), marshhay cordgrass, maritime saltwort (*Salicornia* spp.) and saltmarsh bulrush (*Scirpus robustus*). Widgeongrass (*Ruppia maritima*) may occupy some of the open water adjacent to the tidal flats (Soil Survey Staff, n.d.).

The high / intermediate marsh community is a permanently saturated or flooded wetland. The vegetation of the site is entirely influenced by elevation, daily tidal inundation, and salinity levels. Natural shallow drains and ponds are interspersed throughout the site (Soil Survey Staff, n.d.). High marsh is irregularly flooded and dominated by graminoids such as marshhay cordgrass, saltgrass, and bulrushes (*Schoenoplectus* spp.) (Texas Parks and Wildlife).

Current Vegetation

There are three predominant vegetation communities present on the site: the spoil piles, low regularly flooded marsh, and high, irregularly flooded, marsh. On August 1 and July 31, Wildwood installed 16 wetland delineation plots at the site. These data were stratified by community type and summarized in Table 6.

Table 6. Species observed on sixteen plots stratified by community type that were sampled in August 2017 with wetland indicator status and absolute percent cover.

Common Name	Scientific Name	Indicator Status	Low Marsh (n=2)	High Marsh (n=9)	Spoil Pile (n=5)
<u>Native</u>					
bushy bluestem	<i>Andropogon glomeratus</i>	FACW			2%
eastern baccharis	<i>Baccharis halimifolia</i>	FAC		2%	3%
turtleweed	<i>Batis maritima</i>	OBL	5%	14%	6%
sea-ox-eye daisy	<i>Borrchia frutescens</i>	OBL		2%	19%
Texas windmill grass	<i>Chloris texensis</i>	N/A			1%
saltgrass	<i>Distichlis spicata</i>	OBL		32%	
high-tide bush	<i>Iva frutescens</i>	FACW		5%	0%
needlegrass rush	<i>Juncus roemerianus</i>	OBL	1%	1%	
powderpuff	<i>Mimosa strigillosa</i>	FAC			1%
dwarf saltwort	<i>Salicornia bigelovii</i>	OBL		0%	
Virginia glasswort	<i>Salicornia depressa</i>	OBL	23%	13%	2%
smooth cordgrass	<i>Spartina alterniflora</i>	OBL	80%		
saltmeadow cordgrass	<i>Spartina patens</i>	FACW		8%	10%
gulf cordgrass	<i>Spartina spartinae</i>	OBL		22%	51%
huisache	<i>Vachellia farnesiana</i>	FACU			0%
Hercules' club	<i>Zanthoxylum clava-herculis</i>	FAC			0%
Subtotal			108%	100%	96%
<u>Non-Native / Invasive</u>					
King Ranch bluestem	<i>Bothriochloa ischaemum</i>	N/A			9%
deep-rooted sedge	<i>Cyperus entrerianus</i>	FACW			1%
Macartney rose	<i>Rosa bracteata</i>	UPL			0%
Subtotal			0%	0%	10%
Grand Total			108%	100%	106%

¹ Note that reported percentages are for absolute cover which accounts for overlapping vegetation therefore may add up to more than 100 percent cover.

Designed Post-Project Vegetation

Post-project vegetation would be similar to, and have the same species as, the low marsh and high marsh types summarized in Table 6. The restored marsh surface would be planted following construction with transplants obtained from those adjacent marsh communities summarized in Table 6.

2.7 Soils

As shown in Table 7 and **Figure 12**, soils at the site are mapped by the Natural Resources Conservation Service (the "NRCS") as clays and sandy loams (Soil Survey Staff 2017). The most dominant series on site is Ijam which represents the spoil piles. The NRCS classifies these soils as hydric however observations onsite indicate that most of the piles are of sufficient elevation and slope as to not be hydric. Follet soils have a permanent water table at or slightly above the water surface during low tides and range to 12 inches above the surface during high tides. Narta soils are subject to flooding 1 to 5 times in 100

years. Narta soils remain saturated for long periods during the spring and late summer months to early fall months. Tracosa soils are permanently saturated with water and are covered with 2 to 12 inches of water by daily high tides (Soil Survey Staff, n.d.).

Table 7. NRCS SSURGO soil map units present within the proposed bank site (Soil Survey Staff 2017).

Map Unit Symbol	Map Unit Name	Acres	Percent of Site	Percent Hydric	Drainage Class
Fo	Follet clay loam, 0 to 1 percent slopes, frequently flooded	51	12	100	Very Poorly Drained
IjmB	Ijam clay, 0 to 2 percent slopes, frequently flooded	178	43	100	Poorly Drained
Na	Narta fine sandy loam, 0 to 1 percent slopes, rarely flooded	92	22	95	Poorly Drained
Tx	Tracosa mucky clay-clay, low complex	73	18	96	Very Poorly Drained
W	Water	15	4	-	-
Total		409			

2.8 National Wetlands Inventory

Figure 13 is a map of the National Wetlands Inventory for the site and Table 8 is an acreage summary of the map. The site is predominantly mapped as regularly and irregularly flooded estuarine, intertidal, emergent wetlands with persistent vegetation. Intertidal wetlands are defined as those being exposed and flooded by tides. Regularly flooded wetlands are flooded and exposed daily by the tide. Irregularly flooded wetlands are flooded by tidal water less often than daily (Cowardin, Carter, Golet, & LaRoe, 1979).

Table 8. National Wetlands Inventory mapping of the site (U.S. Fish and Wildlife Service, 2017).

Tract	Acres	System	Subsystem	Class	Subclass	Water Regime	Special Modifier
East Tract							
E1UBL	13	Estuarine	Subtidal	Unconsolidated Bottom		Subtidal	
E1UBLx	1	Estuarine	Subtidal	Unconsolidated Bottom		Subtidal	Excavated
E2EMIN	39	Estuarine	Intertidal	Emergent	Persistent	Regularly Flooded	
E2EMIP	56	Estuarine	Intertidal	Emergent	Persistent	Irregularly Flooded	
E2USMx	0	Estuarine	Intertidal	Unconsolidated Shore		Irregularly Exposed	Excavated
E2USN	3	Estuarine	Intertidal	Unconsolidated Shore		Regularly Flooded	
E2USP	1	Estuarine	Intertidal	Unconsolidated Shore		Irregularly Flooded	
PEM1A	3	Palustrine		Emergent	Persistent	Temporarily Flooded	
PEM1K	37	Palustrine		Emergent	Persistent	Artificially Flooded	
East Tract Total	154						
West Tract							
E1UBL	9	Estuarine	Subtidal	Unconsolidated Bottom		Subtidal	
E1UBLx	0	Estuarine	Subtidal	Unconsolidated Bottom		Subtidal	Excavated
E2EMIN	98	Estuarine	Intertidal	Emergent	Persistent	Regularly Flooded	
E2EMIP	32	Estuarine	Intertidal	Emergent	Persistent	Irregularly Flooded	
E2USMx	0	Estuarine	Intertidal	Unconsolidated Shore		Irregularly Exposed	Excavated
E2USN	3	Estuarine	Intertidal	Unconsolidated Shore		Regularly Flooded	
E2USP	1	Estuarine	Intertidal	Unconsolidated Shore		Irregularly Flooded	
PEM1A	4	Palustrine		Emergent	Persistent	Temporarily Flooded	
PEM1Ch	25	Palustrine		Emergent	Persistent	Seasonally Flooded	Diked/Impounded
West Tract Total	172						
Grand Total	326						

2.9 Hydrology

Historical Hydrology Impacts

Prior to disturbance, wetland hydrology was primarily driven by the tides. Freshwater inputs to the system came from direct precipitation, Basford Bayou which bisects the site, and an unnamed tributary which fed into Basford Bayou where the Harbor Drive bridge is now located. East of the site is Basford Lake, Pierce Marsh, and Jones Bay.

By 1969 aerial photography indicates that subsidence had largely degraded Pierce Marsh. Sometime before that aerial photography indicates that past dredging of Basford Bayou had occurred immediately west of the site. Harbor Drive was constructed around 1969 which restricted tidal inputs to the west tract through a bridge over Basford Bayou. An unnamed canal was constructed along the east boundary and the spoil piled such that tidal inputs are restricted to a 100-yard gap at Basford Bayou. Sometime between 1969 and 1975, construction of the Highland Bayou Diversion Canal severed freshwater inputs from the watershed and diverted flows from Basford Bayou.

Current Hydrology

Tides remain the primary driver of hydrology at the site.

Designed Post-Project Hydrology

The objective of the mitigation plan is to remove the spoil material down to the historic wetland surface. Based on a desktop review of the soil maps, national wetland inventory data, and historic aerial photographs it is likely that the restored marsh surface would be predominantly irregularly flooded high marsh or flooded by the tide less often than daily. Some areas would exist that are regularly flooded low marsh. The saturation visible in the 1969 aerial photograph indicates that both high and low marsh areas were filled with spoil on the west tract (**Figure 6**). While it is of poorer quality resolution, the 1961 aerial photograph appears to show that predominantly high marsh was filled on the east tract (**Figure 5**).

2.10 Jurisdictional Determination

A delineation of jurisdictional wetlands was conducted in March 2018 by Horizon Environmental Services, Inc. The report is being prepared for submission to the U.S. Army Corps of Engineers for verification and approval. Table 9 contains a summary of the delineation. A map of the delineation is shown in **Figure 14**.

A survey conducted by a Licensed State Land Surveyor will be obtained prior to submittal of draft mitigation banking instrument. The purpose of this survey will be to delineate any state submerged lands within the project area. No mitigation credit will be requested from state submerged lands.

Table 9. Jurisdictional wetlands at the site.

Resource Type	Acres in Project Area
<u>West Tract</u>	
Non-wetland	35.8
Wetland	183.7
Open Water (State Submerged Land)	9.0
Subtotal	228.5
<u>East Tract</u>	
Non-wetland	44.8
Wetland	120.5
Open Water (State Submerged Land)	15.7
Subtotal	181.0
<u>Total</u>	
Non-wetland	80.6
Wetland	304.1
Open Water (State Submerged Land)	24.8
Total	409.5

2.11 Hydrogeomorphic Functional Assessment

The tract has been separated into six Wetland Assessment Areas (WAAs): 1) non-wetland spoil areas; 2) wetlands west of Harbor Drive and within the former containment levee; 3) wetlands east of Harbor Drive and within the former containment levee; 4) wetlands west of Harbor Drive and outside of the former containment levee; 5) wetlands east of Harbor Drive, and 6) the former borrow pit east of Harbor Drive. A map of the WAAs may be found as **Figure 15**. The following discussions are based on the general ability of the wetlands onsite to function relative to the U.S. Army Corps of Engineer's Tidal Fringe iHGM assessment method.⁶ **Appendix C** contains a desktop iHGM assessment for each WAA showing the current baseline and projected subindex scores 1, 3, 5, and 7 years' post-construction and revegetation.

Current Functional Capacity of the Site

WAA 1 – Non-wetland spoil areas

This wetland assessment area consists of historic wetlands that were filled with spoil during the construction of the Highland Bayou Diversion Canal. They are no longer wetlands. A baseline score of 0 is assumed for this wetland assessment area.

WAA 2 – Wetlands west of Harbor Drive and within former containment levee

Wetland assessment area 2 consists of wetlands located within the perimeter of historic holding dikes/levees that were constructed to hold spoil material as it was cast from the diversion canal. The dike was eroded away in the northeast corner which allows the tide into the site through a single opening. A

⁶ For the Tidal Fringe iHGM:

<http://www.swg.usace.army.mil/Portals/26/docs/regulatory/functional%20Assessment/SWGTidalFringeIhGM.pdf>

simple tidal network has redeveloped in association with this breach. There are several habitat types present including low marsh in the northeast corner, high marsh throughout, a subtidal creek that exits the WAA, one large depression within the WAA and immediately north of the WAA, and a large unvegetated flat north of the WAA. The WAA generally has typical vegetation, but it does have an unnaturally inflated amount of woody cover (eastern baccharis and *Iva frutescens*) due to the spoil cast along the western edge of the WAA which has elevated the marsh surface. The marsh is broad and it is located over 451 feet from water greater than six feet deep (Basford Bayou). Soils are predominantly a clay loam. Roughness is moderate to high due to the high amounts of vegetation cover of predominantly *Batis* and *Salicornia* spp with additional shrubs and plants with tall stiff leaves.

WAA 3 – Wetlands east of Harbor Drive and within former containment levee

Wetland assessment area 3 consists of wetlands located within the perimeter of historic holding dikes/levees that were constructed to hold spoil material as it was cast from the diversion canal. The dike cuts the WAA off from tidal exchange. The marsh lacks both tidal creeks and isolated ponds and depressions. It is dominated by invasive species, primarily *Typha* sp. The WAA is greater than 451 feet from water greater than 6 feet that is accessible (e.g. from the north because the southern portion is behind the major portion of the containment levee). Marsh width is greater than 600 feet after considering the marsh north of the WAA. Soils are predominantly a clay loam. Roughness is high due to the high amounts of *Typha*. Within 150 feet from the edge of the WAA there is high marsh, low marsh, subtidal creeks, depressions, and unvegetated flats.

WAA 4 – Wetlands west of Harbor Drive and outside of the former containment levee

Wetland assessment area 3 consists of wetlands located west of Harbor Drive and outside of the containment levee. Hydrology within this WAA has been altered by the presence of a spoil bank and containment levee along the its southern boundary, the upstream diversion of Basford Bayou, and the Harbor Drive road bed. These factors combine to create a moderate hydrological restriction. The WAA has a well-developed tidal network as evidenced by Basford Bayou, the presence of at least two subtidal creeks, and several intertidal and subtidal ponds and flats. There are number of habitat types present including low marsh, high marsh, subtidal creeks, ponds and depressions, and unvegetative flats. The marsh is adjacent to Basford Bayou, a waterbody likely greater than 6 feet deep. The marsh surface is wide, greater than 600 feet. The WAA has over 90 percent vegetation cover with typical species. Vegetation is predominantly short flexible grass to short stiff trailing stems. The marsh is wide, and the mean marsh width is over 600 feet. Soil textures range from clay loam to sandy loam.

WAA 5 – Wetlands east of Harbor Drive

WAA 4 is the wetland area east of Harbor Drive. WAA 4 has similar functions to WAA 3 but with more low marsh and fewer tidal creeks.

WAA 6 – Former borrow pit east of Harbor Drive

WAA 5 is a 0.6 acre borrow pit of unknown depth constructed in the high marsh adjacent to Harbor Drive. The borrow pit has no vegetation growing within it. A baseline score of 0 was assumed this WAA.

Anticipated Function Following Restoration

WAA 1 – Non-wetland spoil areas

Removing spoil would immediately restore wetlands. The restored marsh is expected to have no hydrological restrictions and would lack tidal creeks and isolated ponds. Large portions of the marsh would be high marsh, not affected by the daily tide. Habitat types present or immediately nearby would include low marsh, high marsh, and subtidal creeks. The WAA would generally be set back over 150 feet from water deeper than 6 feet. The restored marsh would be between 526 and 600 feet in width on average. The restored marsh would have some topographic relief and be covered with predominantly short flexible stem grass. Herbaceous cover is expected to be over 90 percent based on the adjacent marsh areas. Soils below the spoil are clay loam.

WAA 2 – Wetlands west of Harbor Drive and within former containment levee

The only improvement foreseen to this WAA is the enhancement of the historic hydroperiod by removal of spoil piles from the adjacent WAA 1 and from removing the former containment levee that is restricting the tidal exchange with the adjacent wetland. All other variables are expected to remain the same.

WAA 3 – Wetlands west of Harbor Drive and within former containment levee

The only improvement foreseen to this WAA is the enhancement of the historic hydroperiod by removal of spoil piles from the adjacent WAA 1 and from removing the former containment levee that is restricting the tidal exchange with the adjacent wetland. All other variables are expected to remain the same.

WAA 4 – Wetlands west of Harbor Drive and outside of the former containment levee

The only improvement foreseen to this WAA is the enhancement of the historic hydroperiod by removal of spoil piles from the adjacent WAAs. This activity would enhance the wetland by improving the hydroperiod and reducing the degree of hydrological modifications. All other variables are expected to remain the same.

WAA 5 – Wetlands east of Harbor Drive

The only improvement foreseen to this WAA is the rehabilitation of the historic hydroperiod by removal of any hydrological restrictions (spoil piles). All other variables are expected to remain the same.

WAA 6 – Former borrow pit east of Harbor Drive

Filling in the borrow pit would restore a high marsh wetland surface free of hydrological restrictions. The restored marsh would be a high marsh surrounded by high marsh and unvegetated flats. The marsh would have greater than 90 percent typical vegetation present following achievement of performance standards. The marsh surface would be an average of 151-225 feet in width and it would be located over 451 feet from water greater than or equal to six feet in depth. Soils would remain the same but roughness would improve to that of the adjacent marsh surface with vegetation being predominantly short flexible stem grass.

2.12 Threatened and Endangered Species

No observations have been made of threatened or endangered species during the site visits conducted to date. An official species list of federally listed threatened and endangered species was obtained from the U.S. Fish and Wildlife for the site (Appendix D). Species identified on this list either have no critical habitat designated or critical habitat that falls outside project area. The project is not expected to result in an adverse impact to these listed species.

2.13 Cultural Resources

The proposed bank site has not been formally surveyed for the presence of historic or prehistoric cultural resources. No previously recorded prehistoric or historic sites are currently known to be located within or within the vicinity of the bank boundaries. The permit area that would be subject to ground disturbing activities has been so extensively modified by the placement of spoil that little likelihood exists for the proposed bank to impinge upon a historic property, even if present within the affected area.

2.14 Existing and Known Proposed Airports

To comply with FAA Advisory Circular (AC) 150/5200-33B a Geographic Information System (GIS) was used to determine the presence of known or proposed private or commercial airports located or proposed to be located within five miles of the proposed project. No proposed or existing airports occur within 10,000 feet of the project site. There are two heliports approximately three miles from the site (Republic Helicopters Inc, FAA# 24742.63*H and HHI Hitchcock, FAA# 24060.02*H). There are two airports located within approximately 3.5 to 4.0 miles from the site (Freyer Field, FAA# 24060.01*A and Westwind Helicopters, FAA# 24742.39*A). The project is not expected to create a significant wildlife hazard to aviation for these nearby airports.

2.15 General Need

Authorization of the mitigation bank would allow for consolidation of compensatory mitigation projects into one site where functional uplift can occur with less risk and uncertainty than at multiple small and scattered permittee-responsible mitigation projects. Authorization of the mitigation bank would also reduce temporal losses associated with tidal wetland impacts when compared to permittee-responsible mitigation.

The proposed service area would include the Austin-Oyster Bayou watersheds **Figure 18**. The Austin-Oyster Bayou watersheds do not have a tidal wetland mitigation bank option available within them. As a result, any tidal wetland impacts that occur within these watersheds must be mitigated through permittee-responsible mitigation. Mitigation banks are preferred over permittee-responsible mitigation projects because they reduce some of the risks and uncertainties associated with mitigation (2008 Rule, 2008).

Galveston Bay does already have a tidal wetland mitigation bank option available, the Gulf Coastal Plains Mitigation Bank. However, that bank has a different service area than the proposed bank and it is located on the opposite side of the bay from the proposed mitigation bank site. The Gulf Coastal Plains Mitigation Bank is also on the opposite side of the bay from the greater Houston area. Most of the impacts that have utilized the Gulf Coastal Plains Mitigation Bank have been located on the west side of Galveston Bay, near Houston. The Gulf Coastal Plains Mitigation Bank services these subbasins on a

secondary basis. The proposed mitigation bank would service these subbasins (West Galveston Bay and Buffalo-San Jacinto) on a primary basis. The sponsor believes demand is sufficient within this area to support two banks. In the past four years the Gulf Coastal Plains Mitigation Bank has sold over 60 credits. The proposed bank's location would provide permit applicants on the west side of Galveston Bay with a mitigation option that would require fewer credits due to the different service area ratios.

2.16 Technical Feasibility

The conceptual mitigation plan is described in Section 3.1 and a map of the conceptual mitigation plan is included as **Figure 17**. The proposed activities are routine and feasible and consist of removing the spoil previously cast on the marsh surface during construction of the Highland Bayou Diversion Canal. Following removal of the spoil artificial revegetation would occur using transplants acquired from the adjacent marsh, or for certain species using local seed when available. The designed condition will be self-sustaining over time and require minimal maintenance as it will restore pre-spoil conditions which are self-sustaining and require minimal maintenance in the adjacent undisturbed wetlands.

2.17 Mortgages, Easements, and Encumbrances

The tract is subject to a deed of trust. The bank holding the deed of trust has indicated their willingness to subordinate the deed of trust to a conservation easement and the use of the site as a mitigation bank. A draft subordination agreement would be provided with the draft mitigation banking instrument.

A title policy prepared by a title company operating within Texas and dated March 25, 2015 is included as Appendix E. The title policy is for the entire property the tract is a part of and as a result contains a lot information not directly related to the bank tracts. As a result, the information for the tracts south of the Highland Bayou Diversion have been redacted. The mitigation bank is located on tracts 5A and 5B mentioned in the title policy. A survey plat that accompanies the policy is also included as **Figure 16**. The survey plat shows the location of the easements on the subject tracts. The title search associated with this policy went as far back in time as possible and includes instruments on this tract as far back as 1942, or 75 years.

Portions of the east and west tracts are subject to several right-of-way easements. All easements currently located on the east and west tracts would be excluded from the mitigation bank and the conservation easement. On the west tract pipeline right of ways would deduct approximately 14 acres of enhancement acreage along the "V" shaped pipeline corridor. On the east tract there are a three utility and access easements that parallel Harbor Drive. These would exclude approximately 6 acres of enhancement from the east side. No credits would be associated with areas as they will not be a part of the mitigation bank. The acreages and maps within this prospectus do not reflect these deductions but it is the sponsors intent to net the areas out prior to development of the draft mitigation banking instrument.

A licensed state land surveyor has been engaged to survey out submerged state lands within the boundary of the east and west tracts. These lands would also be deducted from the mitigation bank and the conservation easement once they have been surveyed out, prior to development of the draft mitigation banking instrument.

Two spoil easements are also shown on **Figure 16** as being on the subject tracts. These easements were for depositing spoil for the construction of the Highland Bayou Diversion Canal. They expired five years

after their date of execution (June 1977) and are inactive. The sponsor has coordinated with Galveston County and they affirm that the easement is no longer in effect. A copy of this coordination is included as Appendix F.

2.18 Current Site Risks

The only significant long-term foreseeable risks to the site are subsidence, sea level rise, and lateral erosion from the Highland Bayou Diversion Canal and the smaller unnamed canal on the east boundary.

Lateral erosion can be mitigated by leaving a spoil terrace or constructing a bench along the fronts of both canals. No recent lateral erosion was observed along Highland Bayou Diversion Canal during the July/August site visit and it appeared stable. This was because a bench has already formed along the canal (**Photo 9**).

Subsidence at the site is not considered to be a risk. Historically subsidence was significant in the area and ranged from 1-2 feet from 1906 to 2000 (Harris-Galveston Subsidence District). Estimated rates of future subsidence for this area are insignificant (Leatherman, 1984) as intensive groundwater pumping has been curtailed (Ravens, Thomas, Roberts, & Santeschi, 2009). Subsidence near the site at Harris Galveston Subsidence District's PAM 22 and PAM 23 monitoring sites has been approximately 0.1 – 0.0 feet per decade respectively (Harris-Galveston Subsidence District, 2017).

Sea level rise at Pier 21 in the Galveston Ship Channel has been shown to be approximately 0.65 centimeters per year (cm y^{-1}) over the past 100 years. Of that, subsidence has been approximately 0.4 cm y^{-1} and eustatic sea level rise approximately 0.2 cm y^{-1} . Sediment accretion rates act to offset sea-level rise. The long-term sediment accretion rate at Galveston Island State Park has been estimated at 0.22 cm y^{-1} based on core data (Ravens, Thomas, Roberts, & Santeschi, 2009). This is on the low end of the range when compared to long-term vertical accretion rates observed in mainland Texas coastal marshes (Feagin & Yeager, 2008). Based on the current subsidence data and historic sea level rise data as well as local sediment accretion data it appears that sea level rise could impact the site by three to six inches over the next 50 to 100 years (Table 10). Since the reestablishment area is expected to be predominantly high marsh, this level of potential change could be accommodated by the site.

Table 10. Approximate anticipated elevation changes after 50 and 100 years at the bank site.

Factor	After 50 Years	After 100 Years
Subsidence	-0.25 feet	-0.50 feet
Sea Level Rise	-0.35 feet	-0.70 feet
<u>Natural Marsh Accretion</u>	<u>+0.35 feet</u>	<u>+0.70 feet</u>
Net Change	-0.25 feet	-0.50 feet

The 2006 LiDAR data were used to determine the potential impact the anticipated elevation change would have on the site. The data indicated that approximately 10 acres of the site would be at risk of conversion to open water after 100 years. This was based on a review of the LiDAR data that found that broken marsh or open water had a LiDAR return of approximately 0.7 feet NAVD 88. Increasing this amount by 0.5 feet would inundate approximately another 10 acres over the next 100 years. This change could be managed through the beneficial use of dredge material obtained from the Highland Bayou Diversion Canal and pumped as a slurry into the conversion areas. The estimated cost of this activity

could be included as a line item into the long-term stewardship endowment. The sponsor welcomes additional comment and feedback on this conceptual approach.

3 BANK ESTABLISHMENT & OPERATION

3.1 Conceptual Mitigation Plan

Figure 17 is an illustration of the conceptual mitigation plan showing the location of the proposed spoil removal areas.

The following describes the construction methods, timing and sequence, grading plan, and soil management and erosion control measures on a step by step basis:

Step 1 – Remove Spoil & Transport to Placement Area

Approximately 550,000 cubic yards of spoil would be removed using conventional earth moving equipment including excavators, bulldozers, earthmovers, and dump trucks. The grading plan would be to remove spoil to the historic wetland surface. If necessary the excavation depth (elevation and slope of the proposed final substrate) may be identified prior to construction using soil cores, but based on soil pits dug to date, the former surface is readily evident based on color (see **Photo 5**). The elevation of the adjacent undisturbed marsh surface on the south side of the diversion and the undisturbed marsh surface surrounding the spoil impacted areas of the site could also be used to interpolate the design marsh surface.

The plan is to either truck the material offsite or to dilute the spoil into a slurry and pump it offsite. Construction would begin by initially construction road access along the spoil pile to avoid wetland impacts to the site. The spoil would then be excavated from the area furthest from Harbor Drive and working back towards Harbor Drive.

Spoil material removed from the site will be placed approximately 1.5 miles south east of the site within the Harborwalk development site as used as fill for Area 1 designated within the U.S. Army Corps of Engineers Permit Number SWG-2007-00597 (the section 10/404 Individual Permit Application for the Harborwalk Development). This permit is currently being renewed with the application submitted to the U.S. Army Corps of Engineers on February 2, 2018. Analysis of the 2006 LiDAR data indicates that over 535,000 cubic yards of material would be needed to fill Area 1 to an elevation of 9 feet NAVD 88. Mitigation for impacts associated with filling this area was completed prior to October 6, 2009. A copy of the permit renewal application and the original permit is included as Appendix G. The location of the spoil placement area is shown on **Figure 17**.

Soil management and erosion control measures would be in place prior to initiation of construction and would be maintained as the project was underway. Wetland impacts would be minimized by accessing the piles from existing roads / non-wetland spoil areas identified on **Figure 17**. Silt fence, hay socks, hay bales, etc. would be used to prevent offsite movement of suspended sediments and spoil during the excavation and placement process.

Construction of the project would occur during the driest seasons to maximize the available days that work could occur. Construction may have to cease during wetter seasons but during this period soil erosion control measures would be maintained.

Step 2 – Revegetate

Following construction and reestablishment of the historic wetland surface, the site would be revegetated using native plant materials collected from the adjacent marsh areas. For species that can be established successfully using seed, the area may be seeded for these species using seed from a local seed supplier. The primary method of revegetation is anticipated to be hand transplanting on a grid spacing. Revegetation would occur late in the dormant season once migratory waterfowl are offsite unless a cover crop is needed in which case that would be seeded as soon as possible following construction.

Step 3 – Non-native/noxious species abatement

Non-native/noxious species abatement needs are expected to be limited at the site during construction since it appears that non-native/noxious species are absent from the marsh types proposed for restoration at the site. Refer to Table 6 for this determination which shows that these species were absent within non-spoil impacted areas that have the target hydrologic and salinity regime.

Step 4 – Post-project Monitoring and Maintenance

Bank monitoring, reporting, and long-term management is discussed in the following sections.

3.2 Determination of Credits

The bank would be developed using the Galveston Corps Districts' Tidal Fringe iHGM functional assessment.⁷ Credit yield will be determined by comparing current baseline conditions to those which will result from the proposed activities over an estimated 7-year timeframe following construction and revegetation. Data obtained from reference sites within the boundary of the proposed bank would be used to determine the ultimate ecological lift anticipated from the site. Appendix C contains a summary of the total estimated credit yield by wetland assessment area and for all wetland assessment areas combined.

Phasing

Given the large amounts of material to be hauled offsite the bank may be phased in one or more parts over time. The sponsor will develop a phasing plan as part of the draft mitigation banking instrument. A phase would be based on completing spoil removal and excavation for a portion of the site at a time. Phase I being east of Harbor Drive and south of Basford Bayou, Phase II being west of Harbor Drive, and Phase III being the borrow pit and spoil east of Harbor Drive and north of Basford Bayou. These phases would be completed in sequential order.

Credit Release Schedule

No credits would be released for the site until U.S. Army Corps of Engineers signature of the mitigation banking instrument, recording of the conservation easement, establishment of financial assurance, and establishment of the long-term management fund. Upon achievement of these tasks credits would be released on the following schedule for each phase initiated:

⁷ Tidal Fringe iHGM:

<http://www.swg.usace.army.mil/Portals/26/docs/regulatory/functional%20Assessment/SWGTidalFringeIHGM.pdf>

1 st Credit Release (Advanced Credits)	15 percent of a phase's total projected credits for executing the mitigation banking instrument, recording the conservation easement, establishment of the financial assurance and long-term management fund. The mitigation banking instrument, conservation easement, and long-term management fund would be established on the entire site, all phases, prior to the initial credit release of any phase. The establishment of the financial assurance would be in respect to each respective phase.
2 nd Credit Release (Advanced Credits)	20 percent of the phase's total projected credits for completing construction / planting (construction to be completed within 2 calendar years after initial crediting of a phase)
3 rd Credit Release	Upon U.S. Army Corps of Engineers verification that the site has accrued wetland functional lift beyond the baseline and previous "advanced" credit releases
Subsequent Releases	Upon U.S. Army Corps of Engineers verification that the site has accrued wetland functional lift beyond previous credit releases

3.3 Monitoring

Monitoring of the site would be performed to determine whether the project is on track to meet performance standards or if adaptive management is needed. Monitoring would be performed annually for the first 15 years following signature of the mitigation banking instrument or until all performance standards have been met, whichever is later. Monitoring would be conducted as follows:

1. Infrastructure:

- i. Monitoring of infrastructure would consist of annual inspection of boundary markers (fencing, signage, etc.), and access gates. If deficiencies are found they would be documented, included in the annual report, and corrected according to the maintenance plan as soon as practicable.

2. Vegetation:

- i. Following construction permanent monitoring stations would be established within each wetland assessment area. Each plot would be permanently marked, and the location recorded with a GPS unit. Vegetation monitoring would be made annually, at a consistent time late in the growing season.

ii. Number of Stations:

- 1. A total of sixteen monitoring stations would be installed. Three stations would be established in each of wetland assessment areas 1-5, the stations shall be located across the hydrology gradient, with one near the wettest area and one near the driest. One station shall be located within Wetland Assessment Area 6.

iii. Annual Vegetation Monitoring Protocol

1. Annually for the first 15 years following signature of the mitigation banking instrument or until all performance standards have been met, whichever is later, each station would be visited at a consistent time late in the growing season. From the station, digital photographs would be taken facing north, east, south, and west for comparison with other years.

iv. Quantitative Vegetation Monitoring

1. Following the initial credit release, quantitative monitoring would be performed in year's corresponding with subsequent credit releases or associated with specific quantitative performance standards. Herbaceous and scrub-shrub vegetation would be assessed using quadrats (1 m²) placed on alternating sides of a transect at each of the odd-numbered intervals (1m, 3m, 5m, 7m, and 9 m.). The transects shall originate at a monitoring station and be in a cardinal direction selected randomly at the time of each survey (e.g. one year possibly going north and the next year possibly going in a different direction). The herbaceous cover within each of the five quadrat samples will be identified and absolute percent cover will be estimated for each transect. All vegetation will be identified to the lowest possible taxonomic group and will be categorized by the most recently published National Wetland Plant List's wetland indicator status.

3. Hydrology

i. Annual Hydrology Monitoring Protocol

1. Indicators of hydrology as described in the 1987 Manual (U.S. Army Corps of Engineers, 1987) and the Atlantic and Gulf Coastal Plain Regional Supplement (U.S. Army Corps of Engineers, 2010) would be recorded for all vegetation monitoring stations during each monitoring event.

4. Wetland Function Monitoring

- i. Following the initial credit release, the results of an iHGM analysis would be performed in year's corresponding with credit releases or associated with specific quantitative wetland performance standards. Wetland function shall be assessed using the appropriate iHGM model based on the hydrological and vegetation monitoring results. This analysis shall be used as the basis for credit releases following submittal of the as-built report.

Following signature of the mitigation banking instrument, the U.S. Army Corps of Engineers, after coordinating with the Interagency Review Team, may reduce or waive the remaining monitoring requirements upon a determination that the project has achieved its performance

standards. Conversely the U.S. Army Corps of Engineers, after coordinating with the Interagency Review Team, may extend the original monitoring period upon a determination that performance standards have not been met or the project is not on track to meet them. The U.S. Army Corps of Engineers, after coordinating with the Interagency Review Team, may also revise monitoring requirements when remediation and/or adaptive management is required.

3.4 Reporting

The sponsor shall provide annual monitoring reports in hard copy and in editable electronic format to the U.S. Army Corps of Engineers and Interagency Review Team. Annual monitoring reports will be submitted by January 31 of each year for the preceding calendar year's activities. Reporting would be performed annually for the first 15 years following signature of the mitigation banking instrument or until all performance standards have been met, whichever is later.

Each monitoring report would contain the following:

- 1) Project Overview Section
 - a. Corps Permit Number and Mitigation Bank Name
 - b. Name and contact information of party responsible for monitoring and the date(s) monitoring was conducted
 - c. A brief paragraph describing the purpose of the bank, and the acreage and type of work authorized to improve and protect aquatic resources.
 - d. Written description of the location, and coordinates of the mitigation site (expressed as latitude/longitude).
 - e. Dates the project commenced and/or was completed.
 - f. Dates covered by the monitoring period.
 - g. Short statement on whether the performance standards are being met.
 - h. Dates of any recent corrective or maintenance activities conducted since the previous report submission.
 - i. Specific recommendations for any additional corrective or remedial actions.
- 2) Requirements Section
 - a. List the monitoring requirements and performance standards, as specified in the mitigation banking instrument, and evaluate whether the bank is successfully achieving the approved performance standards or trending towards success. A table shall be created to compare the performance standards to the conditions and status of the site.
- 3) Summary Data Section
 - a. Summary data shall be provided to substantiate the success and/or potential challenges associated with the bank. Photo documentation shall be provided to support the findings and recommendations referenced in the monitoring report and to assist the U.S. Army Corps of Engineers in assessing whether the compensatory mitigation project is meeting applicable performance standards for that monitoring period. Submitted photos shall be formatted to print on a standard 8 ½" x 11" piece of paper, dated, and clearly labeled with the direction from which the photo was taken. The photo location points shall also be identified on a map included with the report.
- 4) Maps and Plans Section

- a. Maps shall be provided to show the location of the mitigation site relative to other landscape features, habitat types, and locations of photographic reference points, sampling data points, and/or other features pertinent to the mitigation work plan. Maps shall clearly delineate the bank perimeter. Each map and diagram will be formatted to print on an 8 ½ x 11 piece of paper. As-built plans may be included.
- 5) Conclusions Section
 - a. A general statement shall be included that describes the condition of the bank. If performance standards are not being met then a description of the difficulties and potential remedial actions proposed by the sponsor including a timetable shall be provided.
- 6) Copy of the Credit Ledger
 - a. An annual ledger report shall be included with the annual monitoring report. The sponsor must compile an annual ledger report showing the beginning and ending balance of available credits and permitted impacts for each resource type, all additions and subtractions of credits, and any other changes in credit availability (e.g., additional credits released, credit sales suspended). The ledger report is part of the administrative record for the mitigation bank or in-lieu fee program. The U.S. Army Corps of Engineers will make the ledger report available to the public upon request.
- 7) Financial Assurance and Long-term Management Funding Report
 - a. A financial assurance and long-term management fund report shall be included with the annual monitoring report. The report shall include an itemization of all account activity related to the long-term management fund for the reporting year and an assessment of the fund's current performance to reasonably ensure perpetual funding for long-term management.
- 8) Conservation Easement Holder Report
 - a. The conservation easement holder shall monitor the site annually. The sponsor shall provide a copy of the conservation easement holder's most recent signed and dated annual report within the annual monitoring report.
- 9) As-built Report (reported one time only)
 - a. Upon completion of the proposed construction activities an as-built report shall be provided within the following annual monitoring report, or sooner, to document post construction conditions and compare them to planned conditions.

Following signature of the mitigation banking instrument, the U.S. Army Corps of Engineers, after coordinating with the Interagency Review Team, may reduce or waive the remaining reporting requirements upon a determination that the project has achieved its performance standards. Conversely the U.S. Army Corps of Engineers, after coordinating with the Interagency Review Team, may extend the original reporting period upon a determination that performance standards have not been met or the project is not on track to meet them. The U.S. Army Corps of Engineers, after coordinating with the Interagency Review Team, may also revise reporting requirements when remediation and/or adaptive management is required.

3.5 Performance Standards

In accordance with 33 CFR 332.5 performance standards shall be ecologically based criteria that will be used to determine whether the bank is achieving its objectives.

1. Prior to initial credit release for each phase the sponsor shall provide a copy of and/or respective documentation of the following to the U.S. Army Corps of Engineers, SWG Regulatory Division Chief:
 - a. A conservation easement recorded with the Galveston County Clerk that has been approved by the U.S. Army Corps of Engineers in coordination with the Interagency Review Team,
 - b. An established and executed financial assurance approved by the U.S. Army Corps of Engineers in coordination with the Interagency Review Team,
 - c. An established and executed long-term management fund,
2. Within two calendar years of the date a phase is initially credited by the U.S. Army Corps of Engineers, the sponsor must provide the U.S. Army Corps of Engineers and Interagency Review Team an as-built report with plan drawings and a signed statement demonstrating that construction for that phase, including hydrologic improvements, and planting is complete and compliant with the mitigation work plan,
3. Within seven calendar years of the date the mitigation banking instrument is signed by the U.S. Army Corps of Engineers, and/or prior to the final credit release, the sponsor shall fully fund the long-term management endowment,
4. Within a credited phase, all plant species listed by the Texas Invasive Plant and Pest Council's Invasive plants database at http://texasinvasives.org/plant_database/index.php (or such successor Uniform Resource Locator as Texas Invasive Plant and Pest Council may provide) must comprise less than 5 percent cover of the herbaceous, shrub-sapling, or tree strata,
5. Once a phase is constructed, the sponsor shall maintain wetland conditions as determined by the applicable parameters described in the local Regional Supplement to the Wetland Delineation Manual (U.S. Army Corps of Engineers, 2010),
6. Additional Performance Standards for Credited Areas
 - a. Within two calendar years of U.S. Army Corps of Engineers receipt of the as-built report:
 - i. The sponsor must achieve and maintain a minimum of 50 percent areal cover of emergent and/or submergent herbaceous plant species either identified in the planting list or other native hydrophytic species naturally recruited throughout all wetland areas. At least 66 percent of the areal cover of the plant community present must comprise plant species with wetland indicator status of FACW or OBL,
 - b. Within five calendar years of U.S. Army Corps of Engineers receipt of the as-built report:
 - i. The sponsor must achieve and maintain a minimum of 75 percent areal cover of emergent and/or submergent herbaceous plant species either identified in the planting list or other native hydrophytic species naturally recruited throughout all wetland areas. At least 66 percent of the areal cover of the plant community present must comprise plant species with wetland indicator status of FACW or OBL,
7. Additional Performance Standards for Non-Credited Areas

- a. Within three calendar years of U.S. Army Corps of Engineers receipt of the as-built report the sponsor must achieve and maintain a minimum of 75 percent areal cover of native herbaceous plant species.

3.6 Long-Term Management

The long-term owner and manager of the bank and property would be the sponsor. The sponsor will act as the long-term site manager through its agent, but at any time may choose to assign this role to a Corps-approved entity.

Implementation of long-term management practices would be necessary to maintain the bank as a native tidal fringe ecosystem once restoration activities have occurred. A long-term management plan will be included in the draft mitigation banking instrument. Anticipated long-term management needs include invasive plant control using chemical and mechanical means on a two to three-year rotation, posting and fencing of the boundary as needed, monitoring, and coordination by the site manager. General maintenance required to ensure continued viability of the site once construction is complete is expected to be minimal given the nature of the target ecological community and its resilience to non-native/noxious species.

Use of the land would be restricted as detailed in the perpetual site protection instrument. Uses compatible with the purpose of the bank may be deemed acceptable only if specifically authorized by the district engineer after coordination with the Interagency Review Team. Examples of such uses might include performing academic research or establishing hunting leases, provided these activities do not have the potential to reduce the ecological condition or function of the site, nor give rise to a condition counter to that intended in the mitigation banking instrument. The sponsor may amend the list of authorized uses after U.S. Army Corps of Engineers approval and coordination with the Interagency Review Team.

The long-term management plan will be funded by a long-term management fund held by the Texas Parks and Wildlife Foundation. The endowment or trust would be 100 percent funded prior to the final release of credits. Funding of the endowment would include provisions to address inflationary adjustments and cost contingencies.

3.7 Site Protection

Prior to the release of credits, the sponsor would protect the bank site in perpetuity using an appropriate, U.S. Army Corps of Engineers-approved, conservation easement held by a third party. The sponsor proposes to use the Galveston Bay Foundation as the third-party easement holder. A copy of their letter of intent to hold the conservation easement is included as Appendix H.

4 ASSURANCE OF SUFFICIENT WATER RIGHTS

Hydrology at the site would be supplied by groundwater and tidal flux from Galveston Bay via the preexisting adjacent marsh as well as the adjacent Basford Bayou and Highland Bayou Diversion Canal. The project would not impound state waters and does not require a water use permit.

5 PROPOSED SERVICE AREA

5.1 Credit Types and Use

The bank will have one credit type: Tidal Wetland. Tidal wetland credits would be used as compensatory mitigation for impacts to tidal wetlands.

Use of the bank's credits would be limited to only in-kind wetland compensation unless approved on a case-by-case basis by the U.S. Army Corps of Engineers after coordination with the Interagency Review Team.

5.2 Service Area Extent

A map of the proposed service area is contained as **Figure 18**. The bank will have a primary and secondary service area based on the 8-digit Hydrologic Unit Code (HUC) system. The service area is located within the State of Texas and the U.S. Army Corps of Engineers, Galveston Regulatory District.

Primary Service Area

The primary service area encompasses the West Galveston Bay, HUC 12040201 and the Buffalo-San Jacinto Subbasin HUC 12040104. Debiting ratios for the primary service area will be on a 1:1 basis. The primary service area specifically excludes Galveston Island. All lands owned, leased, or managed by Texas Parks and Wildlife Department are excluded from service area coverage.

Secondary Service Area

The secondary service area would be defined as the entire 8-digit HUCs that are adjacent to the primary service area. This includes the East Galveston Bay (HUC 12040202), Austin-Oyster Subbasin (HUC 12040205), North Galveston Bay (HUC 12040203) and the Lower Trinity Subbasin (HUC 12030203). Debiting ratios for the secondary service area will be on a 1:1.5 basis.

The secondary service area specifically excludes the following areas: Bolivar Peninsula west of a line extending from Latitude 29.510319 North, Longitude -94.501597 West southeastward to Latitude 29.506703 North, Longitude -94.499762 West. All lands owned, leased, or managed by Texas Parks and Wildlife Department are excluded from service area coverage.

The proposed service area descriptions and the proposed ratios are shown below in Table 11.

Table 11. Wetland and stream service area descriptions and credit ratios.

Service Area	Ratio	HUC Number	HUC Name
Primary	1:1	12040204 / 12040104	West Galveston Bay / Buffalo-San Jacinto Subbasin
Secondary	1.5:1	12040205 / 12040203 / 12030203 / 12040202	Austin-Oyster / North Galveston Bay / Lower Trinity / East Galveston Bay Subbasins

The sponsor proposes that on a case by case basis, the U.S. Army Corps of Engineers, after coordination with the Interagency Review Team, would consider, and may approve, the use of the bank outside the

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primary and secondary service areas when doing so is appropriate, practicable, and environmentally preferable.

6 QUALIFICATIONS OF THE SPONSOR

The sponsor has engaged with Wildwood Environmental Credit Company, LLC to manage the implementation, performance, and long-term management of the project. Wildwood manages four compensatory mitigation banks and three permittee-responsible mitigation sites in Texas and Oklahoma. These include the 19,079-acre Pineywoods Mitigation Bank (SWF-2004-00458) that has successfully completed its initial monitoring period, the 2,478-acre Burleson Wetlands Mitigation Bank (SWF-2009-00189) and the 583-acre Flat Creek Mitigation Bank (SWF-2014-00105), both of which are currently undergoing enhancement, and the 3,013-acre American Burying Beetle Conservation Bank (2014-F-0455) that is currently under long-term management. Permittee-responsible mitigation sites include the 12.4-mile stream mitigation site associated with SWF-2006-00251 that is in its fourth year of monitoring, the 2,262-foot stream mitigation site associated with SWF-2014-00303 that is in its second year of monitoring, and the 876-acre Keystone McAlester Conservation Area associated with U.S. Fish and Wildlife permit number TE80492A-0 that is in its fifth year of monitoring. All projects are in, and have always been in, compliance with the appropriate regulatory agencies. In addition to this project Wildwood is in the permitting phase on one prospective mitigation bank in the U.S. Army Corps of Engineers' Fort Worth District, the Indian Creek Mitigation Bank (SWF-2018-00121), and one prospective mitigation bank in the Galveston District, the Sea Breeze Mitigation Bank (SWG-2016-00086).

Cliff Sunda is the project manager and point of contact for the project. Mr. Sunda is a certified forester and professional wetlands scientist. He has ten years of experience permitting, operating, and managing compensatory mitigation projects.

Horizon Environmental Services, Inc. is the primary ecological services provider for the project. Horizon's responsibilities include wetland delineation and jurisdictional determination, cultural resources and threatened and endangered species surveys, and providing technical review of the restoration and revegetation plan and all regulatory submittals. Horizon has over 27 years of experience providing these services along the Texas Gulf Coast. Lee Sherrod is responsible for the work conducted by Horizon and he conducted the jurisdictional determinations at the site. Mr. Sherrod is a professional wetland scientist with over 38 years of experience.

A summary of the key personnel's qualifications is included as Appendix I.

7 CONCLUSION

In conclusion, the bank has high potential for rehabilitating, re-establishing, and enhancing approximately 409 acres of tidal fringe wetlands adjacent to Harbor Drive and the Highland Bayou Diversion Canal in Galveston County, Texas. The site consists of tidal marsh and spoil piles cast during the construction of the diversion canal. Implementation of the mitigation plan would result in the re-establishment, enhancement, and rehabilitation of tidal fringe wetlands. The bank will be established and operated in accordance to 33 CFR Part 332, *Compensatory Mitigation for Losses of Aquatic Resources*; Final Rule, dated April 10, 2008 (2008 Rule, 2008). Additional details will be provided in the draft Mitigation Banking Instrument.

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APPENDIX A - PROJECT MAPS

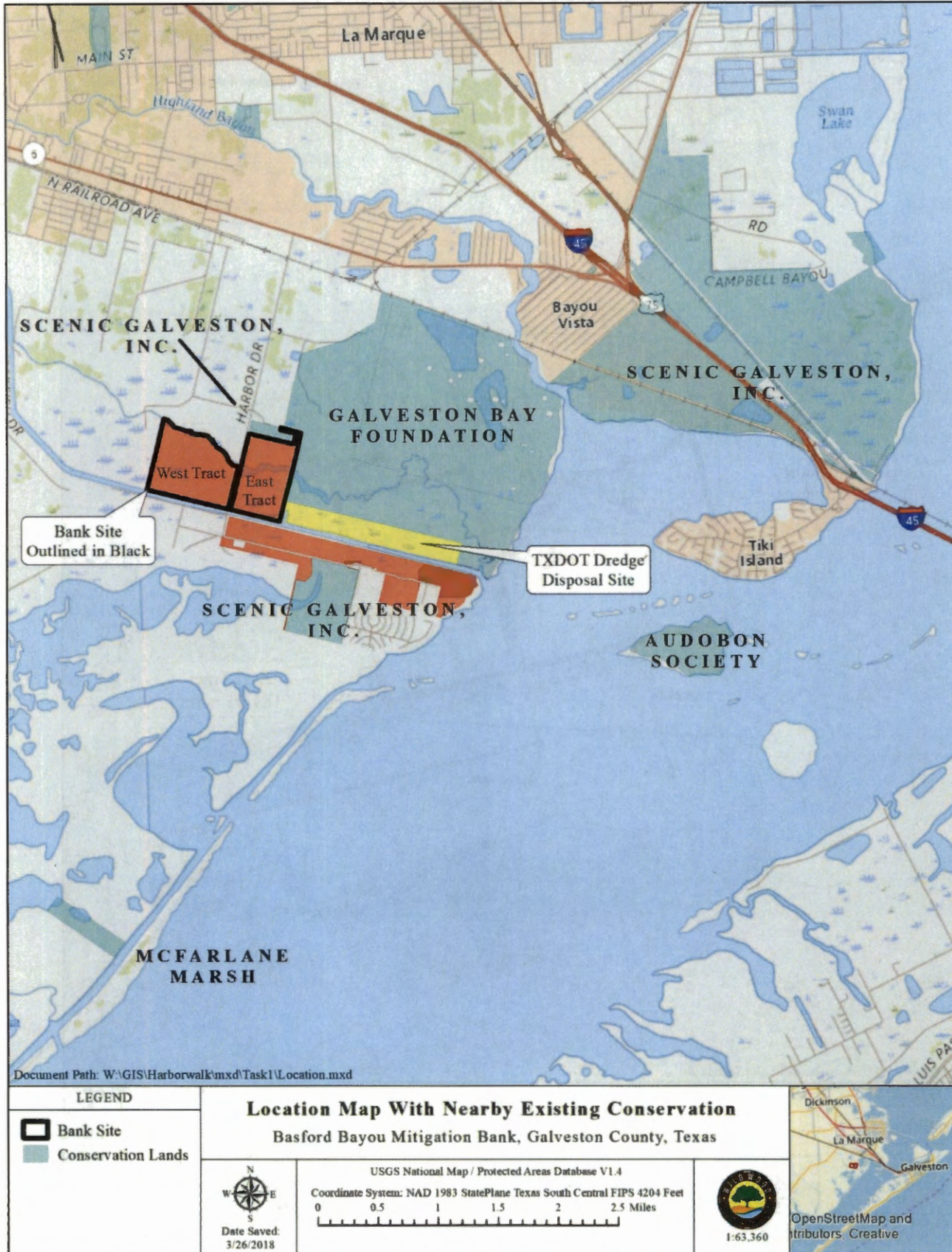


Figure 1. Location map showing nearby conservation areas.

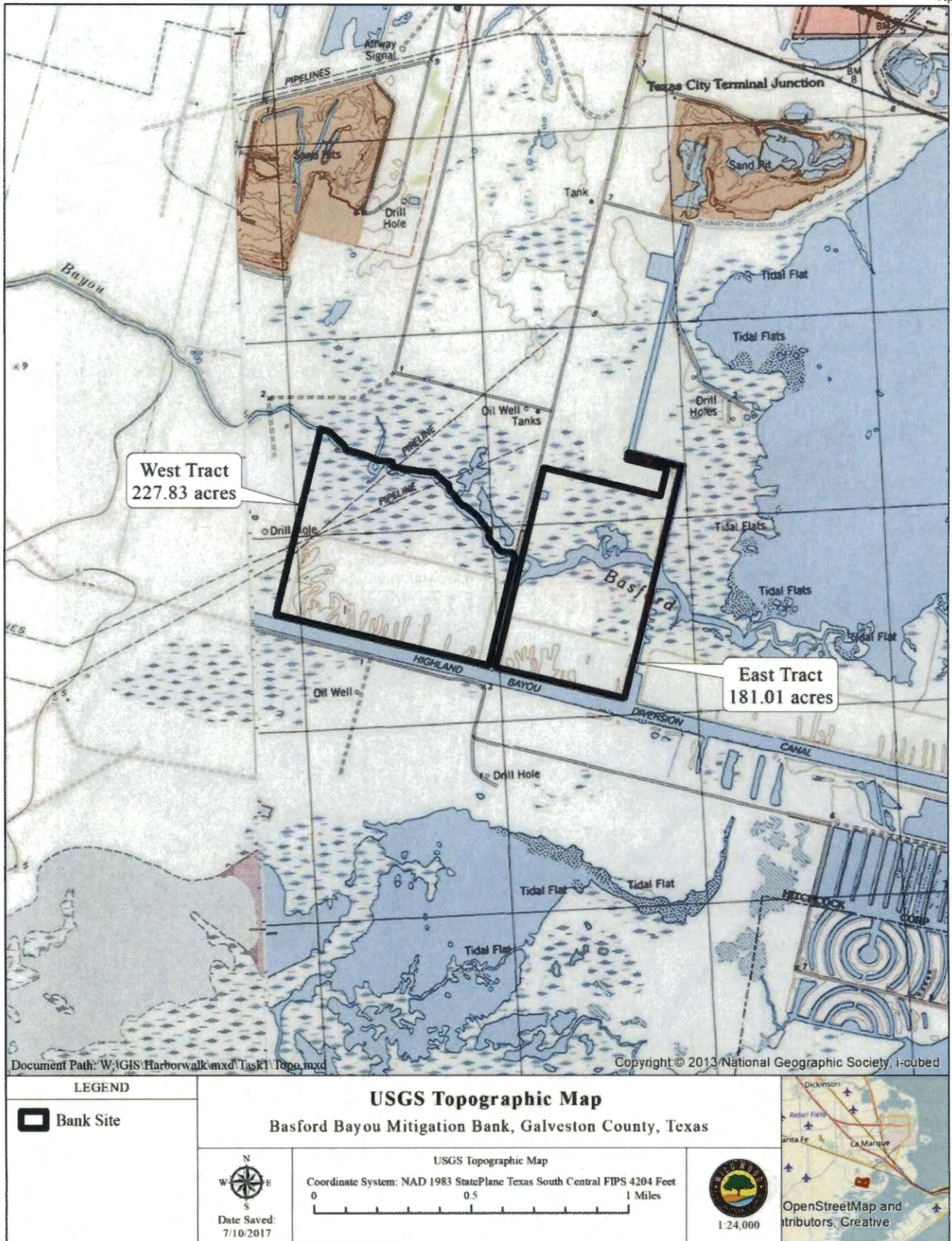


Figure 2. USGS topographic map of the site.

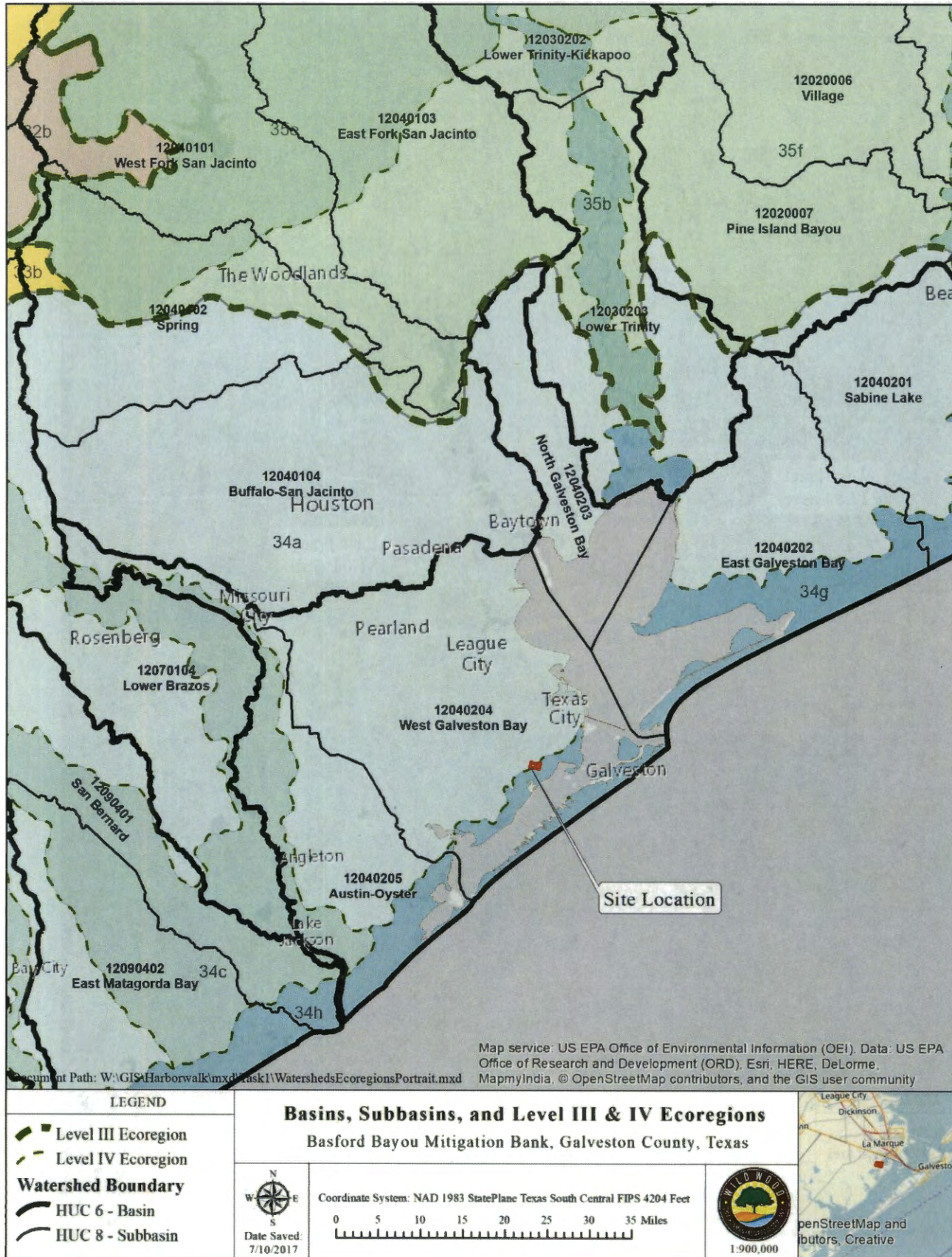


Figure 3. Area showing the Watershed Boundary Dataset and Omernik ecoregions.



Figure 4. Small scale aerial photo map showing the 2015 color infrared aerial photograph.

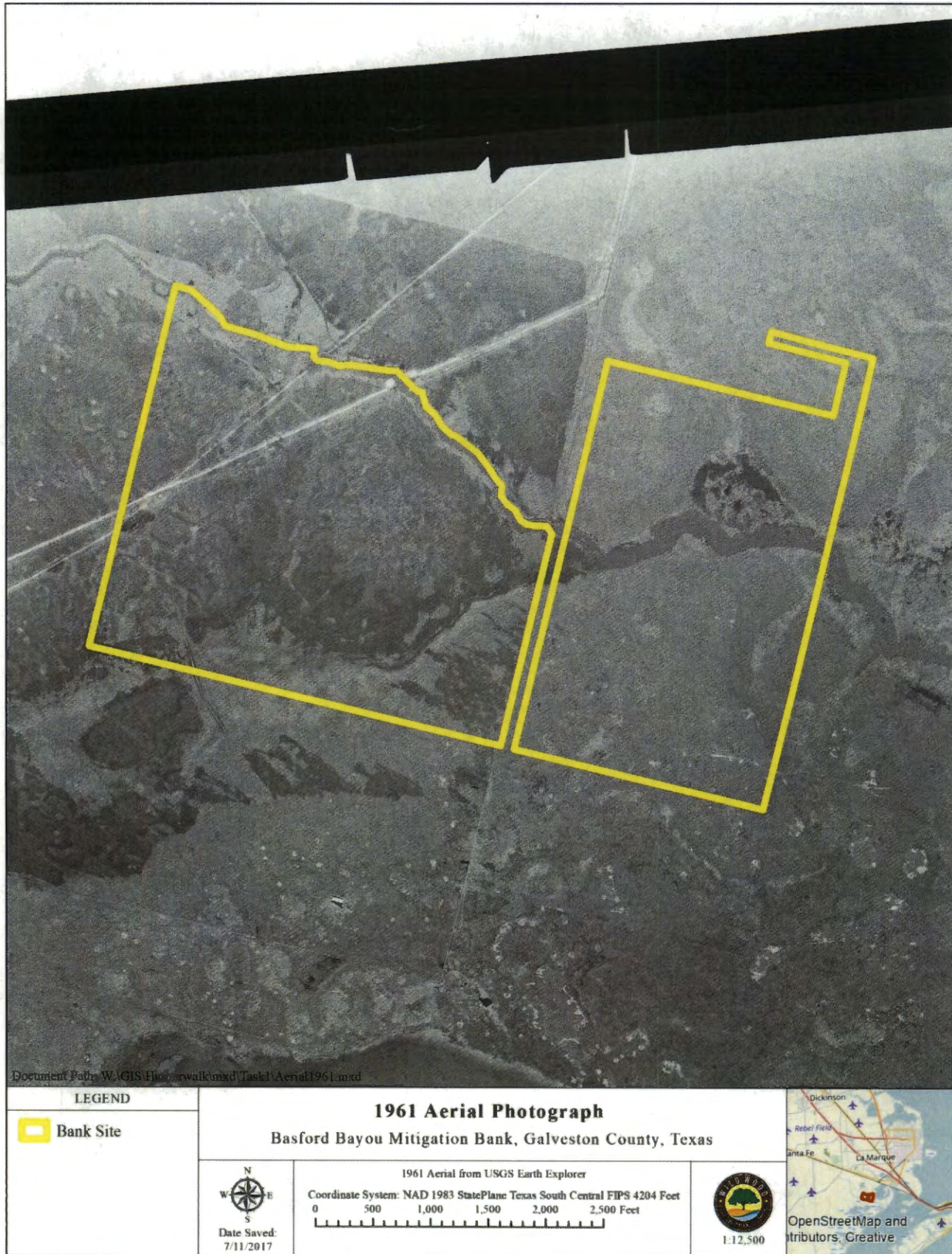
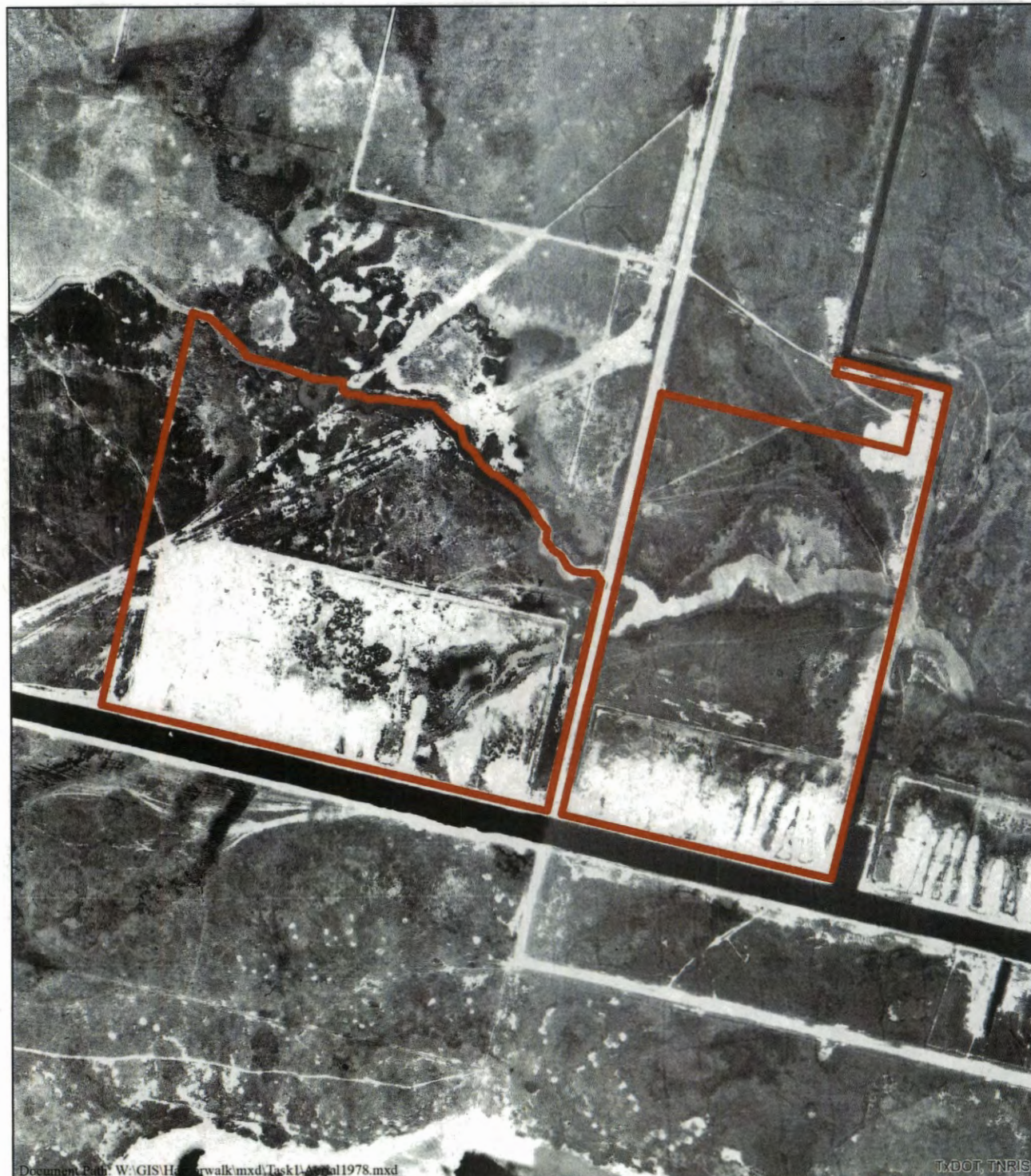


Figure 5. Aerial photograph of the site in 1961.



Figure 6. Aerial photograph of the site in 1969 showing partial completion of the Highland Bayou Diversion Canal.



Document Path: W:\GIS\Harriswalk\Task1\Aerial1978.mxd

TxDOT TNRS

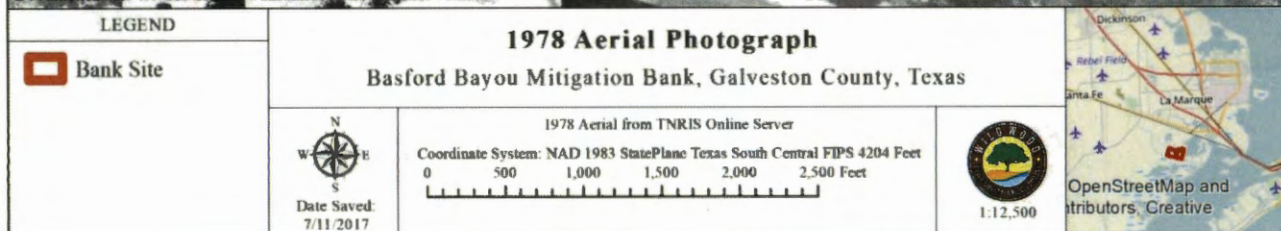


Figure 7. Aerial photograph of the site in 1978 showing completion of the diversion canal and nearby oil and gas exploration.

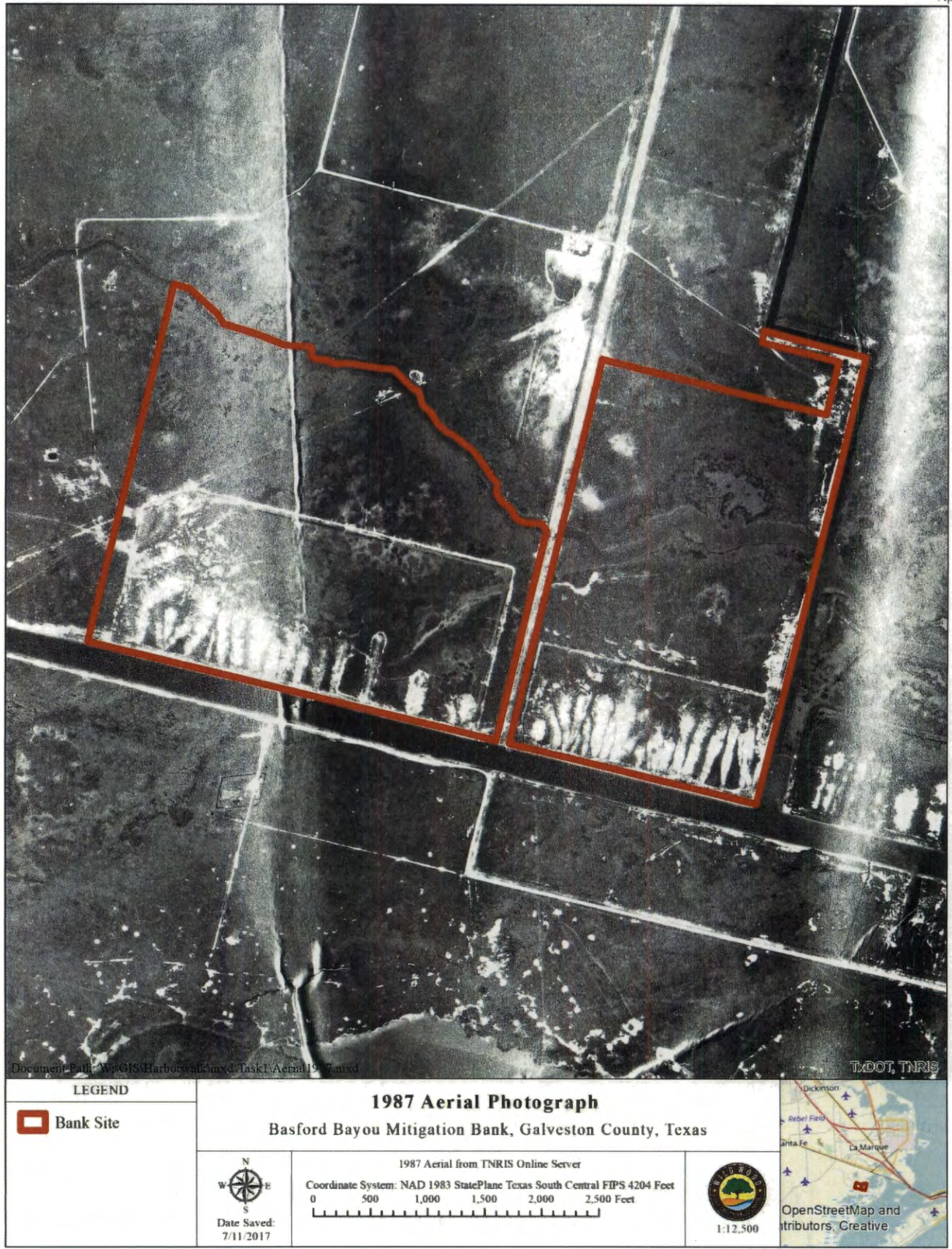


Figure 8. Aerial photograph of the site in 1987 showing additional nearby oil and gas exploration.



Figure 9. Aerial photograph of the site in 1996.



Figure 10. Large scale aerial photograph of the site in 2015.

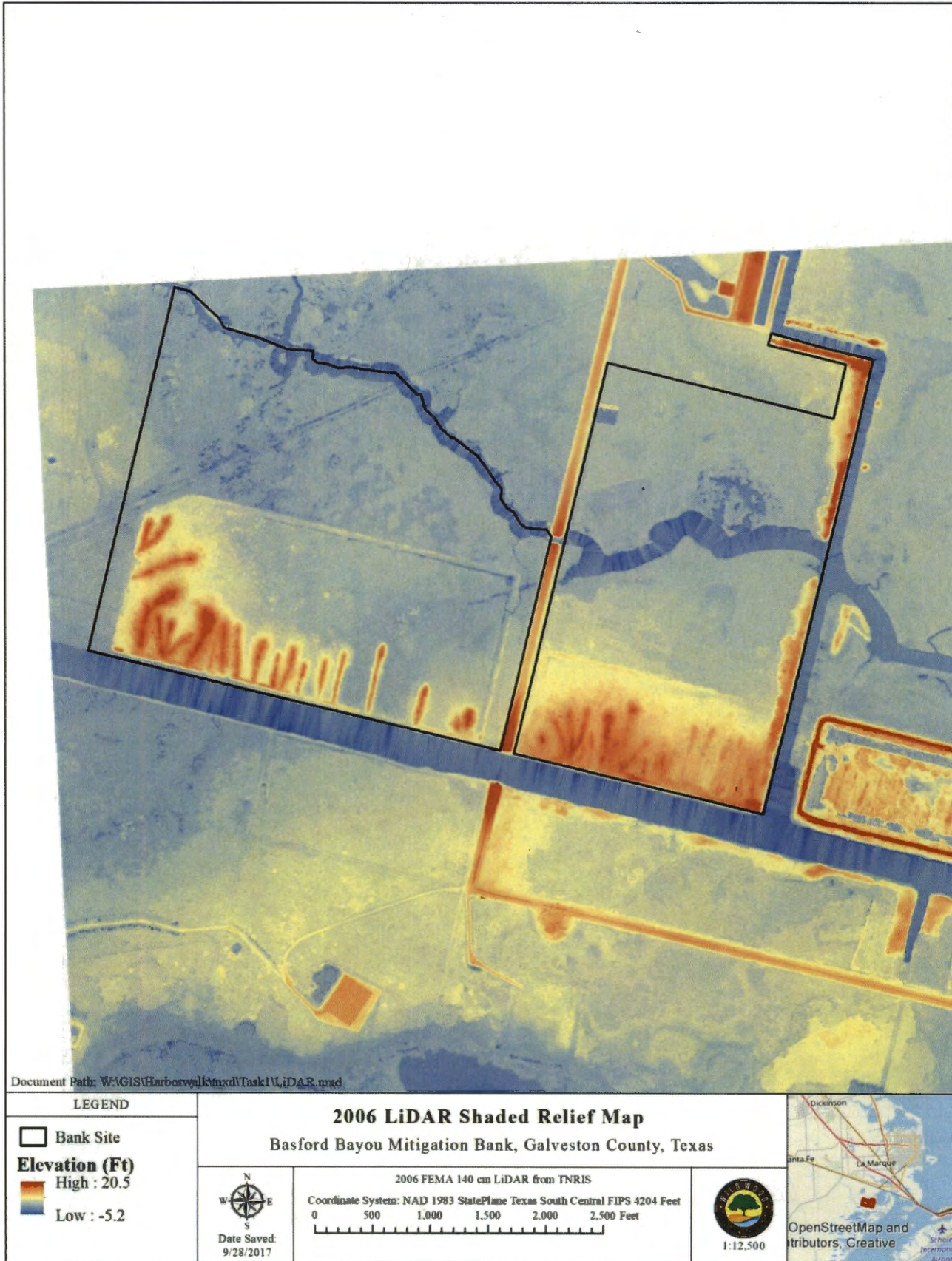


Figure 11. FEMA 2006 140 cm LiDAR data for the site.



Figure 12. NRCS SSURGO Soil survey map of the site over the National Map baselayer.



Figure 13. National Wetland Inventory classification of the site.

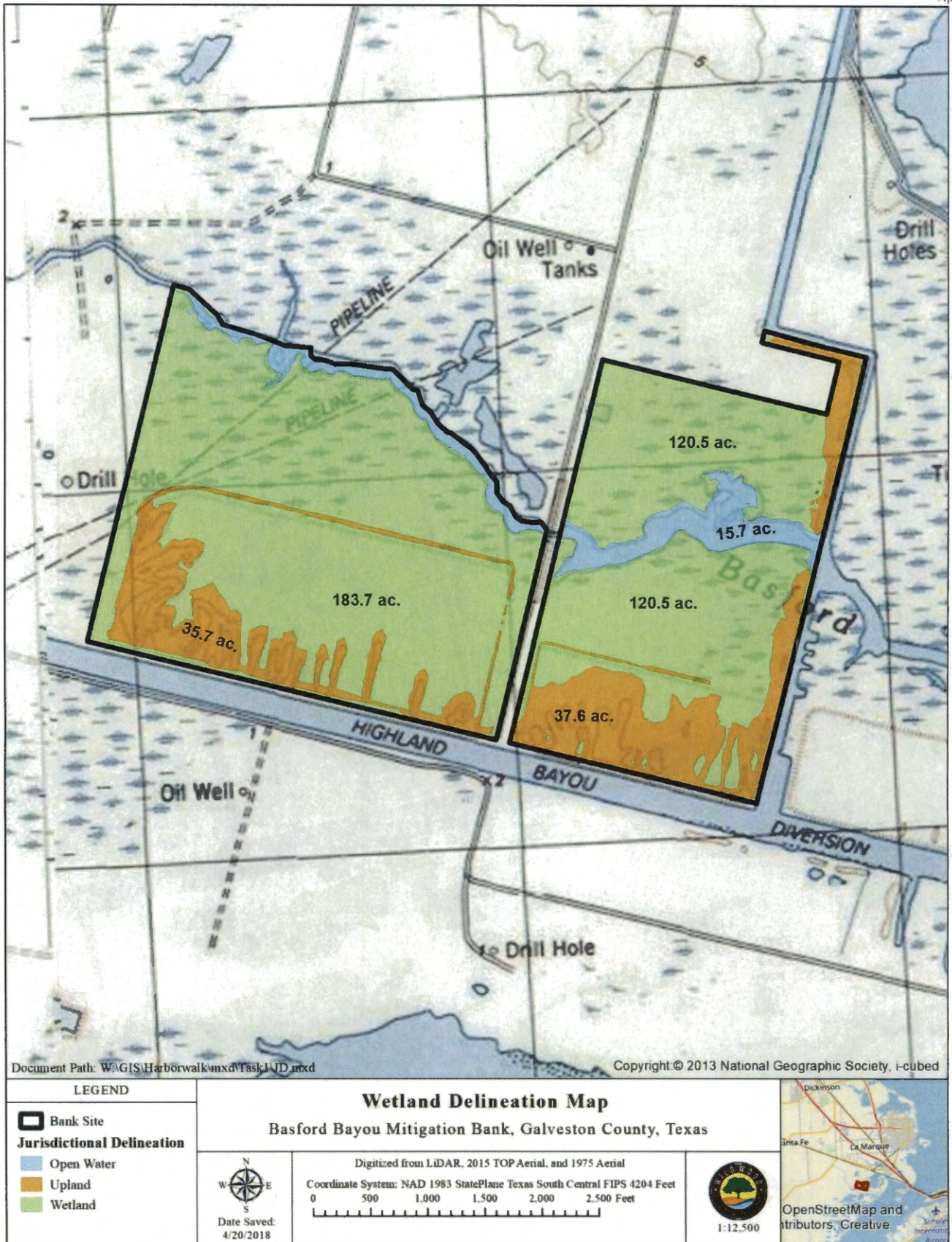


Figure 14. Wetland delineation of the site.



Figure 15. Map of wetland assessment areas used for discussion and credit calculation.

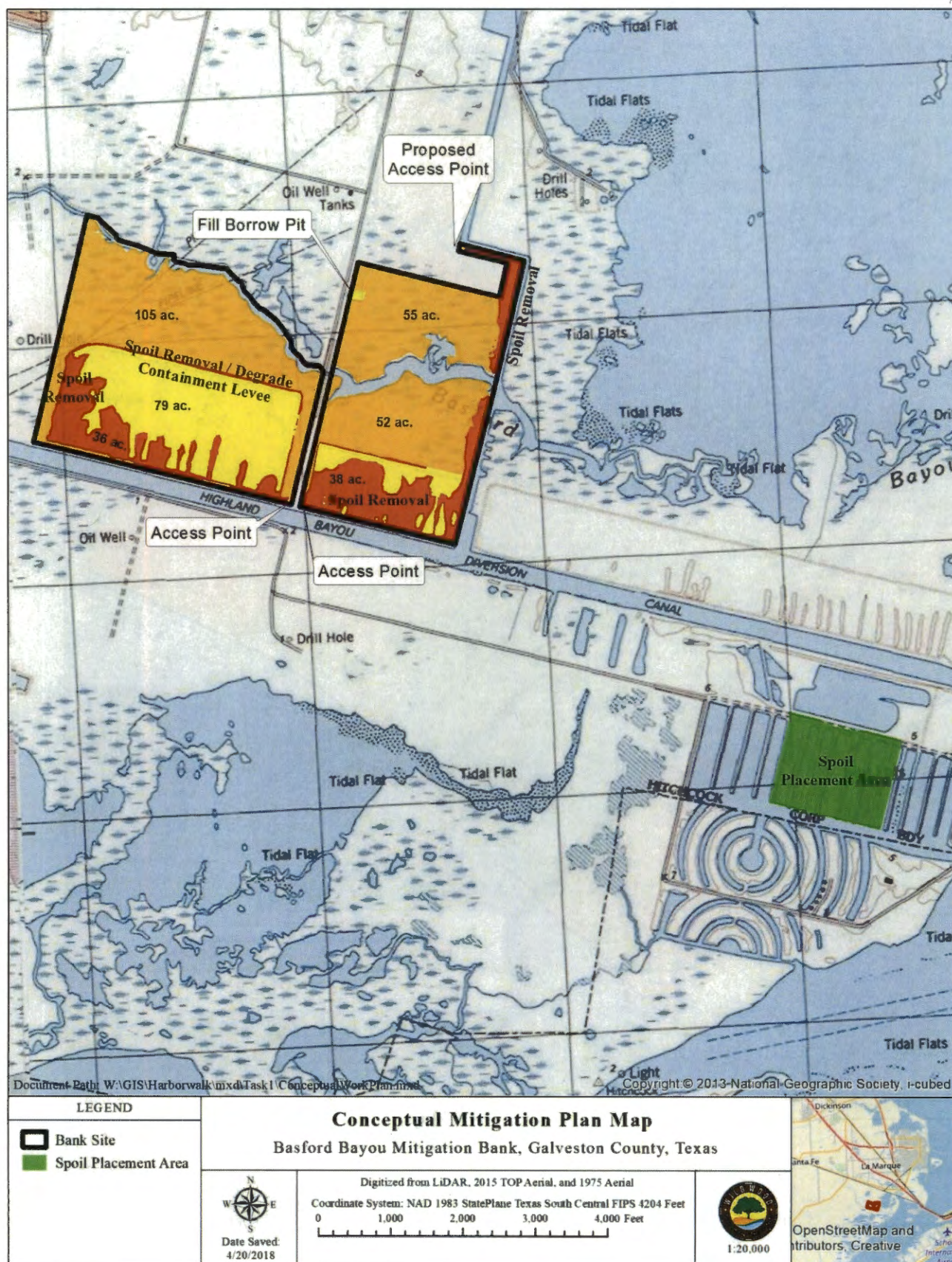


Figure 17. Conceptual Site Development Plan.

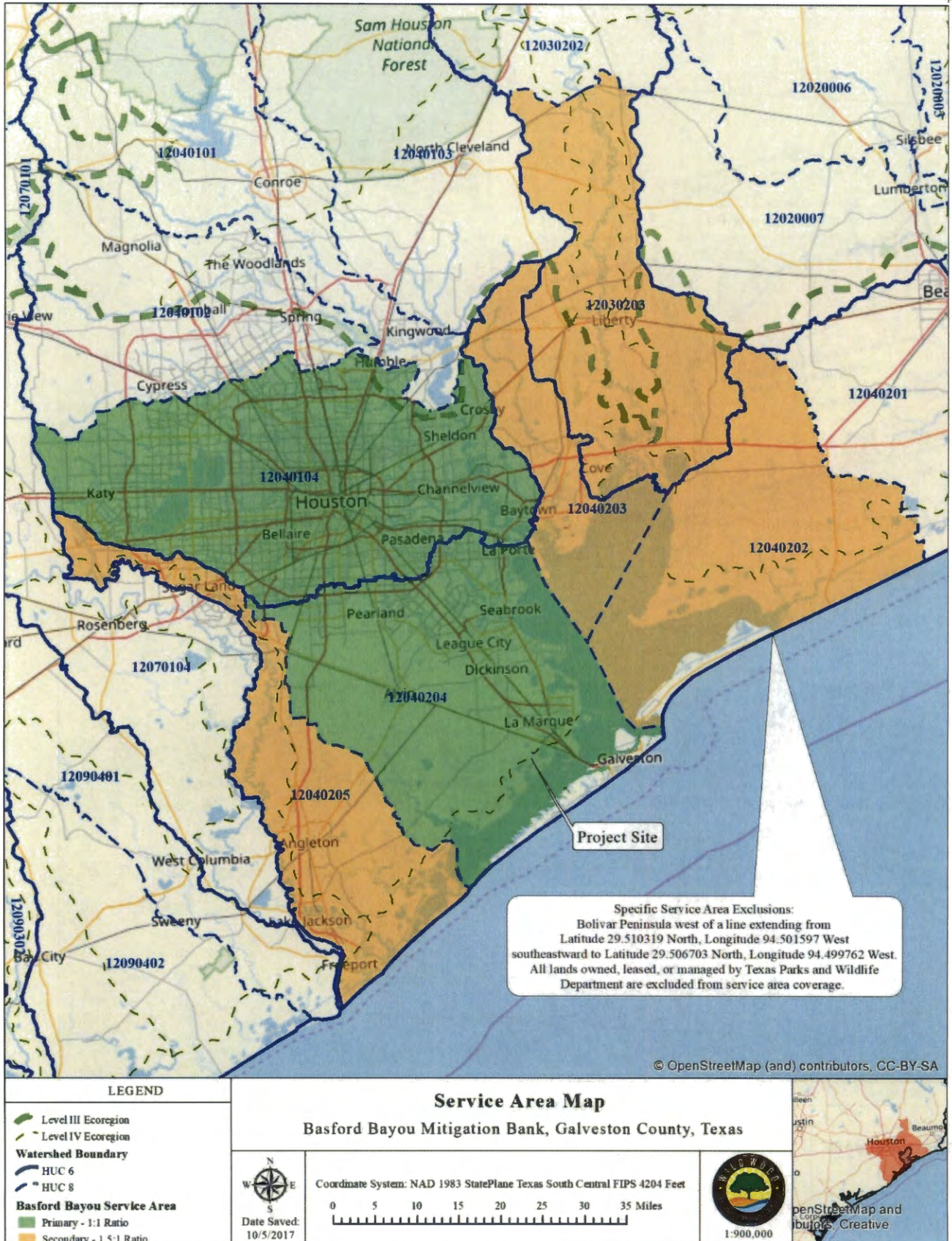


Figure 18. Proposed service area map.

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[illegible]

Figure 19. Map of photo locations.



Photo 1. View of west tract looking north through *Distichlis spicata* dominated area (7/31/2017).180



Photo 2. West tract *Spartina alterniflora* dominated area looking east (7/31/2017).



Photo 3. *Salicornia virginica* dominated alkaline flat looking south (7/31/2017).



Photo 4. Former containment levee that is 0.9 feet higher than adjacent marsh surface (7/31/2017).



Photo 5. Typical soil profile in spoil covered area showing underlying wetland soil (7/31/2017).



Photo 6. Transitional scrub-shrub wetland on spoil with abundant *Borreria frutescens* (7/31/2017).



Photo 7. Toe of spoil pile in non-wetland area (7/31/2017).



Photo 8. Top of spoil pile (7/31/2017).



Photo 9. North side of Highland Bayou Diversion Canal looking west (7/31/2017).



Photo 10. *Typha* sp. dominated freshwater wetland (left) along Highland Bayou Diversion Canal (7/31/2017).

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Photo 11. Western boundary of spoil pile looking north from Diversion Canal (7/31/2017).



Photo 12. Looking east from *Distichlis spicata* / *Batis maritima* wetland at spoil pile (7/31/2017).



Photo 13. Pipeline corridor intersection near northwest corner of spoil pile (7/31/2017).



Photo 14. Basford Bayou looking east near northwest corner of bank site (7/31/2017).

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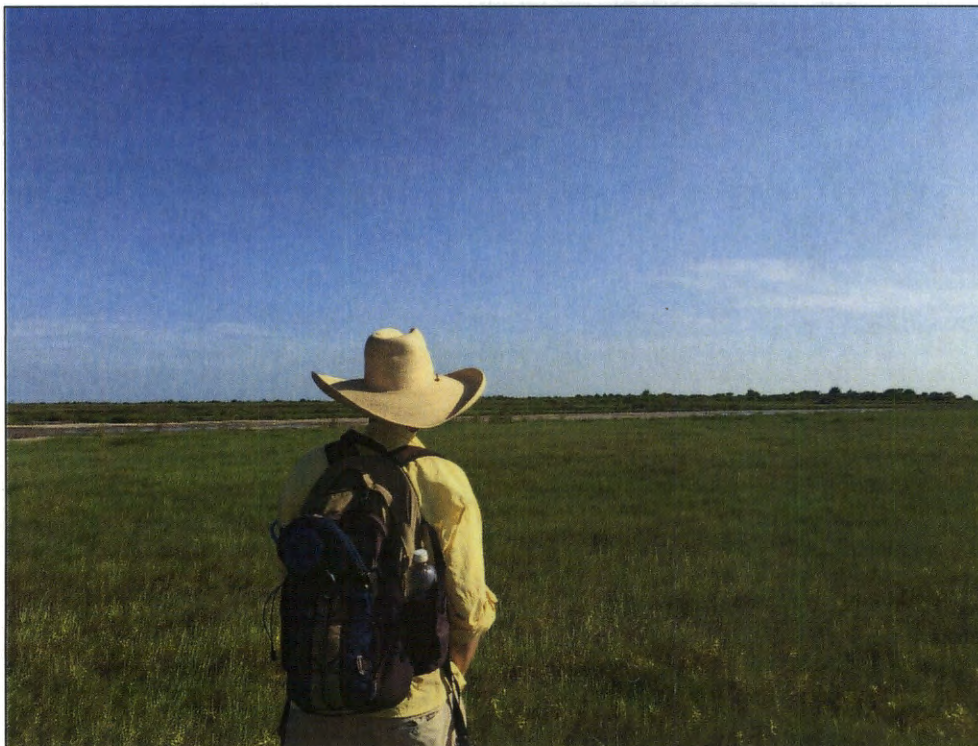


Photo 15. *Distichlis spicata* dominated wetland on west end of project (7/31/2017).



Photo 16. Intertidal zone near west end of project (7/31/2017).



Photo 17. Scrub-shrub wetland and upland area on west end of spoil piles (7/31/2017).



Photo 18. Containment levee looking east (7/31/2017).

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Photo 19. Boundary of *Spartina alterniflora* and *Salicornia* wetland on east tract (8/1/2017).



Photo 20. Toe of spoil bank on east boundary of the east tract (8/1/2017).



Photo 21. Top of spoil pile on east tract looking west (8/1/2017).



Photo 22. Where Basford Bayou flows out of the east tract (8/1/2017).



Photo 23. Former borrow pit on east tract (8/1/2017).



Photo 24. Heavily grazed pasture adjacent to West Tract (8/1/2017).



Photo 25. Gulf cordgrass dominated flat on east tract (8/1/2017).



Photo 26. Scrub-shrub wetland on east tract (8/1/2017).



Photo 27. View of someone standing on the retention levee on the east tract (8/1/2017).



Photo 28. Heavily disturbed scrub-shrub wetland (potentially not-wetland) area within retention levee (8/1/2017).

APPENDIX C – iHGM ANALYSIS

The following pages summarize the baseline iHGM functional capacity of the site as well as estimate the functional capacity that will result from implementing the project 1, 3, 5, and 7 years' post-construction and revegetation.

The tract has been separated into six Wetland Assessment Areas (WAAs): 1) non-wetland spoil areas; 2) wetlands west of Harbor Drive and within the former containment levee; 3) wetlands east of Harbor Drive and within the former containment levee; 4) wetlands west of Harbor Drive and outside of the former containment levee; 5) wetlands east of Harbor Drive, and 6) the former borrow pit east of Harbor Drive. A map of the WAAs may be found as **Figure 15**. The following discussions are based on the general ability of the wetlands onsite to function relative to the U.S. Army Corps of Engineer's iHGM assessment methods.⁸

⁸ For Tidal Fringe iHGM:

<http://www.swg.usace.army.mil/Portals/26/docs/regulatory/functional%20Assessment/SWGTidalFringeIHGM.pdf>

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Combined Functional Capacity Unit Gain for all WAAs						
Function	Baseline	Year 1	Year 3	Year 5	Year 7	Total
Biota		79.8	12.8	14.1	12.8	119.5
Botanical		8.2	25.5	28.2	25.7	87.6
Physical		85.3	3.8	3.9	0.0	93.0
Chemical		119.2	26.0	19.3	13.6	178.1
Total		292.5	68.1	65.5	52.1	478.2
Percent of Total		61%	14%	14%	11%	

WAA 1		Baseline Acres: 0				
Type	Tidal	Post-Construction Acres: 80.6				
Function	Baseline	Year 1	Year 3	Year 5	Year 7	
V _{edge}	0.00	0.40	0.40	0.40	0.40	
V _{hydro}	0.00	1.00	1.00	1.00	1.00	
V _{dhc}	0.00	0.50	0.50	0.50	0.50	
V _{typical}	0.00	0.10	0.40	0.70	1.00	
V _{slope}	0.00	0.50	0.50	0.50	0.50	
V _{width}	0.00	1.00	1.00	1.00	1.00	
V _{rough}	0.00	0.20	0.40	0.60	0.60	
V _{soil}	0.00	0.80	0.80	0.80	0.80	
Biota	0.00	0.43	0.58	0.73	0.88	
Botanical	0.00	0.10	0.40	0.70	1.00	
Physical	0.00	0.70	0.74	0.78	0.78	
Chemical	0.00	0.32	0.63	0.84	1.00	
Biota	0.0	34.7	46.7	58.8	70.9	
Botanical	0.0	8.1	32.2	56.4	80.6	
Physical	0.0	56.4	59.6	62.9	62.9	
Chemical	0.0	25.8	50.8	67.7	80.6	
Functional Capacity Unit Gain		Total				
Biota	34.7	12.0	12.1	12.1	12.1	70.9
Botanical	8.1	24.1	24.2	24.2	24.2	80.6
Physical	56.4	3.2	3.3	3.3	3.3	62.9
Chemical	25.8	25.0	16.9	16.9	12.9	80.6
Total	125.0	64.3	56.5	49.2	295.0	
	42%	22%	19%	17%		

WAA 2		Baseline Acres: 78.7				
Type	Tidal	Post-Construction Acres: 78.7				
Function	Baseline	Year 1	Year 3	Year 5	Year 7	
V _{edge}	0.70	0.70	0.70	0.70	0.70	
V _{hydro}	0.30	1.00	1.00	1.00	1.00	
V _{dhc}	0.80	0.80	0.80	0.80	0.80	
V _{typical}	1.00	1.00	1.00	1.00	1.00	
V _{slope}	1.00	1.00	1.00	1.00	1.00	
V _{width}	1.00	1.00	1.00	1.00	1.00	
V _{rough}	0.80	0.80	0.80	0.80	0.80	
V _{soil}	0.80	0.80	0.80	0.80	0.80	
Biota	0.74	0.94	0.94	0.94	0.94	
Botanical	1.00	1.00	1.00	1.00	1.00	
Physical	0.78	0.92	0.92	0.92	0.92	
Chemical	0.55	1.00	1.00	1.00	1.00	
Biota	58.2	74.0	74.0	74.0	74.0	
Botanical	78.7	78.7	78.7	78.7	78.7	
Physical	61.4	72.4	72.4	72.4	72.4	
Chemical	43.3	78.7	78.7	78.7	78.7	
Functional Capacity Unit Gain		Total				
Biota	15.8	0.0	0.0	0.0	0.0	15.8
Botanical	0.0	0.0	0.0	0.0	0.0	0.0
Physical	11.0	0.0	0.0	0.0	0.0	11.0
Chemical	35.4	0.0	0.0	0.0	0.0	35.4
Total	62.2	0.0	0.0	0.0	0.0	62.2
	100%	0%	0%	0%	0%	

WAA 3		Baseline Acres: 12.8					WAA 4		Baseline Acres: 105				
Type Tidal		Post-Construction Acres: 12.8					Type Tidal		Post-Construction Acres: 105				
Function	Baseline	Year 1	Year 3	Year 5	Year 7		Function	Baseline	Year 1	Year 3	Year 5	Year 7	
V _{edge}	0.40	0.40	0.40	0.40	0.40		V _{edge}	1.00	1.00	1.00	1.00	1.00	
V _{hydro}	0.00	1.00	1.00	1.00	1.00		V _{hydro}	0.60	1.00	1.00	1.00	1.00	
V _{nhc}	0.80	0.80	0.80	0.80	0.80		V _{nhc}	0.80	0.80	0.80	0.80	0.80	
V _{typical}	0.50	0.50	0.60	0.90	1.00		V _{typical}	1.00	1.00	1.00	1.00	1.00	
V _{slope}	1.00	1.00	1.00	1.00	1.00		V _{slope}	0.10	0.10	0.10	0.10	0.10	
V _{width}	1.00	1.00	1.00	1.00	1.00		V _{width}	1.00	1.00	1.00	1.00	1.00	
V _{rough}	1.00	0.20	0.40	0.60	0.60		V _{rough}	0.60	0.60	0.60	0.60	0.60	
V _{soil}	0.80	0.80	0.80	0.80	0.80		V _{soil}	0.80	0.80	0.80	0.80	0.80	
Biota	0.36	0.65	0.70	0.85	0.90		Biota	0.87	0.99	0.99	0.99	0.99	
Botanical	0.50	0.50	0.60	0.90	1.00		Botanical	1.00	1.00	1.00	1.00	1.00	
Physical	0.76	0.80	0.84	0.88	0.88		Physical	0.62	0.70	0.70	0.70	0.70	
Chemical	0.00	0.71	0.77	0.95	1.00		Chemical	0.77	1.00	1.00	1.00	1.00	
Biota	4.6	8.3	9.0	10.9	11.5		Biota	91.4	104.0	104.0	104.0	104.0	
Botanical	6.4	6.4	7.7	11.5	12.8		Botanical	105.0	105.0	105.0	105.0	105.0	
Physical	9.7	10.2	10.8	11.3	11.3		Physical	65.1	73.5	73.5	73.5	73.5	
Chemical	0.0	9.1	9.9	12.2	12.8		Chemical	80.9	105.0	105.0	105.0	105.0	
Functional Capacity Unit Gain		Total			Functional Capacity Unit Gain		Total		Total			Functional Capacity Unit Gain	
Biota	3.7	0.7	1.9	0.6	6.9		Biota	12.6	0.0	0.0	0.0	0.0	12.6
Botanical	0.0	1.3	3.8	1.3	6.4		Botanical	0.0	0.0	0.0	0.0	0.0	0.0
Physical	0.5	0.6	0.5	0.0	1.6		Physical	8.4	0.0	0.0	0.0	0.0	8.4
Chemical	9.1	0.8	2.3	0.6	12.8		Chemical	24.1	0.0	0.0	0.0	0.0	24.1
Total	13.3	3.4	8.5	2.5	27.7		Total	45.1	0.0	0.0	0.0	0.0	45.1
	48%	12%	31%	9%				98%	0%	0%	0%	0%	

WAA 5 Baseline Acres: 107.1
Type Tidal Post-Construction Acres: 107.1

Function	Baseline	Year 1	Year 3	Year 5	Year 7
V _{edge}	1.00	1.00	1.00	1.00	1.00
V _{hydro}	0.60	1.00	1.00	1.00	1.00
V _{nlc}	0.80	0.80	0.80	0.80	0.80
V _{typical}	1.00	1.00	1.00	1.00	1.00
V _{slope}	0.10	0.10	0.10	0.10	0.10
V _{width}	1.00	1.00	1.00	1.00	1.00
V _{rough}	0.60	0.60	0.60	0.60	0.60
V _{soil}	0.80	0.80	0.80	0.80	0.80

Biota	0.87	0.99	0.99	0.99	0.99
Botanical	1.00	1.00	1.00	1.00	1.00
Physical	0.62	0.70	0.70	0.70	0.70
Chemical	0.77	1.00	1.00	1.00	1.00
Biota	93.2	106.0	106.0	106.0	106.0
Botanical	107.1	107.1	107.1	107.1	107.1
Physical	66.4	75.0	75.0	75.0	75.0
Chemical	82.5	107.1	107.1	107.1	107.1

Functional Capacity Unit Gain	Total
Biota	12.8
Botanical	0.0
Physical	8.6
Chemical	24.6
Total	46.0
	100%
	0%
	0%
	0%

WAA 6 Baseline Acres: 0.6
Type Tidal Post-Construction Acres: 0.6

Function	Baseline	Year 1	Year 3	Year 5	Year 7
V _{edge}	0.00	0.40	0.40	0.40	0.40
V _{hydro}	0.00	1.00	1.00	1.00	1.00
V _{nlc}	0.00	0.30	0.30	0.30	0.30
V _{typical}	0.00	0.10	0.40	0.70	1.00
V _{slope}	0.00	1.00	1.00	1.00	1.00
V _{width}	0.00	0.60	0.60	0.60	0.60
V _{rough}	0.00	0.20	0.20	0.40	0.40
V _{soil}	0.00	0.80	0.80	0.80	0.80

Biota	0.00	0.41	0.56	0.71	0.86
Botanical	0.00	0.10	0.40	0.70	1.00
Physical	0.00	0.72	0.72	0.76	0.76
Chemical	0.00	0.32	0.63	0.84	1.00
Biota	0.0	0.2	0.3	0.4	0.5
Botanical	0.0	0.1	0.2	0.4	0.6
Physical	0.0	0.4	0.4	0.5	0.5
Chemical	0.0	0.2	0.4	0.5	0.6

Functional Capacity Unit Gain	Total
Biota	0.2
Botanical	0.1
Physical	0.4
Chemical	0.2
Total	0.9
	41%
	18%
	23%
	18%

WAA 1: Tidal - 80.6 Acres V_{side} : the amount of the marsh-water meters/hectare

Site Description	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
Marsh shows deterioration due to subsidence large amounts of open water	0.80						0.80
Well developed tidal drainage network present OR Simple tidal network with isolated ponds & depressions in the marsh interior OR Large amount of shallow shoreline in relation to the entire area Simple tidal drainage network...isolated ponds and depressions are few and lacking	1.00 0.70						1.00 0.70
Marsh lack both tidal creeks & isolated ponds & depressions, shoreline is linear or smooth...Marsh area is large relative to shoreline length. OR the WAA is a depression that is not affected by the daily tide (i.e. high marsh)	0.40		x	x	x	x	0.40

 V_{hydro} : site hydroperiod or degree of hydrological modifications

Site Description	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
Site is open, no hydrologic restrictions	1.00		x	x	x	x	1.00
Moderate hydrologic restriction (i.e. low level berms that overtop freq. by waves, or has multi-breaches or large numerous culverts)	0.60						0.60
Severe hydrologic restriction (High elevation berm with in freq over-top, small culverts, sincel opening or breach)	0.30						0.30
Site receives water only during extreme storm events	0.10						0.10
Site is cut off from tidal exchange	0.00						0.00

 V_{acc} : The number of habitat types present

(Habitat types: within 150 ft of the edge of the WAA)

Habitat Types:
Low Marsh / High Marsh / Subtidal Creeks / Intertidal Creeks ponds or depressions / SAVs / Oyster Reef / Unvegetative flats Algal flats / Mangroves / Coarse woody debris

Number of habitat types	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
1	0.20						0.20
2	0.30						0.30
3	0.50		x	x	x	x	0.50
4	0.70						0.70
5	0.80						0.80
6	1.00						1.00

WAA 1: Tidal - 80.6 Acres

V_{total}: proportion of the site that is covered by vegetation typical of the regional subclass

Invasive species: tallow, alligator weeds, spiny aster, common reed, rattlebox, cattail, flat sedge

(*Sagittum subiferrum*, *Alternanthera philoxeroides*, *Aster spinosus*, *Phragmites drummondii*, *Sesbania drummondii*, *Typha* sp., *Cyperus entrinatus*)

Total % Cover by typical species	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
10%	0.10		x				0.10
20%	0.10						0.10
30%	0.20						0.20
40%	0.40			x			0.40
50%	0.50						0.50
60%	0.60						0.60
70%	0.70				x		0.70
80%	0.90					x	0.90
90%	1.00						1.00
100%	1.00						1.00

V_{deep}: distance to water greater than or equal to 6 feet deep

Distance to Navigation Channel or water greater than or equal to 6 ft deep	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
Less than 150 ft	0.10						0.10
151-450 ft	0.50		x	x	x	x	0.50
Greater than 451 ft	1.00						1.00

V_{mean}: average marsh width

Mean Width WAA Distance (ft)	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
0-30 ft	0.10						0.10
31-75 ft	0.25						0.25
76-150 ft	0.50						0.50
151-225 ft	0.60						0.60
226-300 ft	0.80						0.80
301-375 ft	0.85						0.85
376-450 ft	0.90						0.90
451-525 ft	0.95						0.95
526-600 ft	1.00						1.00
Greater than 600 ft	1.00		x	x	x	x	1.00

WAA 1: Tidal - 80.6 Acres

Vrough: Manning's roughness coefficient: $n_{base} + n_{topo} + n_{veg} = \text{manning's } n$
(nbase)

Sediment surface	0.025	Base value for bare marsh soil.
	0.03	More than 25% of the sediment surface covered with gravel or broken shell

(ntopo)

Topographic relief	0.001	WAA is flat no microtopographic or macrotopographic relief
	0.005	WAA has 5-25% topographic relief
	0.010	WAA has 26-50% topographic relief
	0.200	WAA has greater than 50% topographic relief

(nveg)

Vegetation	Less 50% cover	50-75% cover	76-100% cover	Description of Conditions
	0.025	0.030	0.035	Predominantly Short flexible stem grass (i.e., <i>Spartina alterniflora</i> , <i>S. patens</i> , <i>Distichlis spicata</i>)
	0.035	0.040	0.050	Predominantly short stiff trailing stems (i.e. <i>Batis</i> & <i>Salicornia</i>)
	0.050	0.060	0.070	Predominantly tall flexible grass (i.e. tall <i>Spartina alterniflora</i> , <i>S. cynosuroides</i> , <i>Scirpus</i> sp.)
	0.070	0.100	0.160	Predominantly tall with stiff leaves or mixed with woody shrubs (i.e. <i>Juncus roemerianus</i> , Mangroves, etc.)

FCI variables sub index (rounded appropriately)

Roughness	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
0.04	0.10						0.10
0.05	0.20		x				0.20
0.06	0.40			x			0.40
0.07	0.60				x		0.60
0.08	0.80					x	0.80
0.09	1.00						1.00
0.10	1.00						1.00

V_{soil}: predominant soil texture

Soil Texture	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
Sandy	0.20						0.20
Sandy loam	0.40						0.40
Loam	0.60						0.60
Clay loam	0.80		x	x	x	x	0.80
Clay	1.00						1.00

WAA 2: Tidal - 78.7 Acres

V_{site} : the amount of the marsh-water meters/hectare

Site Description	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
Marsh shows deterioration due to subsidence large amounts of open water	0.80						0.80
Well developed tidal drainage network present OR Simple tidal network with isolated ponds & depressions in the marsh interior OR Large amount of shallow shoreline in relation to the entire area Simple tidal drainage network...isolated ponds and depressions are few and lacking	1.00						1.00
	0.70	x	x	x	x	x	0.70
Marsh lack both tidal creeks & isolated ponds & depressions, shoreline is linear or smooth....Marsh area is large relative to shoreline length. OR the WAA is a depression that is not affected by the daily tide (i.e. high marsh)	0.40						0.40

V_{hydro} : site hydroperiod or degree of hydrological modifications

Site Description	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
Site is open, no hydrologic restrictions	1.00		x	x	x	x	1.00
Moderate hydrologic restriction (i.e. low level berms that overtop freq. by waves, or has multi-breaches or large numerous culverts)	0.60						0.60
Severe hydrologic restriction (High elevation berm with in freq over-top, small culverts, single opening or breach)	0.30	x					0.30
Site receives water only during extreme storm events	0.10						0.10
Site is cut off from tidal exchange	0.00						0.00

V_{hab} : The number of habitat types present

(Habitat types: within 150 ft of the edge of the WAA)

Habitat Types
Low Marsh / High Marsh / Subtidal Creeks / Intertidal Creeks
Ponds or depressions / SAVs / Oyster Reef / Unvegetative flats
Algal flats / Mangroves / Coarse woody debris

Number of habitat types	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
1	0.20						0.20
2	0.30						0.30
3	0.50						0.50
4	0.70						0.70
5	0.80	x	x	x	x	x	0.80
6	1.00						1.00

WAA 2: Tidal - 78.7 Acres

V_{total}: proportion of the site that is covered by vegetation typical of the regional subclass

Invasive species: tallow, alligator weeds, spiny aster, common reed, rattlebox, cattail, flat sedge

(*Spartum seiferum*, *Alternanthera philoxeroides*, *Aster spinosus*, *Phragmites drummondii*, *Sesbania drummondii*, *Typha sp.*, *Cyperus eritranianus*)

Total % Cover by typical species	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
10%	0.10						0.10
20%	0.10						0.10
30%	0.20						0.20
40%	0.40						0.40
50%	0.50						0.50
60%	0.60						0.60
70%	0.70						0.70
80%	0.90						0.90
90%	1.00	X	X	X	X	X	1.00
100%	1.00						1.00

V_{deep}: distance to water greater than or equal to 6 feet deep

Distance to Navigation Channel or water greater than or equal to 6 ft deep	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
Less than 150 ft	0.10						0.10
151-450 ft	0.50						0.50
Greater than 451 ft	1.00	X	X	X	X	X	1.00

V_{width}: average marsh width

Mean Width WAA Distance (ft)	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
0-30 ft	0.10						0.10
31-75 ft	0.25						0.25
76-150 ft	0.50						0.50
151-225 ft	0.60						0.60
226-300 ft	0.80						0.80
301-375 ft	0.85						0.85
376-450 ft	0.90						0.90
451-525 ft	0.95						0.95
526-600 ft	1.00						1.00
Greater than 600 ft	1.00	X	X	X	X	X	1.00

WAA 2: Tidal – 78.7 Acres

Vrough: Manning's roughness coefficient: $n_{base} + n_{topo} + n_{veg} = \text{manning's } n$
(tbase)

Sediment surface	0.025	Base value for bare marsh soil
	0.03	More than 25% of the sediment surface covered with gravel or broken shell

(ntopo)

Topographic relief	0.001	WAA is flat no microtopographic or macrotopographic relief
	0.005	WAA has 5-25% topographic relief
	0.010	WAA has 26-50% topographic relief
	0.200	WAA has greater than 50% topographic relief

(nveg)

Vegetation	Less 50% cover	50-75% cover	76-100% cover	Description of Conditions
	0.025	0.030	0.035	Predominantly Short flexible stem grass (i.e. <i>Spartina alterniflora</i> , <i>S. patens</i> , <i>Distichlis spicata</i>)
	0.035	0.040	0.050	Predominantly short stiff trailing stems (i.e. <i>Batis</i> & <i>Salicornia</i>)
	0.050	0.060	0.070	Predominantly tall flexible grass (i.e. tall <i>Spartina alterniflora</i> , <i>S/ cynosuroides</i> , <i>Scirpus</i> sp.)
	0.070	0.100	0.160	Predominantly tall with stiff leaves or mixed with woody shrubs (i.e. <i>Juncus roemerianus</i> , Mangroves, etc.)

FCI variables sub index (rounded appropriately)

Roughness	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
0.04	0.10						0.10
0.05	0.20						0.20
0.06	0.40						0.40
0.07	0.60						0.60
0.08	0.80	X	X	X	X	X	0.80
0.09	1.00						1.00
0.10	1.00						1.00

V_{soil}: predominant soil texture

Soil Texture	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
Sandy	0.20						0.20
Sandy loam	0.40						0.40
Loam	0.60						0.60
Clay loam	0.80	X	X	X	X	X	0.80
Clay	1.00						1.00

WAA 3: Tidal - 12.8 Acres

V_{site} : the amount of the marsh-water meters/hectare

Site Description	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
Marsh shows deterioration due to subsidence large amounts of open water	0.80						0.80
Well developed tidal drainage network present OR Simple tidal network with isolated ponds & depressions in the marsh interior OR Large amount of shallow shoreline in relation to the entire area Simple tidal drainage network...isolated ponds and depressions are few and lacking	1.00 0.70						1.00 0.70
Marsh lack both tidal creeks & isolated ponds & depressions, shoreline is linear or smooth...Marsh area is large relative to shoreline length. OR the WAA is a depression that is not affected by the daily tide (i.e. high marsh)	0.40	X	X	X	X	X	0.40

V_{site} : site hydroperiod or degree of hydrological modifications

Site Description	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
Site is open, no hydrologic restrictions	1.00		X	X	X	X	1.00
Moderate hydrologic restriction (i.e. low level berms that overtop freq. by waves, or has multi-breeches or large numerous culverts)	0.60						0.60
Severe hydrologic restriction (High elevation berm with in freq over-top, small culverts, single opening or breach)	0.30						0.30
Site receives water only during extreme storm events	0.10						0.10
Site is cut off from tidal exchange	0.00	X					0.00

V_{site} : The number of habitat types present

(Habitat types: within 150 ft of the edge of the WAA)

Habitat Types:
Low Marsh / High Marsh / Subtidal Creeks / Intertidal Creeks Ponds or depressions / SAVs / Oyster Reef / Unvegetative flats Algal flats / Mangroves / Coarse woody debris

Number of habitat types	Variable Sub index	Baseline	Year 1	Year 3	Year 5	Year 7	Variable Sub index
1	0.20						0.20
2	0.30						0.30
3	0.50						0.50
4	0.70						0.70
5	0.80	X	X	X	X	X	0.80
6	1.00						1.00