Stream/Wetland Functional Assessment and Mitigation Plan

State Highway 99 (Grand Parkway) Segment B1 Project
From I-45 South to FM 2403

Galveston and Brazoria Counties, Texas

CSJ-3510-01-001, CSJ-3510-01-003, CSJ-3510-02-001, CSJ-3510-02-003, CSJ-0178-02-092

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Acronyms and Abbreviations

ALU	Aquatic Life Use
AV	Visual Channel Alteration Assessment
CI	Condition Index
CV	Visual Channel Assessment
FCI	Functional Capacity Index
FCU	Functional Capacity Unit
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FM	Farm to Market
GIS	Geographic Information System
I	Interstate
iHGM	Interim Hydrogeomorphic
NRCS	Natural Resources Conservation Service
PEM	Palustrine Emergent
PFO	Palustrine Forested
PSS	Palustrine Shrub-Scrub
PUB	Palustrine Unconsolidated Bottom
ROW	Right-of-way
RCI	Reach Condition Index
RCId	Reach Conditional Index Delta
SAR	Stream Assessment Reaches
SH	State Highway
SWG	Galveston District
TCEQ	Texas Commission on Environmental Quality
TSWQS	Texas State Water Quality Standards
TxDOT	Texas Department of Transportation
USACE	U.S. Corps of Engineers
USGS	U.S. Geological Survey
UV	Desktop Aquatic Use Assessment
WAA	Wetland Assessment Area
WHAP	Wetland Habitat Assessment Procedure

1.0 Introduction

The Texas Department of Transportation (TxDOT) conducted a U.S. Army Corps of Engineers (USACE) Galveston District (SWG) Level 1 Stream Condition Assessment and Interim Hydrogeomorphic (iHGM) Functional Assessment of wetlands and completed a Mitigation Plan for impacts to waters of the United States (U.S.) for State Highway (SH) 99 (Grand Parkway) Segment B1 from Interstate (I)-45 South to north of Farm to Market Road 2403 (FM 2403), which extends between League City and Alvin in Galveston and Brazoria Counties, Texas (CSJ-3510-01-001, CSJ-3510-01-003, CSJ-3510-02-001, CSJ-3510-02-003, and CSJ-0178-02-092).

SH 99 Segment B1 is a 14.2-mile alignment, with 9.1 miles on new location, from I-45 west on a new location to SH 35 and south along SH 35, ending just north of FM 2403 through Galveston and Brazoria Counties (**Attachment 1, Exhibit 1**). SH 99 Segment B1 would be constructed as a four-lane, controlled-access tollway facility consisting of two lanes in each direction within a 400-foot-wide right-of-way (ROW) and auxiliary lanes between on-ramps and off-ramps, where appropriate. The purpose of SH 99 Segment B1 is to efficiently link suburban communities and major roadways, enhance mobility, respond to economic growth, and provide an additional hurricane evacuation route.

Stream and wetland functional assessments are used to assess the current functional condition of these waters for use when determining the appropriate mitigation for unavoidable impacts to waters of the U.S. The site visits for the delineation and functional assessments were completed on March 5, 2024. Stream and wetland mitigation credits will be purchased from mitigation banks to offset impacts to waters of the U.S.

2.0 Existing Conditions

Current land use within and adjacent to the project area consists of existing ROW, agricultural land, residential, commercial, forests, and open land. Current changes within or just outside the project area consist of growth/urbanization with the conversions of land from agricultural and forests to residential (**Attachment 1, Exhibit 2**).

2.1 FEMA FIRM

The Federal Emergency Management Agency (FEMA) maintains flood insurance rate maps (FIRMs) that depict mapped floodplains. FEMA FIRM data were reviewed to evaluate the location of mapped floodplains in relation to water features within the project area (FEMA 2011). Refer to **Exhibit 3** in **Attachment 1** for an illustration of the FEMA FIRM data within and surrounding the project area.

2.2 USGS Topographic Maps

U.S. Geological Survey (USGS) topographic maps illustrate elevation contours, drainage patterns, and hydrography. The Dickinson, Algoa, and Manvel, Texas, USGS quadrangles maps dated 1956 and 1999 were reviewed to assist in determining the location and type of water features within the project area. Refer to **Exhibit 4** in **Attachment 1** for a 7.5-minute series USGS topographic overview map.

According to the topographic map, the elevation throughout the project area ranges from approximately 5 feet to 45 feet. USGS topographic maps for the Dickinson, Algoa, and Manvel, Texas USGS quadrangle maps identified a total of 10 waterbodies crossing the project ROW. Moving northeast to southwest along the project area, water features identified by USGS topographic maps include Magnolia Bayou, a tributary to Magnolia Bayou, six drainage ditches, Dickinson Bayou, and Mustang Bayou.

2.3 Soils

The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) soil data were reviewed to evaluate the mapped soils within the project area. NRCS soil data show a total of nine soils within the project area (**Attachment 1, Exhibit 5**). All nine soils within the project area are considered hydric. These soils include the following:

- LaA – Lake Charles clay, 0 to 1% slopes. The Lake Charles series consists of very deep, moderately well-drained, very slowly permeable soils that formed in clayey sediments. These soils are on broad coastal prairies. Slopes are mainly less than 1% but range from 0 to 8%.
- Bn – Bernard-Edna complex, 0 to 1% slopes. The Bernard series consists of very deep, somewhat poorly drained soils that formed in clayey fluviomarine deposits of the Beaumont Formation. These soils are on flats on flat coastal plains. Slopes range from 0 to 1%. The Edna series consists of very deep, somewhat poorly drained soils that formed in loamy fluviomarine deposits derived from the Beaumont Formation of Pleistocene age. These nearly level to gently sloping soils are on ancient meander ridges. Slope ranges from 0 to 5% but most less than 1%.
- Be – Bernard clay loam, 0 to 1% slopes. (Refer to Bernard series).

- Ar – Aris fine sandy loam, 0 to 1% slopes. The Aris series consists of very deep, poorly drained soils. These nearly level soils formed in loamy fluviomarine deposits derived from the Beaumont Formation. Slope ranges from 0 to 1%.
- Ed – Edna loam, 0 to 1% slopes. (Refer to Edna series).
- Ls – Leton, occasionally flooded – Aris, rarely flooded complex, 0 to 1% slopes. The Leton series consists of very deep, poorly drained, very slowly permeable soils. Slope ranges from 0 to 1% but is dominantly less that 0.5%.
- Me – Morey silt loam, rarely flooded. The Morey series consists of very deep, somewhat poorly drained very slowly permeable soils. These nearly level to very gently sloping soils formed in clayey and loamy sediments of the Beaumont Formation of Pleistocene age. Slopes range from 0 to 3%.
- Ba – Bacliff clay, 0 to 1% slopes. The Bacliff series consists of very deep, poorly drained soils. These nearly level soils formed in clayey fluviomarine deposits derived from the Beaumont Formation. Slope ranges from 0 to 1% but are typically less than 0.5%.
- Ve – Verland silty clay loam, 0 to 3% slopes. The Verland series consists of very deep, somewhat poorly drained, very slowly permeable soils. These nearly level to very gently sloping soils formed in clayey and loamy sediments of the Beaumont Formation of Pleistocene age. Slopes range from 0 to 3%.

2.4 Vegetation

Vegetation communities found within the project area consisted of Palustrine Emergent (PEM), Palustrine Forested (PFO), and Palustrine Shrub-Scrub (PSS) wetlands, maintained ROW, open field, and upland forested habitats. Dominant species found within PEM wetlands include the following: broadleaf cattail (*Typha latifolia*), Vasey's grass (*Paspalum urvillei*), alligatorweed (*Alternanthera philoxeroides*), spotted ladysthumb (*Polygonum persicaria*), sand spikerush (*Eleocharis montevidensis*), tall flatsedge (*Cyperus eragrostis*), eastern baccharis (*Baccharis halimifolia*), Mexican primrose-willow (*Ludwigia octovalvis*), marsh bristlegrass (*Setaria parviflora*), Cherokee sedge (*Carex cherokeensis*), erect centella (*Centella erecta*), oppositeleaf spotflower (*Acmella oppositifolia*), common rush (*Juncus effusus*), starrush whitetop (*Rhynchospora colorata*), perennial ryegrass (*Lolium perenne*), green ash (*Fraxinus pennsylvanica*), southern dewberry (*Rubus trivialis*), eastern poison ivy (*Toxicodendron radicans*), dallisgrass (*Paspalum dilatatum*), Bermudagrass (*Cynodon dactylon*), peppervine (*Ampelopsis arborea*), saltgrass (*Distichlis spicata*), slender plantain (*Plantago heterophylla*), common reed (*Phragmites australis*), annual marsh elder (*Iva annua*), nutgrass (*Cyperus rotundus*), bigpod sesbania (*Sesbania herbacea*), common carpetgrass (*Axonopus fissifolius*), Virginia buttonweed (*Diodia virginiana*), Chinese tallow (*Triadica sebifera*), black willow (*Salix nigra*), and loblolly pine (*Pinus taeda*).

Dominant plant species found within PSS wetlands include the following: yaupon (*Ilex vomitoria*), sugarberry (*Celtis laevigata*), Canada goldenrod (*Solidago altissima*), cherokee sedge, sand spikerush, eastern baccharis, and Chinese tallow.

Dominant plant species found within PFO wetlands include the following: annual ragweed (*Ambrosia artemisiifolia*), willow oak (*Quercus phellos*), common rush, common reed, broadleaf cattail, sand spikerush,

eastern baccharis, southern dewberry, Chinese tallow, marsh bristlegrass, black willow, loblolly pine, and American elm.

Dominant plant species found within upland areas include the following: saw greenbrier (*Smilax bona-nox*), roughleaf dogwood (*Cornus drummondii*), American elm, possumhaw (*Ilex decidua*), pecan (*Carya illinoinensis*), narrowleaf plantain (*Plantago lanceolata*), poverty oatgrass (*Danthonia spicata*), purpletop tridens (*Tridens flavus*), white clover (*Trifolium repens*), Texas vervain (*Verbena halei*), narrowleaf blue-eyed grass (*Sisyrinchium angustifolium*), pinkladies (*Oenothera speciosa*), corn (*Zea mays*), poisonbean (*Sesbania drummondii*), golden tickseed (*Coreopsis tinctoria*), glossy privet (*Ligustrum lucidum*), wax myrtle (*Morella cerifera*), eastern redcedar (*Juniperus virginiana*), dallisgrass, common dandelion (*Taraxacum officinale*), rescuegrass (*Bromus catharticus*), great ragweed (*Ambrosia trifida*), Johnsongrass (*Sorghum halepense*), Torrey's rush (*Juncus torreyi*), smallflower desert-chicory (*Pyrrhopappus pauciflorus*), Kleberg's bluestem (*Dichanthium annulatum*), annual ragweed, scarlet pimpernel (*Anagallis arvensis*), poverty rush (*Juncus tenuis*), Japanese honeysuckle (*Lonicera japonica*), Bermudagrass, annual marsh elder, marsh bristlegrass, perennial ryegrass, Canada goldenrod, starrush whitetop, Cherokee sedge, Vasey's grass, southern dewberry, eastern baccharis, eastern poison ivy, peppervine, yaupon, Chinese tallow, sugarberry, loblolly pine, and willow oak.

2.5 Delineated Aquatic Resources

A total of 38 wetlands, including PEM, PFO, PSS, and Palustrine Unconsolidated Bottom (PUB) wetland types, were identified within the project areas delineation, for a total of 41.14 acres (**Attachment 1, Exhibit 6**). Six streams, including ephemeral, intermittent, and perennial flow regimes, were identified in the project area, for a total of 5,720.10 linear feet (**Table 2-1**). Impacts from the project are anticipated to each of the wetlands and five of the six streams (**Attachment 1, Exhibit 7**). One additional wetland was added to this report, which is overlapped by another TxDOT delineation report, PSS WF 6. This wetland is 0.08 acres bringing the PSS total to 1.12 acres and wetland total count to 39. Impact totals to water features by the project can be found in **Table 2.1**.

Table 2-1. Features Impacted by the Project

Wetlands				Streams				
Class	Number	Quantity (Acres)	Impacts (Acres)	Flow Regime	Number	Quantity (Linear Feet)	Impacts (Linear Feet)	Impacts (Acres)
PEM	28	24.94	24.94	Ephemeral	2	774.70	774.70	0.43
PFO	6	13.99	13.99	Intermittent	1	679.70	76.80	0.02
PSS	3	1.12	1.12	Perennial	3	4,265.70	373.00	0.16
PUB	2	1.17	1.17	**Total**	**6**	**5,720.1**	**1,224.50**	**0.61**
Total	**39**	**41.22**	**41.22**					

3.0 Level 1 Stream Condition Assessment Methods

The Level 1 Stream Condition Assessment (L1SCA) is designed to assess the functional condition of all ephemeral and intermittent streams and for impacts less than 500 linear feet to intermittent streams with perennial pools, perennial streams, and wadeable rivers. Unavoidable impacts are proposed to occur to five streams in the project area: ES01, ES02, IS01, PS01, and PS02. For each of these streams, four parameters were visually assessed during the L1SCA, including:

1. Visual Channel Assessment (CV)
2. Desktop Riparian Buffer Assessment (BV)
3. Desktop Aquatic Use Assessment (UV)
4. Visual Channel Alteration Assessment (AV)

Prior to any fieldwork, three 350-foot-long stream assessment reaches (SAR) within the channel of each stream meeting the criteria for an L1SCA were established and spaced 125 feet apart in accordance with L1SCA procedures (USACE 2013). These SARs, along with the space between them, define the study area for each stream where an L1SCA was performed. These streams and their respective SARs are shown in **Exhibit 8** in **Attachment 1** and data sheets are located in **Attachment 2.**

3.1 Visual Channel Assessment

Each SAR was evaluated by visually assessing certain geomorphological indicators, including the channel's incision into the landscape, access to original or recently created floodplains, natural or artificial widening, depositional features (sand or gravel bars, vegetation, etc.), rooting depth to bed elevation ratios, vegetative protection, artificial features such as bulkheading and riprap, and erosion. Each SAR was then categorized based on its channel geometry, channel stability, and access to the floodplain, and scored the CV using the five categories provided.

- Optimal – Score 5
- Suboptimal – Score 4
- Marginal – Score 3
- Poor – Score 2
- Severe – Score 1

3.2 Desktop Riparian Buffer

Using a geographic information system (GIS) platform, the ordinary high-water mark of each stream and aerial photography were used to evaluate the vegetation within a 100-foot buffer on each side of the channel. Vegetation was divided into cover types and assigned values from the following six categories:

- Optimal – Score 5
- High Suboptimal – Score 4.5
- Low Suboptimal – Score 4.0

- Marginal – Score 3
- Poor – Score 2
- Severe – Score 1

The percentage of each cover type, based on the structure of plant communities as well as the composition of native vegetation, was quantified using GIS, and a weighted value for each cover type was calculated. The score for each study area is the sum of the weighted values of all cover types within the 100-foot buffer. The riparian buffer was assessed for the entire study reach rather than broken into transects; therefore, each stream will have a single BV score representing all transects.

3.3 Desktop Aquatic Use Assessment

Each SAR was assessed based on the aquatic life use (ALU) category score assigned to the stream segment by the Texas Commission on Environmental Quality (TCEQ) Texas State Water Quality Standards (TSWQS), based on the physical, chemical, and biological characteristics of the water body (**Attachment 3**). For streams not classified in the TSWQS, the aquatic life use score is based on the stream flow type in accordance with Level 1 procedures (USACE 2013). The five aquatic life use categories and their corresponding SAR scores are:

- Exceptional ALU: Optimal – Score 5
- High ALU: Suboptimal – Score 4
- Intermediate ALU: Marginal – Score 3
- Limited ALU: Poor – Score 2
- Minimal ALU: Severe – Score 1

3.4 Visual Channel Alteration Assessment

Each SAR was assessed for direct impacts on the stream channel from anthropogenic sources. Examples of channel alterations evaluated in this parameter that may disrupt the natural condition of the stream can include straightening of the channel or other channelization, bridges and bottomless culverts, riprap, articulated matting, concrete aprons, gabions or concrete blocks, manmade embankments on streambanks, constrictions to the stream channel, or livestock impacts such as hoof treads. Similar to other Level 1 variables, an AV score was assigned to each SAR from the following categories:

- Optimal – Score 5
- Suboptimal – Score 4
- Marginal – Score 3
- Poor – Score 2
- Severe – Score 1

3.5 Calculations

After evaluating the SARs for the four variables described previously (CV, BV, UV, and AV), a condition index (CI) can be calculated for each SAR. Score values for each variable range from 1 to 5. The CI for each SAR is calculated using the arithmetic mean score for these variables. The calculation for determining CI is:

$$C_I = \frac{CV + BV + UV + AV}{4}$$

Once a CI has been calculated for each SAR, a Reach Condition Index (RCI) is calculated for the entire study area. Similar to the CI for each SAR, an arithmetic mean is used to calculate the RCI. The calculation for determining the RCI is:

$$RCI = \frac{\sum_{n=1}^{Y} CI_N}{Y}$$

Where:

- RCI = Reach Condition Index
- CI = Condition Index for each SAR
- Y – Number of SARs

4.0 Level 1 Stream Condition Assessment Results and Mitigation

4.1 Current Stream Condition

L1SCA was conducted on ES01, ES02, IS01, PS01 (Magnolia Bayou), and PS02 (Dickinson Bayou). These streams are in an undeveloped area, with scores ranging from 1.75 to 3.13 reflecting the environment. The primary factors reducing this stream's score are an unlisted ALU and evidence of past alteration from which the stream has not recovered to a normal stable stream meander pattern. All four streams were uniform throughout their respective study areas to the extent that the CV, UV, and AV scores were the same for all transects within each stream. PS01 C, PS01 D, and PS02 B were desktop delineated due to the lack of right of entry at these locations, so the L1SCA scores were assumed to be similar to other portions of PS01 and PS02 that were delineated and assessed, according to the desktop review.

4.2 Theoretical Stream Condition

Each stream assessed is also given a theoretical RCI to indicate the expected condition of the stream after completion of the project. The theoretical RCI depends on the type of impacts occurring as a result of the project; installation or removal of shoring material, extending or reducing culverts, and straightening portions of the stream are all examples of alterations that would cause the theoretical RCI to differ from current conditions. Because final project design is not complete as of the publication date of this document and TxDOT intends to properly mitigate all potential impacts, the theoretical RCI for all streams assessed is assumed to be a one, the lowest quality. While the actual post-construction RCI for these streams will likely be higher than one, assumption of this value represents a worst-case scenario and ensures that any impacts, up to and including a total loss of stream channel, will be properly mitigated.

4.3 Mitigation Compensation

The mitigation compensation requirement for each stream was calculated using the Reach Conditional Index Delta (dRCI), an impact factor for the type and magnitude of impact, and the linear feet of impacts. dRCI is the difference between the actual and theoretical stream assessments. The stream credit requirement determined from the L1SCA assessment for impacts to waters of the U.S. is 5,156 credits. **Table 4-1** summarizes the results of the Level 1 Stream Assessment and estimated compensation requirements for each stream.

Table 4-1. Level 1 Stream Assessment Results and Mitigation Requirement

Feature	Average Reach Conditional Index (RCI)	Average Theoretical RCI	Change in Reach Conditional Index (dRCI)	Impact Factor	Linear Feet of Impact	Compensation Requirement (Stream Credits)
ES01	1.75	1.00	0.750	2	531.70	798
ES02	3.13	1.00	2.13	4	243	2,070
IS01	2.25	1.00	1.25	3	76.8	288
PS01 Magnolia Bayou	2.83	1.00	1.831	3	273.3	1,501

PS02 Dickinson Bayou	2.668	1.00	1.668	3	99.7	499
Stream Credit Requirements						**5,156**

5.0 Interim Hydrogeomorphic Study Methods

An iHGM analysis was used to calculate current wetland functions and predict potential changes to a wetland's functions that may result from the proposed activities. The SWG Riverine Forested iHGM form was used for forested wetlands, and the SWG Riverine Herbaceous/Shrub iHGM form was used for non-forested wetlands. The analysis yielded the existing physical, biological, and chemical Functional Capacity Index (FCI) of each wetland assessment area (WAA). The FCI is a quantitative number that estimates the capacity of the wetland to perform a function as it relates to the adjacent water body and is calibrated to other wetlands in the region and subclass. In determining the amount of mitigation required, the functional capacity units (FCUs = FCI multiplied by acres) for each function impacted must ultimately be accounted for by the same or greater amount of FCUs for each respective function compensated.

The Riverine Herbaceous/Shrub iHGM uses 10 variables to evaluate non-forested wetlands. The three indices are expressed as:

Temporary Storage and Detention of Storage Water:

$$\frac{\left[\frac{\{V_{dur}+V_{freq}\}}{2}\times\left\{V_{topo}+\left\{\frac{V_{herb}+V_{mid}}{2}\right\}\right\}}{2}\right]}{2}$$

Maintain Plant and Animal Community:

$$\frac{\{V_{mid}+V_{herb}+V_{connect}\}}{3}$$

Removal and Sequestration of Elements and Compounds:

$$\frac{\left[[V_{wood}+V_{freq}+V_{dur}]\left[\frac{\{V_{topo}+V_{herb}+V_{mid}\}}{3}\right]\left[\frac{\{V_{detritus}+V_{redox}+V_{sorpt}\}}{3}\right]\right]}{5}$$

The 10 variables collected for non-forested wetlands include the following:

- V_{dur}: Duration of flooding in an average year
- V_{freq}: Frequency of flooding
- V_{topo}: Percent of site containing topographic features
- V_{wood}: Percent covered by woody vegetation
- V_{mid}: Percent of relative cover between the herbaceous and tree strata
- V_{herb}: Percent of herbaceous cover
- $V_{detritus}$: Percent of area with detritus at the soil surface
- V_{redox}: Abundance of redox features within the top 12 inches of soil

V_{sorpt}: Absorptive soil properties

$V_{connect}$: Connectivity to other habitat types within 600 feet

The Riverine Forested iHGM model includes the variables found in the Riverine Herbaceous/Shrub iHGM with five additional variables that account for the ecological effects of tree stratum. The three indices are expressed as:

Temporary Storage and Detention of Storage Water:

$$\sqrt{\left[\sqrt{V_{dur} \times V_{freq}} \times \frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right]}$$

Maintain Plant and Animal Community:

$$\frac{\left[V_{tree} + V_{cwd} + V_{rich} + \frac{[V_{basal} + V_{density}]}{2} + \left[\frac{V_{mid} + V_{herb}}{2}\right] + V_{connect}\right]}{6}$$

Removal and Sequestration of Elements and Compounds:

$$\frac{\left[V_{wood} + V_{freq} + V_{dur} + \left[\frac{(V_{topo} + V_{cwd} + V_{wood})}{3}\right] + \left[\frac{(V_{detritus} + V_{redox} + V_{sorpt})}{3}\right]\right]}{5}$$

The five additional variables include:

V_{cwd}: Amount of course woody debris

V_{tree}: Percentage of tree species in the stand

V_{rich}: Diversity of tree species

V_{basal}: The average/mean basal area of trees

$V_{denisity}$: The average tree density

6.0 Interim Hydrogeomorphic Study Results

The wetland delineation identified 28 PEMs (24.94 acres), 6 PFOs (13.99 acres), 3 PSSs (1.12 acres), and 2 PUBs (1.17 acres) within the study area. The wetlands within the study area are relatively homogeneous and consist of a single vegetation class, so each wetland was treated as a WAA. The wetland assessment was conducted in the field and with desktop analysis. Variables range from 0.0 to 1.0 based on site conditions at the time of the assessment and desktop findings. Each WAA/wetland feature can be seen in Exhibit 8 in Attachment 1.

6.1 *Non-Forested iHGM*

Duration of flooding (Vdur) is estimated using hydrology indicators described in the 1987 USACE Wetland Delineation Manual and the Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Atlantic and Gulf Coast Region (USACE 2010; Version 2.0). These numbers varied greatly depending on the location of adjacent waterways.

Frequency of flooding (Vfreq) uses indicators described in the 1987 Manual, the Regional Supplement, and FEMA floodplain maps. PEM numbers varied. All PFOs were 0.25 (ponding less than 2 out of 5 years).

Topography (Vtopo) relies on visual estimates conducted in the field to determine what percent of the project area is composed of heterogeneous topographic features (e.g., dips, hummocks, channel sloughs). All assessed areas were smooth, flat, or very gentle with little or no topographic features.

Woody vegetation (Vwood) was assessed with visual observations. Woody vegetation dominated the PFO wetlands. PEM wetlands contained low densities of woody shrubs and trees resulting in scores of 0.1, indicating that woody vegetation cover in these wetlands were less than 10%.

Midstory (Vmid) is the percent of relative cover between the herbaceous and tree strata. The non-forested wetlands averaged less than 1% midstory, sub-index score of 0.10. The PFO midstory layer averaged over 40% to over 50% (sub-index score 0.75 to 1.0).

Herbaceous (Vherb) describes the herbaceous cover in each WAA. Most PEM had a sub-index score of 1.0, which is an herbaceous cover greater than 75%. The PFOs had a lower average herbaceous score.

Detritus (Vdetritus) refers to the presence of either an O or an A soil horizon in the WAA. For this variable, the A must have a value of 4 or less. PEM sub-index score varied throughout the project area. Most PFOs had a sub-index score of 0.3, less than 10% of the area possesses an O or A horizon.

Redoximorphic process (Vredox) is an indicator or periodic aerobic and anaerobic process within the top 12 inches of soil. PEMs and PFOs mostly had redox features in less than 20% in the top 4 inches of the soil.

Sorptive Soil Properties (Vsorpt) are determined using field survey data and the NRCS Web Soil Survey and field data. Most PEMs and PFOs had clayey soils, which is a sub-index score of 1.0.

Connectivity (Vconnect) to other habitat types within 600 feet of the perimeter of the WAA was assessed using recent aerial imagery. Most PEMs and PFOs had a sub-index score of 0.5, which is one or two other habitat types.

Pre-construction sub-index value assigned to each PEM, PSS, and PUB WAA are shown in **Table 6-1.**

Table 6-1. PEM, PSS, and Pond Sub-Index Values

WAA/Feature ID	Vdur	Vfreq	Vtopo	Vwood	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
PEM01	0.50	0.75	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.10
PEM02	0.50	0.75	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.10
PEM03	0.25	0.25	0.10	0.10	0.10	1.00	0.10	0.10	1.00	0.50
PEM04	0.50	0.25	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.50
PEM05	0.50	0.25	0.10	0.10	0.10	0.75	0.10	0.10	1.00	0.50
PEM06	0.25	0.25	0.10	0.10	0.10	1.00	0.30	1.00	1.00	0.75
PEM07	0.25	0.25	0.10	0.25	0.25	1.00	1.00	0.10	1.00	1.00
PEM09	0.10	0.00	0.10	0.10	0.10	1.00	1.00	1.00	1.00	0.50
PEM10	0.25	0.00	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.50
PEM11	0.10	0.00	0.10	0.10	0.10	1.00	1.00	0.10	1.00	0.50
PEM12	0.10	0.00	0.10	0.10	0.10	0.75	1.00	0.10	1.00	0.50
PEM13	0.10	0.00	0.10	0.10	0.25	0.25	0.30	0.10	1.00	0.50
PEM14	0.25	0.25	0.10	0.10	0.10	1.00	1.00	0.10	1.00	0.50
PEM15	0.25	0.25	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.50
PEM16	0.25	0.25	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.50
PEM17	0.25	0.25	0.10	0.10	0.10	1.00	0.50	0.10	1.00	0.50
PEM18	0.25	0.25	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.50
PEM19	0.25	0.25	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.50
PEM20	0.25	0.50	0.10	0.10	0.25	1.00	0.30	0.10	1.00	0.50
PEM21	0.25	0.50	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.75
PEM22	0.50	0.50	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.50
PEM23	0.50	0.50	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.50
PEM24	0.50	0.25	0.10	0.10	0.10	0.75	0.30	0.10	1.00	0.75
PEM25	0.50	0.50	0.10	0.10	0.25	1.00	0.30	0.10	1.00	0.75
PEM26	0.10	0.00	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.10
PEM27	0.50	0.50	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.10
PEM28	0.50	0.50	0.10	0.10	0.10	0.50	0.30	0.10	1.00	0.10
PEM29	0.50	0.50	0.10	0.10	0.10	1.00	0.30	0.10	1.00	0.50
PSS01	0.50	0.25	0.10	0.10	0.50	1.00	0.50	0.10	1.00	0.75
PSS02	0.50	0.50	0.10	0.10	0.50	1.00	0.50	0.10	1.00	0.75

WAA/Feature ID	Vdur	Vfreq	Vtopo	Vwood	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
PSS WF 6	1.00*	1.00*	1.00*	1.00*	1.00*	1.00*	1.00*	1.00*	1.00*	1.00*
PUB01	1.00	1.00	0.10	0.10	0.25	0.10	1.00	0.10	1.00	1.00
PUB02	1.00	1.00	0.10	0.10	0.10	0.10	0.30	0.10	1.00	0.50

*iHGM was not performed during the delineation so highest quality was assumed for pre-construction wetland values.

6.2 *Forested iHGM*

The following results are exclusively for the Riverine Forested iHGM model.

The amount of course woody debris (V_{cwd}) greater than 3 inches in diameter along a 100-foot transect is determined using field data. Most PFOs had a sub-index score of 1.00, with more than seven pieces of coarse woody debris greater than 3 inches.

The percentage of tree species (V_{tree}) in the stand is determined using field data. The majority of the areas had a sub-index score of 0.30, indicating less than 20% of the stands were oak or elm.

Tree richness (V_{rich}) is a measure of the diversity of tree species within the WAAs. A sub-index score of 0.6 was common, indicating three tree species were typically present.

Tree basal area (V_{basal}) is the average/mean basal area of the trees in the WAA. The average basal area was less than 60 square foot per acre.

Tree density ($V_{denisity}$) is based on the number of trees per acre that are at least 3 inches in diameter at breast height. Tree density averaged 300 trees per acre, resulting in a sub-index score of 0.6 in most areas.

The pre-construction sub-index value assigned to each PFO WAA are shown in **Table 6-2**.

Table 6-2. PFO Sub-Index Values

WAA/Feature ID	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
PF001	0.25	0.25	0.10	1.00	0.75	0.30	0.60	0.40	0.60	1.00	0.50	0.30	0.10	1.00	0.50
PF002	0.25	0.25	0.10	1.00	1.00	0.50	0.50	0.40	0.40	0.75	1.00	0.30	0.10	1.00	0.50
PF003	0.25	0.25	0.10	1.00	1.00	0.30	0.40	0.40	0.60	1.00	0.50	0.30	0.10	1.00	0.50
PF004	0.25	0.25	0.10	0.50	1.00	0.30	0.60	0.40	0.60	1.00	0.50	0.30	0.10	1.00	0.50
PF005	0.10	0.25	0.10	1.00	1.00	0.30	0.60	0.40	0.60	0.75	0.30	0.30	0.10	1.00	0.50
PF006	0.50	0.25	0.10	1.00	1.00	0.30	0.60	0.40	0.60	1.00	0.50	0.30	0.10	1.00	0.50

6.3 *Post Impact Scores*

To maximize mitigation, all post-construction scores are zero, which represents a complete loss of the wetland. WAA functional assessment worksheets, which include pre- and post-construction scores, are provided in **Appendix 4**. iHGM site photographs are found in **Attachment 5**. TxDOT is proposing to permit for worst-case scenario impacts and mitigate for full impacts to waters of the U.S. within the project area.

Table 6-3 summarizes the FCI and net loss of FCU scores, with totals of the functional credit unit requirements for mitigation.

Table 6-3. FCI and FCU Values

WAA/ Feature ID	Acreage Impacted	Temporary Storage and Detention of Storage Water (Physical)		Maintain Plant and Animal Communities (Biological)		Removal and Sequestration of Elements and Compounds (Chemical)	
		FCI	FCU	FCI	FCU	FCI	FCU
Non-Forested Wetland							
PEM01	0.570	0.446	0.254	0.400	0.228	0.443	0.253
PEM02	0.450	0.446	0.201	0.400	0.180	0.443	0.200
PEM03	2.380	0.285	0.678	0.533	1.269	0.280	0.666
PEM04	5.690	0.339	1.929	0.533	3.035	0.343	1.954
PEM05	0.550	0.305	0.168	0.450	0.248	0.313	0.172
PEM06	1.110	0.285	0.316	0.617	0.685	0.353	0.392
PEM07	0.020	0.301	0.006	0.750	0.015	0.380	0.008
PEM09	0.180	0.000	0.000	0.533	0.096	0.320	0.058
PEM10	3.330	0.000	0.000	0.533	1.776	0.243	0.810
PEM11	0.370	0.000	0.000	0.533	0.197	0.260	0.096
PEM12	0.060	0.000	0.000	0.450	0.027	0.243	0.015
PEM13	0.110	0.000	0.000	0.333	0.037	0.173	0.019
PEM14	0.110	0.285	0.031	0.533	0.059	0.340	0.037
PEM15	0.340	0.285	0.097	0.533	0.181	0.293	0.100
PEM16	0.500	0.285	0.143	0.533	0.267	0.293	0.147
PEM17	0.060	0.285	0.017	0.533	0.032	0.307	0.018
PEM18	1.970	0.285	0.562	0.533	1.051	0.293	0.578
PEM19	1.950	0.285	0.556	0.533	1.040	0.293	0.572
PEM20	1.960	0.358	0.702	0.583	1.143	0.353	0.693
PEM21	1.650	0.339	0.559	0.617	1.018	0.343	0.567
PEM22	0.060	0.403	0.024	0.533	0.032	0.393	0.024
PEM23	0.300	0.403	0.121	0.533	0.160	0.393	0.118

WAA/ Feature ID	Acreage Impacted	Temporary Storage and Detention of Storage Water (Physical)		Maintain Plant and Animal Communities (Biological)		Removal and Sequestration of Elements and Compounds (Chemical)	
		FCI	FCU	FCI	FCU	FCI	FCU
PEM24	0.050	0.305	0.015	0.533	0.027	0.327	0.016
PEM25	0.080	0.426	0.034	0.667	0.053	0.403	0.032
PEM26	0.070	0.000	0.000	0.400	0.028	0.213	0.015
PEM27	0.090	0.403	0.036	0.400	0.036	0.393	0.035
PEM28	0.100	0.316	0.032	0.233	0.023	0.360	0.036
PEM29	0.840	0.403	0.339	0.533	0.448	0.393	0.330
PSS01	0.090	0.388	0.035	0.750	0.068	0.383	0.035
PSS02	0.950	0.461	0.438	0.750	0.713	0.433	0.412
PSS WF 6	0.08	1.000	0.080	1.000	0.080	1.000	0.080
PUB01	0.090	0.371	0.033	0.450	0.041	0.590	0.053
PUB02	1.080	0.316	0.342	0.233	0.252	0.533	0.576
Total			7.748		14.545		9.117
Forested Wetlands							
PFO01	0.93	0.393	0.365	0.608	0.566	0.467	0.434
PFO02	2.19	0.42	0.92	.063	1.378	0.53	1.168
PFO03	0.03	0.42	0.01	0.58	0.017	0.53	0.016
PFO04	0.07	0.37	0.03	0.53	0.037	0.50	0.035
PFO05	10.69	0.33	3.56	0.57	6.10	0.50	5.38
PFO06	0.08	0.50	0.04	0.61	0.05	0.58	0.05
Total			4.925		8.148		7.083

6.4 *Wetland Habitat Assessment Procedure*

iHGM scores were converted to scores equivalent to the Wetland Habitat Assessment Procedure (WHAP). Coastal Bottomlands Mitigation Bank is a TxDOT-owned mitigation bank that was established using WHAP to determine credit needs. WHAP gives wetlands a high, medium, or low-quality rating at the impact site. iHGM physical, biological, and chemical FCI numbers were averaged together and a low-quality rating was assigned to wetlands with an average FCI from 0.00 to 0.33, medium rating for 0.33 to 0.66, and a high rating for 0.66 to 1.00 (**Table 6-4**). The following ratios are used to determine the mitigation need:

High Quality = 6:1 acre ratio

Medium Quality = 4:1 acre ratio

Low Quality = 2:1 acre ratio

Table 6-4. WHAP Credit Requirements

WAA/ Feature ID	Acreage Impacted	Physical FCI	Biological FCI	Chemical FCI	iHGM Average FCI	WHAP Quality Rating	Number of Credits Required
PEM01	0.57	0.446	0.400	0.443	0.430	Medium	2.28
PEM02	0.45	0.446	0.400	0.443	0.430	Medium	1.80
PEM03	2.38	0.285	0.533	0.280	0.366	Medium	9.52
PEM04	5.69	0.339	0.533	0.343	0.405	Medium	22.76
PEM05	0.55	0.305	0.450	0.313	0.356	Medium	2.20
PEM06	1.11	0.285	0.617	0.353	0.418	Medium	4.44
PEM07	0.02	0.301	0.750	0.380	0.477	Medium	0.08
PEM09	0.18	0.000	0.533	0.320	0.284	Low	0.36
PEM10	3.33	0.000	0.533	0.243	0.259	Low	6.66
PEM11	0.37	0.000	0.533	0.260	0.264	Low	0.74
PEM12	0.06	0.000	0.450	0.243	0.231	Low	0.12
PEM13	0.11	0.000	0.333	0.173	0.169	Low	0.22
PEM14	0.11	0.285	0.533	0.340	0.386	Medium	0.44
PEM15	0.34	0.285	0.533	0.293	0.370	Medium	1.36
PEM16	0.50	0.285	0.533	0.293	0.370	Medium	2.00
PEM17	0.06	0.285	0.533	0.307	0.375	Medium	0.24
PEM18	1.97	0.285	0.533	0.293	0.370	Medium	7.88
PEM19	1.95	0.285	0.533	0.293	0.370	Medium	7.80
PEM20	1.96	0.358	0.583	0.353	0.431	Medium	7.84
PEM21	1.65	0.339	0.617	0.343	0.433	Medium	6.60
PEM22	0.06	0.403	0.533	0.393	0.443	Medium	0.24
PEM23	0.30	0.403	0.533	0.393	0.443	Medium	1.20
PEM24	0.05	0.305	0.533	0.327	0.388	Medium	0.20
PEM25	0.08	0.426	0.667	0.403	0.499	Medium	0.32
PEM26	0.07	0.000	0.400	0.213	0.204	Low	0.14
PEM27	0.09	0.403	0.400	0.393	0.399	Medium	0.36
PEM28	0.10	0.316	0.233	0.360	0.303	Low	0.20
PEM29	0.84	0.403	0.533	0.393	0.443	Medium	3.36
PSS01	0.09	0.388	0.750	0.383	0.507	Medium	0.36
PSS02	0.95	0.461	0.750	0.433	0.548	Medium	3.80
PSS WF 6	0.08	1.000	1.000	1.000	1.000	High	0.48
PUB01	0.09	0.371	0.450	0.590	0.470	Medium	0.36
PUB02	1.08	0.316	0.233	0.533	0.361	Medium	4.32
PFO01	0.93	0.393	0.608	0.467	0.489	Medium	3.72
PFO02	2.19	0.420	0.063	0.530	0.338	Medium	8.76
PFO03	0.03	0.420	0.580	0.530	0.510	Medium	0.12

WAA/ Feature ID	Acreage Impacted	Physical FCI	Biological FCI	Chemical FCI	iHGM Average FCI	WHAP Quality Rating	Number of Credits Required
PFO04	0.07	0.370	0.530	0.500	0.467	Medium	0.28
PFO05	10.69	0.330	0.570	0.500	0.467	Medium	42.76
PFO06	0.08	0.500	0.610	0.580	0.563	Medium	0.32
Total	41.22						156.64

7.0 Mitigation Plan

TxDOT is proposing to permit for worst-case scenario impacts to wetlands and mitigate for full impacts to wetlands within the project area. Impacts to streams have been minimized and one stream avoided completely. Stream impacts from the project total 1,224.50 linear feet (0.62 acre) and the amount of stream avoided within the project area is 4,495.60 linear feet (2.06 acres). Upon review of the design schematic, and in coordination with the project engineers TxDOT would minimize and avoid impacts to waterbodies where practicable. If design allows, the waters of the U.S. would be returned to pre-construction contours. To offset impacts to waters of the U.S., TxDOT proposes to purchase stream credits and wetland credits. The unavoidable impacts to waters of the U.S. will require 5,156 stream credits and 156.64 wetland credits.

7.1 Stream Credits

SH 99 Segment B1 is not within the primary service area of any mitigation banks with stream credits available but is located within the secondary service area of two mitigation banks with stream credits, Katy Prairie Stream Mitigation Umbrella Bank and the proposed Sand Hill Farm. Katy Prairie has stream credits available for purchase now and Sand Hill Farm will have futures credits available once the bank is approved (**Table 7-1**). With the secondary service area 1.5 multiplier, 7,734 stream credits are required to offset impacts.

Table 7-1. Available Stream Credits

Bank Name	Service Area	Available Stream Credits June 2024	Total Credits Available for Purchase
Katy Prairie	Secondary	• 14,955.8 credits available now • Approximately 4,500 to 9,000 estimated release June 2025 • Approximately 9,000 estimated release December 2025 to June 2026	Approximately 28,455.8 to approximately 32,955.8
Sand Hill Farm	Secondary	• 5,199 initial release • 10,397 post-construction release	15,596

7.2 Wetland Credits

SH 99 Segment B1 is within the primary service area of TxDOT's Coastal Bottomlands Mitigation Bank. TxDOT proposes to debit 156.64 credits from the bank.

8.0 Conclusion

A stream and wetland functional assessment was conducted to determine the amount of mitigation required for impacts to the waters of the U.S. from the SH 99 Segment B1 project. The impacts will require 5,156 stream credits (7,734 credits in the secondary service area) and 156.64 wetland credits. TxDOT proposes to purchase 7,734 stream credits from Katy Prairie Mitigation Bank and withdraw 156.64 wetland credits from TxDOT's Coastal Bottomland Mitigation Bank. Sand Hill Farm would be used to purchase credits if Katy Prairie no longer has stream credits available.

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