

Attachment D-9
Fish and Wildlife Coordination Act Report



United States Department of the Interior

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In Reply Refer To:
FWS/R2/ES

May 9, 2019

Colonel Lars N. Zetterstrom
District Engineer
U.S. Army Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553-1229

Re: Brazos River Floodgates/Colorado River Locks Feasibility Study

Dear Colonel Zetterstrom:

This letter provides planning assistance for the Brazos River Floodgates/Colorado River Locks Feasibility Study at the confluences of the Brazos and Colorado Rivers with the Gulf Intracoastal Waterway (GIWW). This assessment was initiated by the Galveston District, Corps of Engineers (USACE) in cooperation with the Texas Department of Transportation (TxDOT), a non-federal sponsor, to conduct a feasibility study to investigate the potential improvements to the Brazos River Floodgates (BRFG) and the Colorado River Locks (CRL) on the GIWW.

This planning assistance is provided, in part, pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and this Fish and Wildlife Coordination Act Report (CAR) represents a final report of the Secretary of the Interior within the meaning of Section 2(b) of the Act. .

The study area entails the widening of the CRL and realignment and widening of the BRFG to facilitate wider barge configurations and increase safety of traffic utilizing the GIWW. The project entails the construction of temporary bypass to facilitate traffic during construction, the removal of locks/floodgates, and the construction of new, wider navigation infrastructure.

We appreciate the opportunity to participate in the planning of this project. If you have any questions or comments concerning this report, please contact Donna Anderson at 281-212-1505.

Sincerely,

Charles Ardizzone
Field Supervisor

Fish and Wildlife Coordination Act Report (CAR)*

**Gulf Intracoastal Waterway, Brazos River Floodgates and Colorado River
Locks, Texas**

***CAR drafted by USACE for the Service; the Service has reviewed and approved the CAR**

Table of Contents

Introduction	1
Background	1
Alternatives under Consideration	3
Dredged Material Management	6
Project Area	6
Habitats	6
Open Water	9
High Marsh	9
Intertidal Marsh	9
Tidal Flat	9
Upland Shrub/Woods	9
Fish and Wildlife Resources	9
Terrestrial	9
Aquatic	10
Threatened and Endangered Species	10
Eagles	11
Migratory Birds	12
Habitat Evaluations	12
Habitat Evaluation Methods	12
Habitat Suitability Index (HSI) Values	13
Mitigation	13
Effects of Climate Change	17
Final Recommendations	17
Works Cited	19

List of Appendices

Appendix A	Preliminary Alternatives Maps
Appendix B	Photographs of Habitat Evaluation Sites

List of Figures

Figure 1 BRFG and CRL Project Location	2
Figure 2 Existing BRFG Facility Conditions	2
Figure 3 Existing CRL Facility Conditions	2
Figure 4 Wildlife Refuges and Resources near BRFG Study Area	7
Figure 5 Wildlife Refuges and Resources near CRL Study Area	7
Figure 6 Habitats in BRFG Study Area	8
Figure 7 Habitats in CRL Study Area	8
Figure 8 Potential Mitigation Wetland Location at BRFG	16
Figure 9 Potential Mitigation Wetland Location at CRL	16

List of Tables

Table 1 Overview of BRFG and CRL Alternatives Considered	4
Table 2 Average HSI Values and Habitat Units for Wetland Habitats	13
Table 3 Summary of Marsh Habitat Impacts and Mitigation Needs	15

Introduction

The Fish and Wildlife Coordination Act (FWCA) (Public Law 85-624; 16 U.S.C. 661-666) requires that the U.S. Army Corps of Engineers (Corps) coordinate with the Department of Interior U.S. Fish and Wildlife Service (Service) where waters of any stream or other water body are proposed or authorized, permitted or licensed to be impounded, diverted...or otherwise controlled or modified to consult for the purpose of “preventing loss of and damage to wildlife resources.” Due to budget and workload constraints, the Service was not able to write the Fish and Wildlife Coordination Act Report (FWCAR) necessary to complete its obligation under the FWCA. As a result, the Corps drafted a FWCAR for Service review and comment, which is presented herein, and is formally adopted by the Service. This FWCAR does constitute the final report of the Secretary of the Interior and fulfills the Service’s requirement as stated in Section 2(b) of the FWCA (48 State. 401, as amended; 16 U.S. C. 661 et. seq.). The FWCA requires that the Section 2(b) report be made an integral part of any report supporting further project authorization or administrative approval.

This final FWCAR provides planning assistance on the proposed Gulf Intracoastal Waterway (GIWW) Brazos River Floodgates (BRFG) and Colorado River Locks (CRL) Feasibility Study located in Brazoria and Matagorda Counties, Texas. The project is authorized under Section 216 of the Flood Control Act of 1970. As a result, the Corps will complete an integrated Feasibility Report and Environmental Impact Statement (IFR-EIS). The purposes of this FWCAR are to identify and describe existing fish and wildlife resources within the proposed study and project areas; evaluate and compare currently proposed alternatives; identify modification or additional alternatives needed to address fish and wildlife related problems, opportunities, and planning objectives; and recommend any preliminary measures for resource protection during early and future project planning and design.

This evaluation is based on the current data and analyses available from Corps sources and Service files. The Service understands the project may be subject to further Congressional approval, and funding will occur sometime in the future with or without project modifications. Additional Service involvement for subsequent detailed planning, engineering design, and construction phases of each planning effort is required to fulfill our responsibilities under the FWCA.

Background

Extending from the Okeechobee waterway at Fort Myers, Florida, to Brownsville, Texas, the GIWW is a Federal shallow-draft navigation channel that is authorized and maintained to a 125-foot bottom width. The BRFG and CRL are located on the GIWW about 40 miles apart in Brazoria and Matagorda Counties, respectively (**Figure 1**), and are integral parts of the GIWW from the Mississippi River to Corpus Christi, Texas. The BRFG were constructed in the 1940s and consist of a 75-foot-wide gate on either side of the Brazos River crossing of the GIWW (**Figure 2**). The CRL, which were initially constructed as floodgates in the 1940s and converted to locks in the 1950s, consists of a set of 75-foot-wide locks on either side of the Colorado River crossing of the GIWW (**Figure 3**). The BRFG and CRL facilities were initially installed to prevent heavy sediment loads in the Brazos and Colorado Rivers from entering the GIWW. At the time they were installed, most tug boats pulled barges behind them rather than using the modern pushing method.



Figure 1 BRFG and CRL Project Location

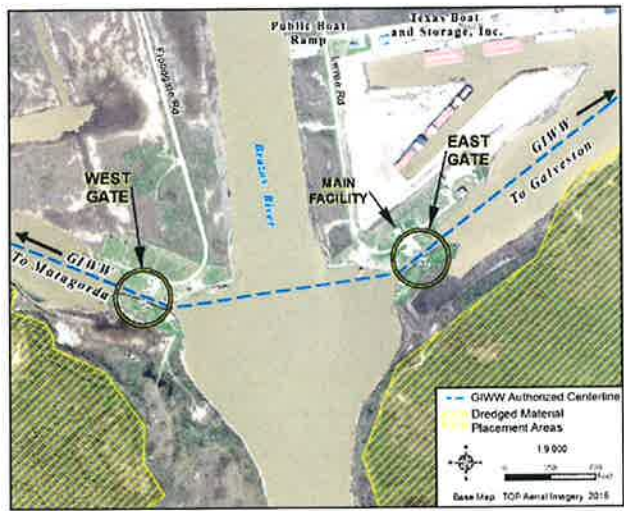


Figure 2 Existing BRFG Facility Conditions

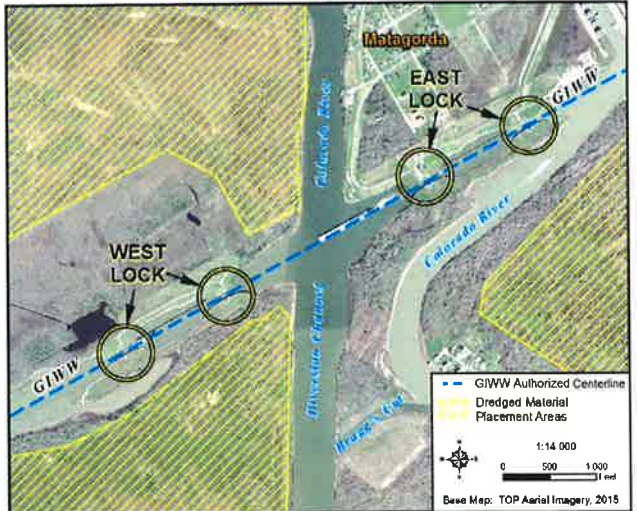


Figure 3 Existing CRL Facility Conditions

The Corps has identified problems that affect navigation through the existing BRFG and CRL facilities. The narrow gate openings and crossing geometry at the two projects create hazardous cross currents and eddies that cause vessels to strike the structures (termed “allisions” since it involves a moving vessel impacting a stationary structure). Due to the 75-foot gate openings at each project, barge tows pushing two barges side-by-side must break apart barges, shuttle them separately across the river, and reassemble the barges into their original configuration. This process, known as “tripping,” results in lost time and higher shipping costs for the navigation industry. This risk is worsened by high river flows, and

shutdowns during high river periods and accident repairs cause additional economic impacts to the navigation industry. Finally, the aging, outdated infrastructure at the BRFG and CRL leads to structural, electrical, and mechanical maintenance issues.

The Corps used the following planning objectives in formulating and evaluating alternative plans for addressing the identified problems over a 50-year period of analysis:

- Reduce navigation delays (tripping, allisions) for vessels transiting the BRFG-CRL system
- Increase navigation efficiency of vessels transiting the BRFG-CRL system
- Minimize vessel allisions which result in facility closures/outages for required repairs
- Manage sedimentation into the GIWW from the Brazos and Colorado Rivers
- Improve overall operations/functions of the facilities, which experience frequent mechanical failures due to aging and outdated systems

Alternatives under Consideration

The Corps evaluated multiple alternatives involving various structural measures to improve navigation and operations at the BRFG and CRL. The Corps also considered non-structural measures such as improvements to scheduled maintenance of the gates/locks, improvements to towing schedules using Automatic Identification System (AIS) or similar scheduling systems, and adding buoys and additional navigation lights to help barges. Non-structural measures alone have been determined to have negligible impacts on the frequency or duration of navigation accidents, so the Corps did not carry non-structural alternative forward for further analysis because they would not meet the study objectives. An exception is the addition of mooring locations, which the Corps is analyzing in a separate study (*Gulf Intracoastal Waterway, Texas, Mooring Basin Modifications, Operations, and Maintenance Discretionary Authority Study*). If needed, the Corps will use non-structural measures at the BRFG and CRL to address any remaining residual risks after recommended structural measures are implemented.

Through multiple screening efforts, the Corps identified five Action Alternatives at BRFG and three Action Alternatives at CRL as reasonable alternatives to be carried forward for further engineering, economic, and environmental analysis (**Table 1**). Preliminary maps of the Corps' Action Alternatives in relation to wildlife habitats are provided in **Appendix A**. (Note: **Appendix A** does not include maps for Alternative 2a at each project site because this alternative would rehabilitate the existing facilities within the existing footprints.) To minimize environmental impacts, the disturbance areas for the Action Alternatives were in and adjacent to the existing GIWW, BRFG, and CRL facilities; therefore, in many cases the Corps determined that potential impacts on fish and wildlife resources would be similar among the alternatives. For example, most alternatives would involve general construction-related disturbances such as dredging and turbidity that may affect aquatic life in the GIWW, as well as construction activities that could temporarily disturb nearby wildlife resources. Relative to fish and wildlife, the alternatives primarily differed in their potential to impact the following (a discussion of the alternatives relative to each of these resources is provided after **Table 1**):

- habitats, particularly marsh habitats;
- threatened and endangered species;
- sedimentation patterns, particularly changes in sediment reaching the Gulf of Mexico; and
- noise levels, particularly from pile driving.

Table 1 Overview of BRFG and CRL Alternatives Considered

Alt. ¹	Alternative Overview	Habitat Impacts (acres) ²		Major Pile Driving Needs	Average Annual Change in Sediment Reaching Deltas
		Marsh/Tidal Flat	Upland Shrub/Woods		
BRFG Alternatives					
No Action	No improvements would be made to the BRFG facility. Normal maintenance activities would continue.	0	0	No	No change (existing 44,382,462 CY to Gulf of Mexico)
2a	<u>Rehab Existing Facilities</u> – Rehabilitate existing floodgates, guide walls, and other infrastructure; no major changes to overall footprint, orientation, operations, or bathymetry; H&H and salinity modeling and analysis assume conditions would be the same as existing.	0	0	Potential	No change
3a	<u>Gate Relocation on Existing Alignment</u> – Move floodgates farther from Brazos River along existing GIWW alignment; widen chamber wall opening from 75 ft to 125 ft.	6.1	49.7	Yes	<50,000 CY (0% change)
3a.1	<u>Open Channel West/East Gate Relocation</u> – Similar to Alternative 3a but only includes a new east floodgate; removes west floodgate, leaving an open channel on west side of river.	13.8	14.0	Yes	-381,575 CY (-1%)
9a	<u>Open Channel</u> – Remove floodgates and excavate an open channel north of the existing GIWW alignment to straighten this section of the GIWW.	30.5	2.7	No	-2,355,693 CY (-5%)
9b/c	<u>New Alignment/Gates with Control Structures</u> – Excavate new channel north of existing GIWW alignment and construct 125-ft floodgates on the new channel. Alt. 9c includes a flow control structure at existing west gate location; Alt. 9b does not.	28.5	4.4	Yes	-1,164,000 CY (-3%)
CRL Alternatives					
No Action	No improvements would be made to the BRFG facility. Normal maintenance activities would continue.	0	0	No	No change (existing 2,432,825 CY to main delta in W. Matagorda Bay; 360,739 CY to Gulf of Mexico)
2a	<u>Rehab Existing Facilities</u> – Rehabilitate existing locks, guide walls, and other infrastructure as needed; no major changes to overall footprint, guide wall orientation, gate operations, or bathymetry; H&H and salinity modeling and analysis assume conditions would be the same as existing.	0	0	Potential	No change
3b	<u>Open Channel</u> – Remove existing locks, creating an open channel through the intersection at the GIWW.	0.7	11.4	No	-226,276 CY (-9%) main delta +438,738 CY (+122%) Gulf
4b.1	<u>Removal of Riverside Gates</u> – Remove riverside gates, converting the locks to floodgates.	0.7	11.4	Yes	+90,653 CY (+4%) main delta -1,280 CY (-0.4%) Gulf

¹The Corps' Tentatively Selected Plan included BRFG Alt. 3a.1 and CRL Alt 4b.1, which were refined based on public and industry input.

²Each alternative would impact open water; however, most open water impacts would be temporary construction impacts (e.g., barge access, pile driving, turbidity, dredging). None of the Action Alternatives would result in a net loss of open water habitat.

Of the alternatives considered, the No Action alternative and Alternative 2a would have the lowest impacts to fish and wildlife resources at each project site because no work would be conducted under the No Action alternative, and Alternative 2a would rehabilitate the existing infrastructure within the existing footprints. However, the No Action alternative and Alternative 2a would not meet the study objectives.

At the BRFG, the Corps determined that Alternatives 9a and 9b/c, which involve the most change in the GIWW alignment, would have the highest impacts to marsh habitats. BRFG Alternative 3a.1 has higher marsh impacts than Alternative 3a; however, the difference in impacts between these two alternatives is due to a slight GIWW realignment that was incorporated into Alternative 3a.1 after preliminary analyses, and through public and industry coordination, to keep the existing gates in operation during construction. Incorporating the realignment into Alternative 3a would result in similar marsh impacts. At the CRL, habitat impacts resulting from the Action Alternatives are similar.

The Corps determined that none of the Action Alternatives should adversely affect threatened or endangered species. Alternatives that require major pile driving have the potential to create high noise and underwater pressure levels, but these effects can be mitigated by incorporating best management practices such as implementing a “soft start” to allow wildlife to leave the area, using vibratory hammers or cushion blocks, conducting work during daylight hours only, and following the National Marine Fisheries Service’s (NMFS) recommended construction conditions for in-water work.

The Corps evaluated changes in sedimentation patterns resulting from the alternatives, which could affect habitats, particularly beach and other piping plover (*Charadrius melodus*) habitats near the river deltas. The largest projected changes in sediment reaching the deltas were observed with alternatives that removed the BRFG and CRL facilities and left open channels along the GIWW (no gates/locks).

Through engineering, economic, and environmental analysis, the Corps identified Alternative 3a.1 at the BRFG and Alternative 4b.1 at the CRL as the Tentatively Selected Plan. This combined plan was determined to be both the National Economic Development plan and the environmentally preferable alternative. In consideration of public comments and further discussions with the navigation industry, the Corps refined the combined alternative to develop the Recommended Plan. At the BRFG, the Recommended Plan involves removing the existing gates on both sides of the river crossing, constructing a 125-foot-wide open channel (no gate structure) on the west side of the river, and constructing a new 125-foot-wide sector gate structure on the east side of the river. The centerline of the GIWW through the BRFG area would be shifted 300 feet south of the existing centerline, allowing the existing floodgates to remain in operation until the new channel and east floodgate are completed. The open channel on the west side of the river will have a bottom width of 125 feet and bottom depth of -12 feet NAVD88. The new 125-foot-wide sector gate on the east side of the river will be set back approximately 1,300 feet from the existing gate structure, providing increased safety and efficient vessel operation through the crossing. The Corps estimates that construction of the open channel and new sector gate at the BRFG will take approximately two years to complete, if adequate funding is provided.

At the CRL, the Recommended Plan involves decommissioning all four existing gate structures and constructing a new 125-foot-wide sector gate structure on each side of the river. The centerline of the GIWW through the CRL area would be shifted 260 feet south of the existing centerline, allowing the existing locks to remain in operation until the new channel and gates are completed. The new channel will have a bottom width of 125 feet and bottom depth of -12 feet NAVD88. The Corps estimates that construction at the CRL will take approximately two years to complete, if adequate funding is provided.

Dredged Material Management

The Corps is proposing to place dredged material resulting from project construction and maintenance in existing dredged material placement areas (DMPA) and ocean dredged material disposal sites (ODMDS). It is the Service's position that the Corps should adopt a standard operating procedure to incorporate beneficial use of dredged material (new work and maintenance material) as a priority for all dredged material management plans (DMMP) along the Texas coast. Dredged material, when of a suitable consistency, can be beneficially used to create and restore coastal marshes; create earthen terraces to control wave action and promote shoreline stabilization and marsh growth over time; create islands for bird nesting, loafing, and roosting; and return sediment and nutrients to the near-shore littoral system. The continued use of confined upland placement areas, acquisition of land for construction of new DMPAs, and use of ODMDS provide little hope of returning important sediment material to the aquatic ecosystem. While the Service understands that the Corps' constraints are tied to current regulations and Corps guidance, the Service will continue to challenge the Corps to develop long-term creative ways to beneficially use dredged material so that sediments are responsibly returned to the aquatic ecosystem and wildlife habitats are restored, enhanced, and protected. This is especially important for projects that will reduce the amount of sediment that reaches the Gulf, such as the Corps' Recommended Plan at the BRFG.

Project Area

The BRFG and CRL project sites are located on the mid-coast within the Mid-Coast Barrier Islands and Coastal Marshes region of the Texas coast (Griffith et al. 2007). The mid-coast region contains large expanses of coastal marshes, wetlands, dunes, beaches, and coastal prairies that provide important habitats for a variety of resident aquatic and terrestrial wildlife, as well as migrating and wintering waterfowl and other migratory birds. In addition, Columbia bottomland forests occur as close as 4 miles inland of the coastline within the Brazos and San Bernard River Basins and provide old-growth habitat that is especially important for Nearctic-Neotropical migratory birds that cross the Gulf during spring and fall migrations (Service 2012). These forests and other coastal habitats are threatened by agriculture, urbanization, oil and gas production, and other development activities that clear forests and drain wetlands. The Service and the Texas Parks and Wildlife Department (TPWD), as well as non-governmental organizations, continually work to protect, conserve, restore, and manage important coastal habitats in the region. National wildlife refuges (NWR) and state wildlife management areas (WMA) near the project sites include San Bernard NWR and Justin Hurst WMA near the BRFG and Mad Island WMA near the CRL (**Figures 4 and 5**).

The project sites are situated in largely undeveloped areas, although some developments occur near the facilities. Developments near the BRFG include a barge storage, cleaning, maintenance, and repair facility located on the GIWW and the Bryan Mound Strategic Petroleum Reserve located north of the BRFG. The city of Freeport and associated urban and industrial development lies 3 miles north and east of the BRFG. Developments near the CRL are associated with the town of Matagorda to the northeast and residences along the original Colorado River channel to the south.

Habitats

Based on site visits conducted by the Corps, general vegetation communities/habitats that are present at the project sites and could be affected by the project alternatives include open water, high marsh, intertidal marsh, tidal flat, and upland shrub/woods. These habitats are described below and shown in relation to the existing BRFG and CRL facilities on **Figures 6 and 7**.



Figure 4 Wildlife Refuges and Resources near BRFG Study Area

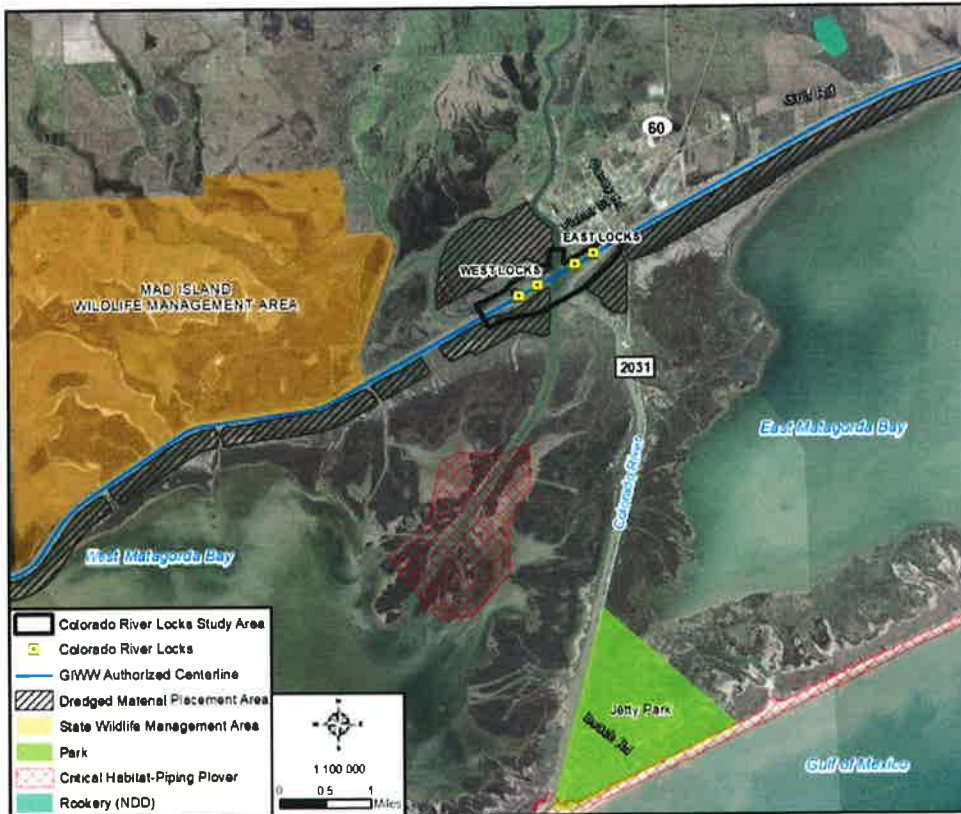


Figure 5 Wildlife Refuges and Resources near CRL Study Area

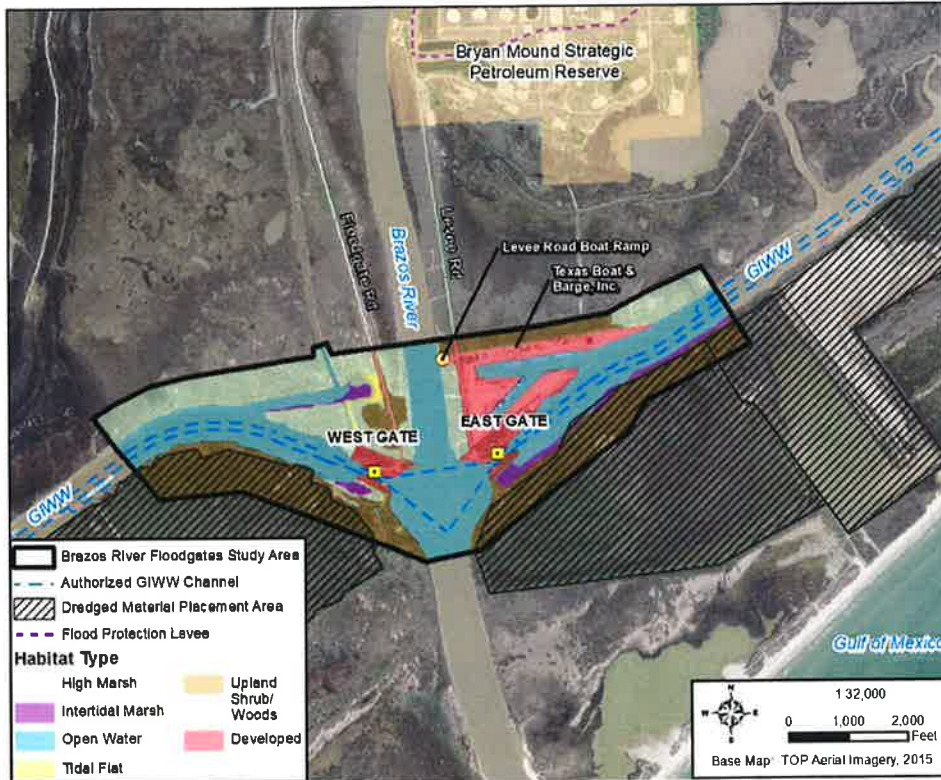


Figure 6 Habitats in BRFG Study Area

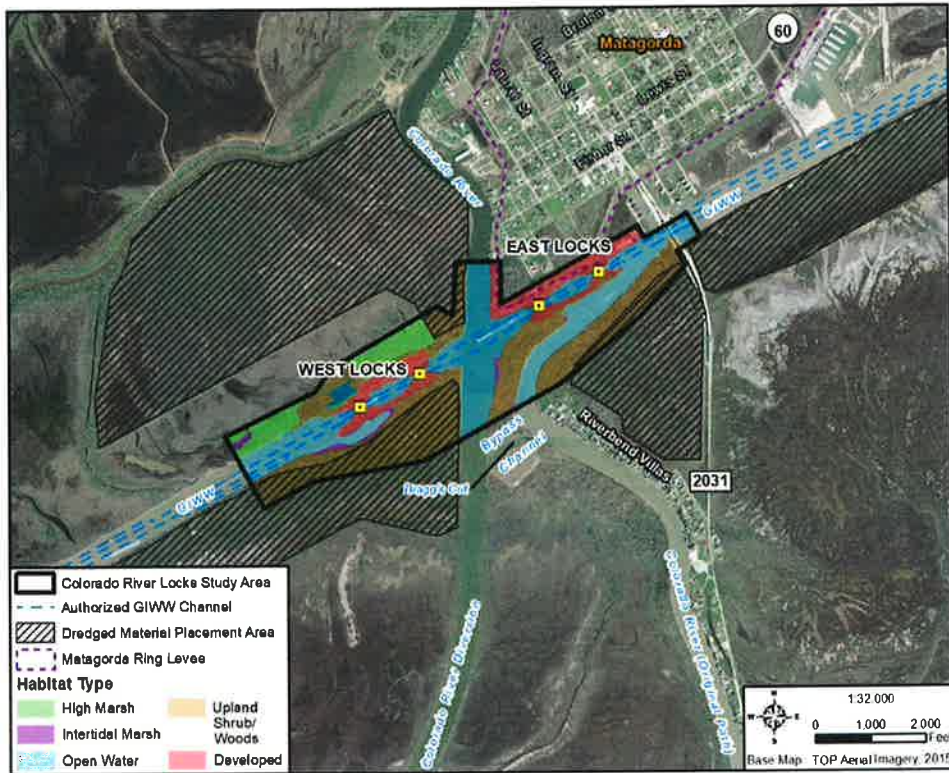


Figure 7 Habitats in CRL Study Area

Open Water

Open water habitat covers over 1/3 of the study areas, with the GIWW and Brazos and Colorado Rivers being the major open water features in the immediate project area. The GIWW is maintained and used for commercial navigation, but it also provides a corridor for aquatic life to move between the marshes, bays, and other aquatic habitats in the region. The Brazos and Colorado Rivers not only provide aquatic habitat, but they also supply the Gulf, bays, and marshes with important influxes of fresh water, sediments, and nutrients. Estuarine habitats in the BRFG vicinity are associated with the Brazos and San Bernard Rivers, Cedar Lakes, Jones Lake, Redfish Bayou, and various sloughs, lakes, and marshes. The major estuarine habitats in the CRL vicinity are associated with East and West Matagorda Bays.

High Marsh

High marsh is the dominant wetland habitat in the study areas, representing 21% of the BRFG study area and 8% of the CRL study area. This habitat is infrequently inundated at high tides and is typically dominated by salt tolerant species such as turtleweed (*Batis maritima*), saltgrass (*Distichlis spicata*), saltworts (*Salicornia* spp.), Gulf cordgrass (*Spartina spartinae*), marshhay cordgrass (*S. patens*), sea-oxeye daisy (*Borrchia frutescens*), seepweed (*Suaeda linearis*), and marsh-elder (*Iva frutescens*), with lesser amounts of smooth cordgrass (*Spartina alterniflora*). In optimum conditions, this cover type provides food, cover, nesting habitat, and living space to marsh dependent species that are not as frequently inundated as intertidal marshes. The cordgrass component is important for clapper rails and marsh wrens, as well as other bird, herpetofauna, and mammal species dependent on the thick grass cover.

Intertidal Marsh

Intertidal marsh represents 1-2% of the study areas and occurs in shallow areas along the GIWW banks and in other areas subject to regular tide fluctuations. Dominant plants include smooth cordgrass, glasswort, turtleweed, and saltgrass. Intertidal marsh provides essential habitat for aquatic species such as fish and shrimp, as the vegetation provides food and cover during higher tides. The intertidal marsh also provides habitat for numerous invertebrates that attract foraging waterbirds and waterfowl.

Tidal Flat

One small area of unvegetated tidal flat was observed in the BRFG study area, adjacent to an intertidal marsh. During a February 2017 site visit, it contained less than 5% plant cover (turtleweed, smooth cordgrass, saltwort, and saltgrass), and algal mats covered an estimated 50% of the flat. The area showed evidence of disturbance from cattle.

Upland Shrub/Woods

The main upland habitat in the study areas consists of shrub/woods vegetation communities that occur in DMPAs that line the GIWW and on river banks. This habitat consists of young (<50 years) trees such as American elm (*Ulmus americana*), sugar hackberry (*Celtis laevigata*), Chinaberry (*Melia azedarach*), Chinese tallow, honey mesquite (*Prosopis glandulosa*), Hercules'-club (*Zanthoxylum clava-herculis*), osage orange (*Maclura pomifera*), roughleaf dogwood (*Cornus drummondii*), and retama (*Parkinsonia aculeata*). Upland shrub/woods habitats provide cover and food sources for a variety of terrestrial wildlife.

Fish and Wildlife Resources

Terrestrial

Mammals known to occur in the project area marshes include swamp rabbit (*Sylvilagus aquaticus*), nutria (*Myocaster coypus*), river otter (*Lontra canadensis*), and muskrat (*Ondatra zibethicus*). The marsh habitats also support a variety of birds including herons, egrets, ibises, least bittern, rails, gallinules, cormorants, pelicans, black-necked stilts, sandpipers, gulls, and terns. Migratory waterfowl species that are expected to occur in the area include gadwall (*Anas strepera*), green-winged teal (*Anas carolinensis*), blue-winged teal (*Anas discors*), northern shoveler (*Anas clypeata*), mallard (*Anas platyrhynchos*), pintail (*Anas acuta*), American wigeon (*Mareca americana*), lesser scaup (*Aythya affinis*), ring-necked duck (*Aythya collaris*), redhead (*Aythya americana*), and canvasback (*Aythya valisineria*). Resident waterfowl species include the mottled duck (*Anas fulvigula*).

Aquatic

The intertidal marsh provides important habitat (i.e., nursery, escape cover, feeding grounds) for a variety of estuarine-dependent fish and shellfish. Important forage and predator fish are typified by alligator gar (*Atractosteus spatula*), ladyfish (*Elops saurus*), finescale menhaden (*Brevoortia gunteri*), gizzard shad (*Dorosoma cepedianum*), bay anchovy (*Anchoa mitchilli*), river carpsucker (*Carpoides carpio*), hardhead catfish (*Arius felis*), channel catfish (*Ictalurus punctatus*), Gulf killifish (*Fundulus grandis*), crevale jack (*Caranx hippos*), pigfish (*Orthopristis chrysoptera*), spotted trout (*Cynoscion nebulosus*), black drum (*Pogonias cromis*), striped mullet (*Mugil cephalus*), Spanish mackerel (*Scomberomorus maculatus*), southern flounder (*Paralichthys lethostigma*), and lizardfish (*Synodus foetens*). Important nektonic shellfish include blue crab (*Callinectes sapidus*), white shrimp (*Penaeus setiferus*), and brown shrimp (*Penaeus aztecus*). Most of the economically important saltwater fishes and crustaceans harvested in Texas spawn offshore and then use estuarine areas for nursery habitat. Nekton use of estuaries is largely governed by seasons. Different species use the same locations in different seasons, and different life stages of the same species use different locations. Aquatic species diversity peaks in the spring and summer, and is typically low in the winter. Some marine species which use estuaries as nursery habitat also have estuarine dependent life stages, typically larvae and juveniles. Larvae or juveniles immigrate into the project area during incoming tides and take advantage of the high productivity of the estuary.

Threatened and Endangered Species

According to Section 7(a)(2) of the Endangered Species Act (ESA) and the implementing regulations, it is the responsibility of each federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any federally listed species. Those federally listed species for which the Service has jurisdiction that may be identified in or near the study area are listed below. In addition, a brief description of basic information regarding those species is provided along with means to reduce the likelihood of any potential impact to those species.

For sea turtles, our review of the proposed project will focus on the effects of the BRFG and CRL on sea turtle nesting since the Service retains jurisdiction of sea turtles while on land per the Memorandum of Understanding (MOU) between the Service and NMFS dated July 18, 1977. NMFS has jurisdiction of sea turtles in the oceans, seas, bays, and estuaries including waters adjacent to nesting beaches. Based on the possible impacts the project may have on sea turtle migration within the GIWW, we recommend that you contact NMFS at (727) 824-5312 regarding their findings on the matter.

While there is no sea turtle nesting habitat within the proposed project areas, sea turtles are known to frequent the Gulf of Mexico, the GIWW, and adjacent bays during the summer, spring, and fall months.

Special precautions should be taken to avoid impacts to any of the sea turtle species during the construction processes.

The West Indian manatee (*Trichechus manatus*) is a rare visitor to the Texas coast and may be found within the project area. Manatees forage on sea grasses found in shallow bays and estuaries along the Texas coast. In the event a manatee is encountered during construction processes, please contact the Texas Coastal Ecological Services Field Office (TCESFO) – Houston (281) 286-8282.

The whooping crane (*Grus americana*) winters on the Texas coast each year, returning to their primary wintering grounds around the Aransas NWR by late October to mid-November and remaining in Texas until March or April. In 2011, the Service and its partners introduced a non-essential, experimental population of whooping cranes in Vermillion Parish, Louisiana, and members of this population are known to use marsh habitat and rice and crawfish fields year-round on the upper Texas coast (Orange and Jefferson Counties) (Service 2017). Whooping cranes have been recorded near the BRFG and CRL study areas at Justin Hurst WMA, San Bernard NWR, and Mad Island WMA (TPWD 2017, eBird 2017) and could forage in the coastal marshes present in the study areas.

The piping plover and red knot (*Calidris canutus rufa*) overwinter along the Texas coast, although they can be found on open beaches, tidal flats, washover areas, and other coastal habitats during most of the year. The Gulf beaches near the BRFG and CRL sites provide suitable foraging, roosting, and loafing habitats, and are designated as critical habitat for the piping plover.

The Corps conducted a review of the above-listed and other threatened and endangered species using the Service developed Information, Planning, and Conservation (IPaC) System, as well as other information on habitat requirements for listed species, known records in TPWD's Texas Natural Diversity Database (TPWD 2017), on-site habitat assessments, and analysis of potential impacts resulting from project construction. Based on their assessment, the Corps determined that construction of the Recommended Plan may affect, but is not likely to adversely affect, the whooping crane, piping plover, red knot, and sea turtles that may migrate through the GIWW. As a result, the Corps developed a Biological Assessment and has consulted with the Service (and NMFS) under Section 7(a)(2) of the ESA. Through consultation, the Service will review the Corps' determinations and provide input on measures to reduce the likelihood of any potential impact to listed species.

The Service recommends that the Corps continue to consider ways to minimize of impacts to threatened and endangered species during future planning, engineering, and design of the project. Also, should the design plans change significantly, the project is relocated, or construction is not implemented within two years following the Corps' analysis, we recommend that the Corps reevaluate the project footprint and coordination with this office.

Eagles

Although the bald eagle (*Haliaeetus leucocephalus*) has successfully recovered and has been removed from the list of threatened and endangered species, it is still protected by the Bald and Golden Eagle Protection Act (BGEPA). Bald eagles are well known to occur and nest near major water bodies in the Texas coastal region, including Brazoria, Matagorda, and surrounding counties (Ortego 2016). The Corps assessed the study area habitats and determined that trees in the vicinity are too small to support bald eagle nests. However, due to the relatively large home ranges of bald eagles and presence of nesting habitat in nearby wooded areas, bald eagles may forage in the Brazos, San Bernard, and Colorado Rivers, GIWW, East and West Matagorda Bays, and other large water bodies in and near the project sites. The

Service recommends the Corps utilize the National Bald Eagle Management Guidelines to identify when and under what circumstances the protective provisions of the BGEPA may apply to their activities. Also, if construction is not implemented within two years following the Corps' analysis, we recommend that the Corps reassess the potential habitats in and adjacent to the impact areas for the potential for bald eagle nests.

Migratory Birds

The Texas coast and its large expanses of marsh, wetland, prairie, forest, and other natural habitats support large numbers of resident, wintering, and migrating birds. Flocks of wintering and migrating waterfowl use bay, marsh, and prairie habitats for foraging and roosting. Large number of Nearctic-Neotropical migratory birds that cross the Gulf during migrations "fallout" in large numbers to rest, shelter, and feed in wooded habitats. Over 40 bird species of conservation concern, which are not listed as threatened or endangered under the ESA but are considered high conservation priorities (Service 2008), are listed as occurring in the Gulf Coastal Prairie region along the Texas coast.

Rookeries used by colonial nesting birds are also documented near the study areas (TPWD 2017) (**Figures 4 and 5**). Species that have been documented nesting in the rookeries include: cattle egret (*Bubulcus ibis*), great egret (*Ardea alba*), tricolored heron (*Egretta tricolor*), great blue heron (*Ardea herodias*), **neotropical cormorant** (*Phalacrocorax brasilianus*), snowy egret (*Egretta thula*), roseate spoonbill (*Platalea ajaja*), least tern (*Sternula antillarum*), laughing gull (*Leucophaeus atricilla*), white ibis (*Eudocimus albus*), reddish egret (*Egretta rufescens*), forrester's tern (*Sterna forsteri*), and black skimmer (*Rynchops niger*) (TPWD 2017). The marsh and open water habitats in the study areas provide foraging habitat for these species.

Habitat Evaluations

Habitat Evaluation Methods

An interagency team of biologists from the Service, NMFS, TPWD, and the Corps was convened to conduct a habitat evaluation of the study area. The Service's *Habitat Evaluation Procedures* (HEP) (Service 1980) were used to analyze and describe the various existing habitats in the study area. The team of biologists collected field data at the BRFG on 15 February 2017 and at the CRL on 22 March 2017. Ten survey sites (six at BRFG, four at CRL) were selected in high marsh, intertidal marsh, and tidal flat habitats. HEP data were collected at each of these sites, and photographs of each sampling location are provided in **Appendix B**. Two additional sampling locations were collected in the upland shrub/woods habitats in the CRL study area; however, these data were not used, as anticipated impacts to shrub/woods habitat resulting from the proposed project activities were determined to not be significant.

Six indicator species were selected to represent fish and wildlife communities that utilize the three habitats evaluated. The clapper rail and marsh wren were selected to represent those species utilizing the high marsh habitat. The clapper rail, red drum, and brown and white shrimp were selected to represent the fish and wildlife community of the intertidal marsh habitat. The least tern was selected to represent the wildlife community of the tidal flats.

HEP requires the use of Habitat Suitability Index (HSI) models developed for each indicator species that use the habitats. The HSI models contain a list of structural habitat composition variables that are contained in optimal habitat. All the variables for each species representing each habitat are compiled and measured in the field. These variables were measured or estimated within a 0.1-acre data plot within the habitat they represent. They are used as indicators of habitat condition or value.

Baseline habitat conditions are expressed as a numeric function (HSI value) ranging from 0.0 to 1.0, where 0.0 represents no suitable habitat for an indicator species and 1.0 represents optimum conditions for the species. HSI values ranging from 0.01 to 0.24 are considered “poor” habitat, 0.25 to 0.49 are considered “below average” habitat, 0.50 to 0.69 are “average” habitat, 0.70 to 0.89 are “good” habitat, and 0.90 to 1.00 are considered “excellent” habitat. Habitat units are calculated by multiplying the HSI for each habitat by the number of acres of the same habitat.

Habitat Suitability Index (HSI) Values

Six habitat types are present within the BRFG study area and five in the CRL study area. Of the approximate 600-acre BRFG study area, approximately 66 acres are developed, 124 acres are high marsh, 16 acres are intertidal marsh, 3 acres are tidal flat, 175 acres are upland shrub/woods, and 216 acres are open water. Of the approximate 400-acre CRL study area, 52 acres are developed, 32 acres are high marsh, 4 acres are intertidal marsh, 172 acres are upland shrub/woods, and 140 acres are open water. Of the study area habitats, habitat evaluations were conducted for the marsh/tidal flat habitats (high marsh, intertidal marsh, and tidal flat) because of the high value of marsh for fish and wildlife and the relative scarcity of wetland habitat types. The upland shrub/woods habitats, developed areas, and open water were not evaluated for habitat suitability.

Table 2 displays the HSI values and habitat units for each habitat in the study area per indicator species. The HSI values ranged from 0.25 for the high marsh at CRL to 1.0 for the high marsh at BRFG. The clapper rail HSI for high marsh at the BRFG maxed out the index at 1.0, providing excellent habitat for the species. At the CRL, however, the high marsh habitats were generally poor for the clapper rail, primarily due to their isolation from tidally influenced water bodies. The clapper rail requires tidally influenced waters with vegetated shoreline adjacent to the habitat. Although all three high marsh sites at the CRL maintained the vegetative structure of high marsh habitats, two of the three sites were not directly connected to the tidally influenced waters. One of the high marsh sites provided good habitat for the marsh wren, which increased the overall HSI score for the high marsh at the CRL.

Table 2 Average HSI Values and Habitat Units for Wetland Habitats										
Habitat Type	Acreeage	Indicator Species							HSI Avg	Habitat Units
		Red Drum	Brown Shrimp	White Shrimp	Clapper Rail	Least Tern	Marsh Wren*	Mottled Duck*		
BRFG										
High Marsh	123.5				1.00				1.00	123.50
Intertidal Marsh	15.8	0.37	0.92	0.90	1.00			0.80	0.80	12.64
Tidal Flat	3.0					0.80			0.80	2.40
CRL										
High Marsh	32.0				0.15		0.85*	0.00*	0.25	8.00
Intertidal Marsh	4.6	0.45	0.97	0.91	0.98				0.83	3.82
* Marsh wren and mottled duck were evaluated only at one of three high marsh sites in the CRL study area. During field visits, the interagency team determined that the other high marsh habitats at BRFG and CRL were not suitable for these species.										

Mitigation

On August 31, 2009, the Corps’ Directorate of Civil Works - Planning Community issued implementation guidance for Section 2036(a) of the Water Resource Development Act of 2007. This guidance requires that the preferred alternative contain a mitigation plan for the fish and wildlife resources that are lost as a result of the unavoidable impacts caused by the project. These impacts must be compensated to the extent justified, and the preferred alternative must have adequate mitigation to ensure the proposed navigation

measures will not have any measurable adverse impact to the significant resources of the area. The Corps recognizes that the wetland resources in the study area are significant and could be permanently impacted as a result of the proposed BRFG and CRL project.

The natural resource agencies assisted the Corps with recommended mitigation opportunities and have identified mitigation measures. We urge the Corps to continue to coordinate with the natural resource agencies to fully vet out all mitigation possibilities during future detailed planning and engineering of the project. The Service (along with other resource agencies) recommends the following mitigation goals:

- 1) No net loss of wetland acres
- 2) Replace lost AAHUs 1:1
- 3) Replace AAHUs in-kind

The President's Council on Environmental Quality defines the term "mitigation" in the National Environmental Policy Act regulations to include: (a) avoiding the impact altogether by not taking certain actions or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and compensating for the impact by replacing or providing substitute resources or environments. The Service supports and adopts this definition of mitigation and considers its specific elements to represent the desirable sequence of steps in the mitigation planning process. Based on current and expected future without-project conditions, the planning goal of the Service is to develop a balanced project, i.e., one that is responsive to navigation needs while addressing the co-equal need for fish and wildlife resource conservation.

The Service's Mitigation Policy (Federal Register, Volume 46, No. 15, January 23, 1981) identifies four resource categories that are used to ensure the level of mitigation recommended by the Service biologist will be consistent with the fish and wildlife resource values involved. Considering the high value of marsh for fish and wildlife and the relative scarcity of that habitat type, those wetlands are considered as Resource Category 2 habitats, the mitigation goal of which is no net loss of in-kind habitat value. The upland shrub/woods habitats in the study area consist of relatively young trees and do not constitute bottomland hardwoods or other significant woodland habitat. Therefore, they are placed in Resource Category 4. The mitigation goal for Resource Category 4 habitats is minimizing the disturbance of those habitats to the extent practicable.

The Corps' Recommended Plan minimizes impacts to marshes and upland shrub/woods habitats to some extent by constructing the proposed improvements adjacent to the existing BRFG and CRL facilities. Because the existing BRFG and CRL are already constructed and require repair/replacement to meet the study's objectives, avoiding impacts altogether (i.e. the No Action alternative) is not feasible. Also, the GIWW needed to be realigned slightly at each project site to keep the existing gates/locks in operation during construction. Therefore, remaining unavoidable project impacts to marshes should be mitigated via compensatory replacement of the habitat values lost.

The Recommended Plan will result in unavoidable impacts to 13.8 acres of marsh at the BRFG (2.4 acres of high marsh and 11.4 acres of intertidal marsh) and 0.7 acre of marsh at the CRL (intertidal marsh). The Corps has prepared a mitigation plan to fully mitigate the impacted marsh habitats, and will implement the mitigation plan during the construction phases of the project. **Table 3** summarizes the

anticipated marsh impacts, in acres and Average Annual Habitat Units (AAHUs), and the mitigation needs at each project site. Based on projected AAHUs for the creation of intertidal and high marsh within the mitigation areas, a total of 14.14 acres of marsh creation are needed at the BRFG to offset wetland losses, including 2.45 acres of high marsh and 11.69 acres of intertidal marsh. At the CRL, 0.74 acre of intertidal marsh creation is needed to offset the marsh losses.

Table 3 Summary of Marsh Habitat Impacts and Mitigation Needs						
Habitat Type	Average Baseline HSI (Annualized)	AAHUs Lost	Acres Lost	Projected Mitigation HSI (Annualized)	AAHUs Needed	Acres Needed
BRFG						
High Marsh	1.00	2.40	2.4	0.98	2.40	2.45
Intertidal Marsh	0.80	9.12	11.4	0.78	9.12	11.69
CRL						
Intertidal Marsh	0.83	0.58	0.7	0.80	0.58	0.74
Total for Both Project Sites	-	12.10	14.5	-	12.10	14.90

The Corps identified three preliminary mitigation alternatives to replace lost habitat values: using a mitigation bank, replacing the lost habitat on-site, or replacing the lost habitat off-site. The habitat replacement associated with the on-site and off-site alternatives include three scales of mitigation measures: (1) the collection of plugs of vegetation from onsite or nearby marshes to be planted, (2) the purchase and planting of marsh vegetation plugs, and (3) the planting of nursery produced pots of marsh vegetation. The mitigation bank alternative was screened out because no mitigation banks containing tidal marsh credits are available for use in this area. Replacing marsh off-site was also screened out since off-site mitigation would require land acquisition. The purchase of lands outside the project area would increase mitigation costs, and the expenditure of federal funds would not be worth the costs when on-site mitigation is possible. The Corps also determined that off-site locations would require pumping dredged material longer distances and levee construction, which not only add mitigation costs but could cause additional wetland impacts that need to be mitigated. Therefore, the on-site planting alternative with three scales of plantings was selected as the mitigation plan for the project.

The Corps used a cost effective/incremental cost analysis using software developed by the Institute of Water Resources to determine the most efficient measures for the three planting scales. The most cost-effective measure involved the collection and planting of marsh vegetation plugs within the project area.

Figures 8 and 9 show potential locations identified by the Corps for the mitigation wetlands at each facility. The Corps has stated that the final design for dredging and placement at each facility would incorporate areas of sufficient size and with appropriate elevations to establish the mitigation wetlands along the existing and proposed GIWW. Within the mitigation areas, the area will be filled and/or contoured to target elevations, which will be determined based on the existing elevations of impacted and/or nearby marshes. The elevations will consider anticipated settling of fill material. In addition, the mitigation areas will be designed to minimize the potential for erosion from vessel wakes, currents in the GIWW, and flooding from the rivers. After the fill material has settled to the target elevation, areas where intertidal marsh will be established will be planted with smooth cordgrass at a minimum of 3-foot centers. Areas where high marsh will be established will be planted at a minimum of 3-foot centers. As stated above, the Service recommends that the Corps continue to coordinate with the natural resource agencies in designing the marsh creation areas and to adequately protect the mitigation areas from erosion and other impacts that may occur along this navigation channel.

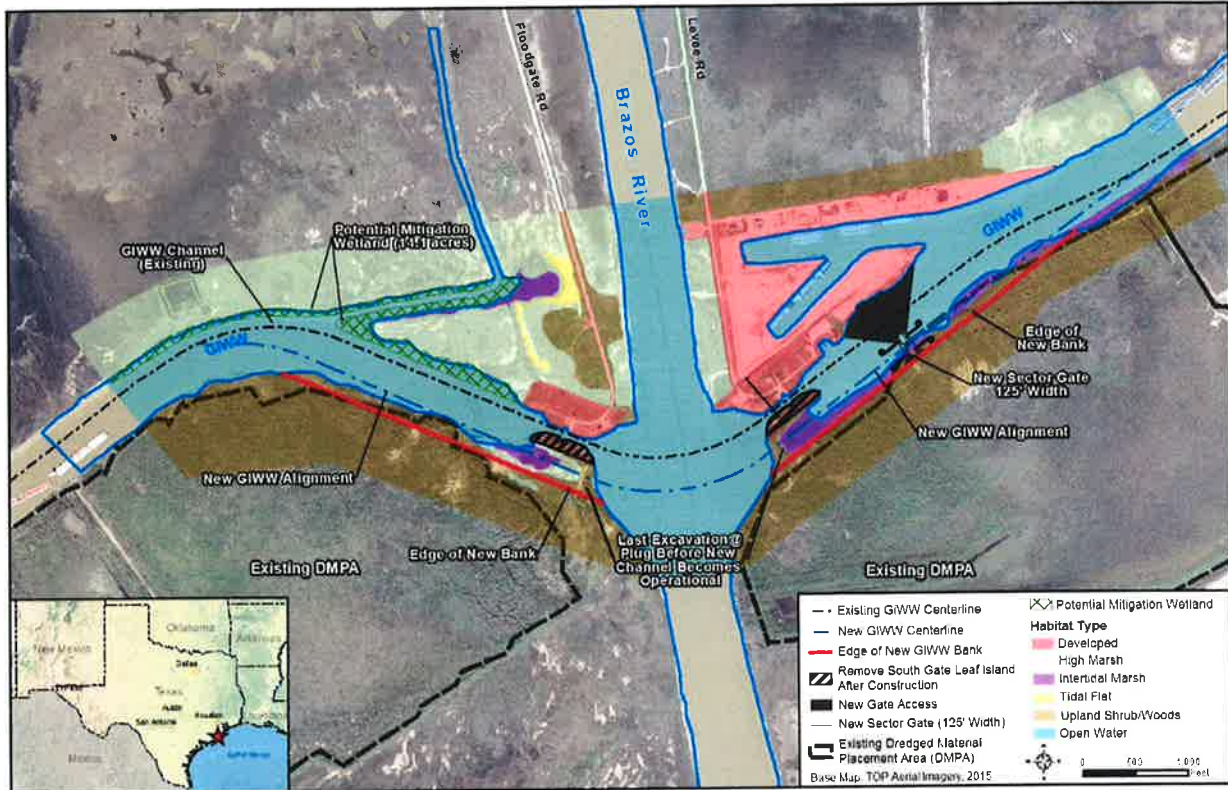


Figure 8 Potential Mitigation Wetland Location at BRFG

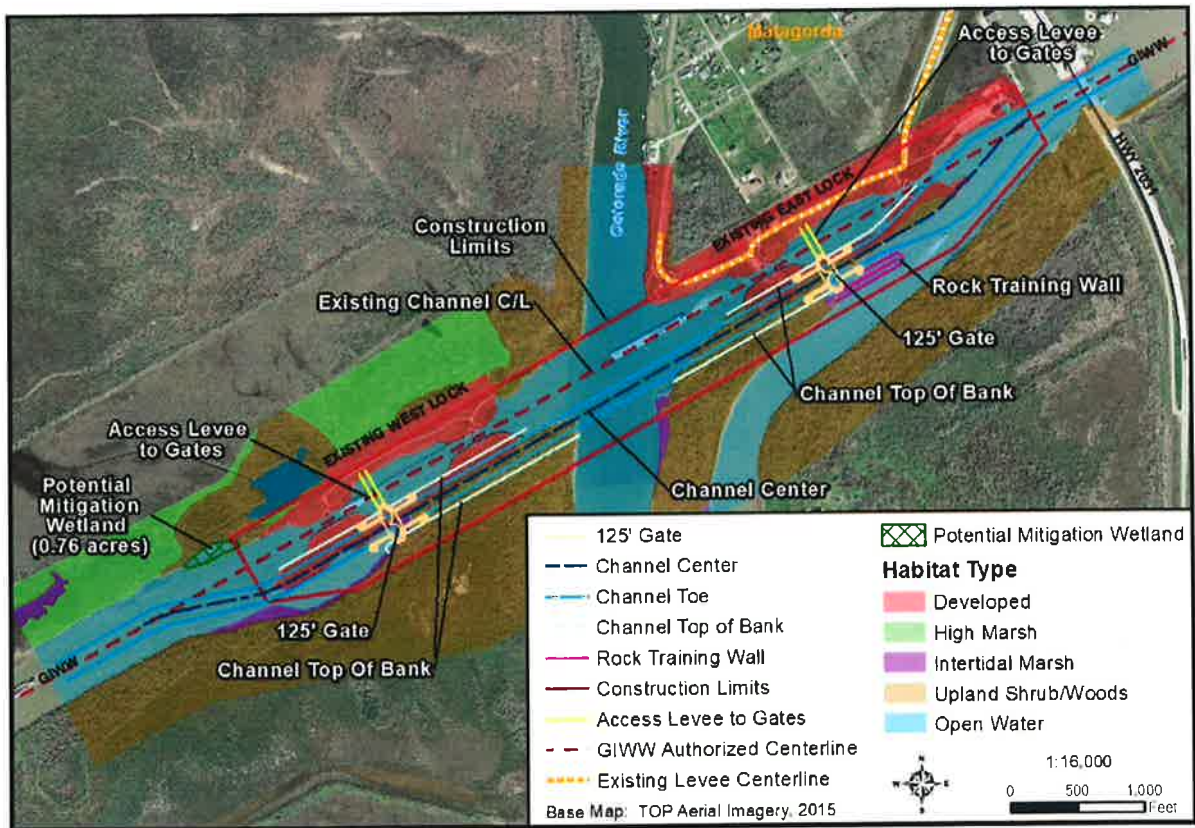


Figure 9 Potential Mitigation Wetland Location at CRL

Effects of Climate Change

As stated in the Service's Strategic Plan for responding to climate change ("Strategic Plan", Service 2010), the current and forecasted rate of global climate change could cause rapid ecosystem changes and increase the risk of species extinctions. It could have direct and indirect adverse impacts on wildlife and their habitats, such as increasing temperatures and drought potential; changing food availability; increasing frequency and intensity of fires and extreme storm events; causing sea level rises that inundate coastal habitats, convert terrestrial habitats, and stimulate actions to protect coastal developments and/or divert development pressure to higher areas; and many more predictable and unforeseen effects.

Recognizing that no one agency, organization, government, or other entity can face the challenge of climate change alone, the Service has prepared a Strategic Plan that emphasizes three major strategies: (1) *Adaptation*—minimizing the impact of climate change on fish and wildlife through the application of cutting-edge science in managing species and habitats; (2) *Mitigation*—reducing levels of greenhouse gases in the Earth's atmosphere; and (3) *Engagement*—joining forces with others to seek solutions to the challenges and threats to fish and wildlife conservation posed by climate change (Service 2010).

Based on Corps data, the tide gage with sea level trend information nearest to the BFRG and CRL is at Freeport, Texas (NOAA Gage 8772440), which shows a mean sea level trend equal to 4.35 millimeters per year (mm/ yr, ± 1.12 mm/ yr), which equates to 1.47 feet/century. Due to the coastal location of the project sites and low-lying nature of the study areas and wetland habitats therein, wetlands and other habitats in the BFRG and CRL vicinities are susceptible to being lost to rising sea levels resulting from climate change, which would affect wildlife communities. Rising sea levels associated with climate change may also affect the amount, shape, and quality of beaches, which provide nesting habitat for threatened and endangered sea turtles and support prey species consumed by piping plover, red knot, and other shorebirds (Service 1995).

The Service urges the Corps to consider sea level rise and other potential effects of climate change when planning this and other coastal projects, including habitat mitigation, creation, restoration, stabilization, and protection projects.

Fish and Wildlife Conservation Measures

The Service's mitigation policy (FR, Volume 46, Number 15, pages 7656-7663, January 23, 1981) provides guidance to help ensure that the level of compensatory mitigation recommended by the Service is consistent with the value and scarcity of the fish and wildlife resources involved. In keeping with that policy, the Service usually recommends that losses of high value habitats, which are becoming scarce be avoided or minimized to the greatest extent possible. Unavoidable losses of such habitats should be fully compensated by replacement of the same kind of habitat value; this is called in-kind mitigation. The mitigation planning goals and associated Service recommendations should be based on the four categories, as shown in Table 4.

Resource Category	Habitat Value of Impacted Area	Mitigation Goal for Resource Category
1	High value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section	No net loss of existing habitat value
2	High value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section	No net loss of in-kind habitat
3	High to medium value for evaluation species and is relatively abundant on a national basis	No net loss of habitat value while minimizing loss of in-kind habitat value
4	Medium to low value for evaluation species	Minimize loss of habitat value

Bottomland hardwood forests, bald cypress swamps, and coastal marshes are considered by the Service to be aquatic resources of conservation importance due to their increasing scarcity and high habitat value for fish and wildlife within the Federal trusteeship (i.e., migratory waterfowl, wading birds, other migratory birds, threatened and endangered species, and inter-jurisdictional fisheries).

Final Recommendations

1. The Service recommends the Corps incorporate beneficial use of dredged material into the DMMP in lieu of using existing or proposed confined upland DMPAs or offshore disposal sites. Beneficial uses for dredged material may include creation and/or restoration of marsh habitats, construction of earthen terraces to control wave action and promote shoreline stabilization and marsh growth, construction of colonial waterbird nesting islands, and other activities that improve and protect coastal habitats.
2. All new work and maintenance material should be tested for contaminants using the standards outlined in the Environmental Protection Agency’s Inland Testing and Ocean Dumping Manuals prior to being used in any beneficial use projects or being placed in upland confined DMPAs or offshore disposal sites. Should testing suggest toxic levels of contaminants are present, the Service recommends disposal of the material within an approved landfill site.
3. The Service recommends the USACE incorporate best management practices into their construction strategies. The Service requests that the Corps initiate coordination with the Service during the design phases of the project and prior to the commencement of any construction activities so the site-specific BMPs can be developed. Measures should be implemented to avoid or minimize the adverse effects of pollution, sedimentation, and erosion by limiting soil disturbances, managing likely pollutants, and limiting the harm that may be caused by accidental discharges of pollutants and sediments, avoiding contact with any wildlife species, removal of trash daily, slower transportation speeds within the project area (on land and in the water), and educating construction staff about the presence of wildlife species in the project area. BMPs attempt to minimize impacts to fish and wildlife species within the immediate construction and nearby areas and may consist of, but not limited to, floating turbidity curtains, limiting certain construction activities to daylight hours, limiting the use of or shielding lights at night, no vegetation removal or soil disturbance should be allowed outside of the project area, removal of mature trees providing soil or bank stabilization should be incorporated with the Service and TPWD, erosive banks should be stabilized using bioengineering solutions to minimize the use of riprap, and using monitors in open water areas to identify sensitive species.

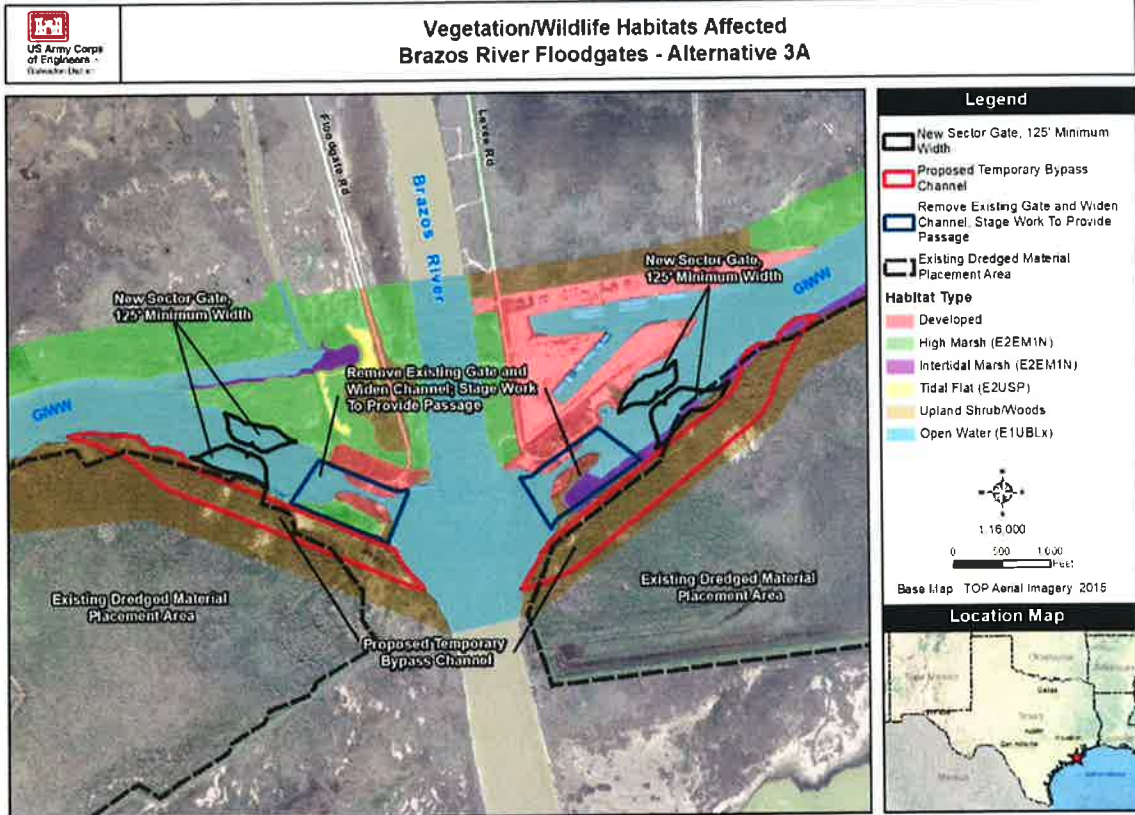
4. The Service recommends the Corps incorporate success criteria, monitoring, and adaptive management into the project's wetland mitigation plan.
5. The Service recommends that the Corps continue to coordinate with the natural resource agencies in designing the proposed marsh mitigation areas, evaluate potential impacts of vessel traffic in the GIWW when designing the mitigation areas, and to adequately protect the mitigation areas from erosion and other impacts that may occur along the GIWW.
6. Wetland creation areas should be planted as early as possible to minimize erosion. Plant species and planting schedules should be fully vetted and coordinated with the Service, NMFS, and TPWD.
7. The Service believes that, through construction and mitigation efforts, additional marsh habitat may be negatively impacted (e.g., moving equipment necessary for wetland construction). We expect these additional impacts to be temporary and should not require mitigation. If the Corps deems that additional permanent wetland impacts may occur, the Service recommends mitigation for any permanent direct or indirect wetland impacts with full compensation and in coordination with the Service, NMFS, and TPWD.
8. The Service recommends that the Corps initiate coordination with NMFS at (727) 824-5312 regarding sea turtle impacts and mitigation issues for the project, and follow the NMFS' recommendations and construction conditions for in-water work.
9. The Service recommends the Corps evaluate the project's impacts to units protected under the Coastal Barrier Resources Act of 1982 and coordinate the Corps' impact determination with the Service.
10. Should this project move to the design and construction phases, the Service recommends that the Corps continue to evaluate the project's effects on threatened and endangered species, bald eagles, wetland habitats, migratory birds, and other natural resources.
11. If the proposed project features change, the status of species change, or the project is not implemented within two years of the date of our ESA coordination completion, the Service recommends that the Corps reevaluate the project's effects and species status and initiate any necessary consultation procedures pursuant to Section 7 of the ESA.
12. The Service recommends the Corps utilize the National Bald Eagle Management Guidelines to identify when and under what circumstances the protective provisions of the BGEPA may apply to their activities. Also, if construction is not implemented within two years following the Corps' analysis, we recommend that the Corps reassess the potential habitats in and adjacent to the impact areas for the potential for bald eagle nests.
13. The Service recommends that construction occur at least 1,000 feet away from a colonial waterbird rookery site during the breeding season of February 1 through September 1.
14. With respect to other migratory birds, the Service recommends that clearing of vegetation and excavation of potential nesting habitats (e.g., wooded areas along the south side of the GIWW) be conducted outside of bird nesting season. Nesting season is highly variable, with larger hawks and raptors nesting during the winter months and some colonial waterbirds nesting as late as August. If construction cannot be completed outside of bird nesting season, we recommend coordination with the TCESFO – Houston (281) 286-8282 to identify survey times and best management practices.
15. The Service urges the Corps to consider sea level rise and other potential effects of climate change when planning this and other coastal projects, including habitat mitigation, creation, restoration, stabilization, and protection projects.
16. The Service requests that the Corps initiate coordination with the Service during the design phases of the project and prior to the commencement of any construction activities so the site-specific BMPs can be developed. Measures should be implemented to avoid or minimize the adverse effects of pollution, sedimentation, and erosion by limiting soil disturbances, managing likely pollutants, and limiting the use.

17. A monitoring and adaptive management plan should be developed prior to the construction of the mitigation features for the project. The Service requests the opportunity to provide input and review the development of the plan to ensure the successful implementation of the mitigation measures.

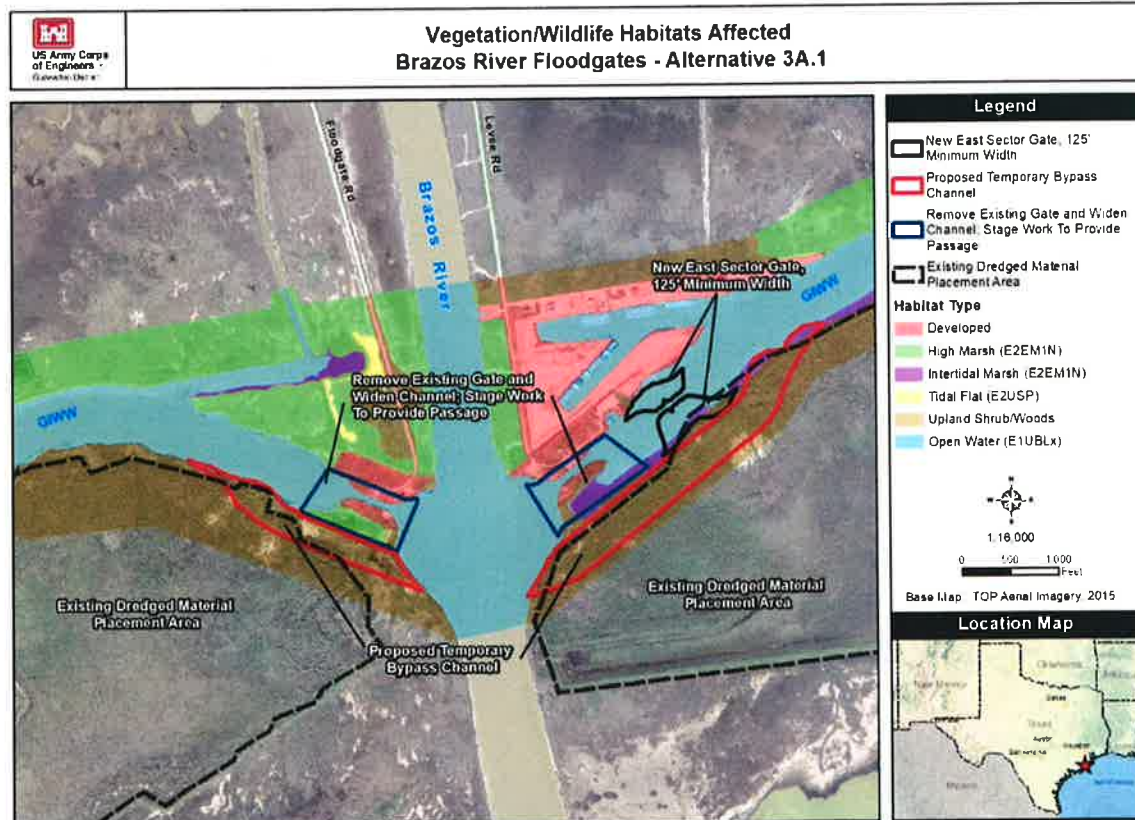
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Appendix A
Preliminary Alternatives Maps

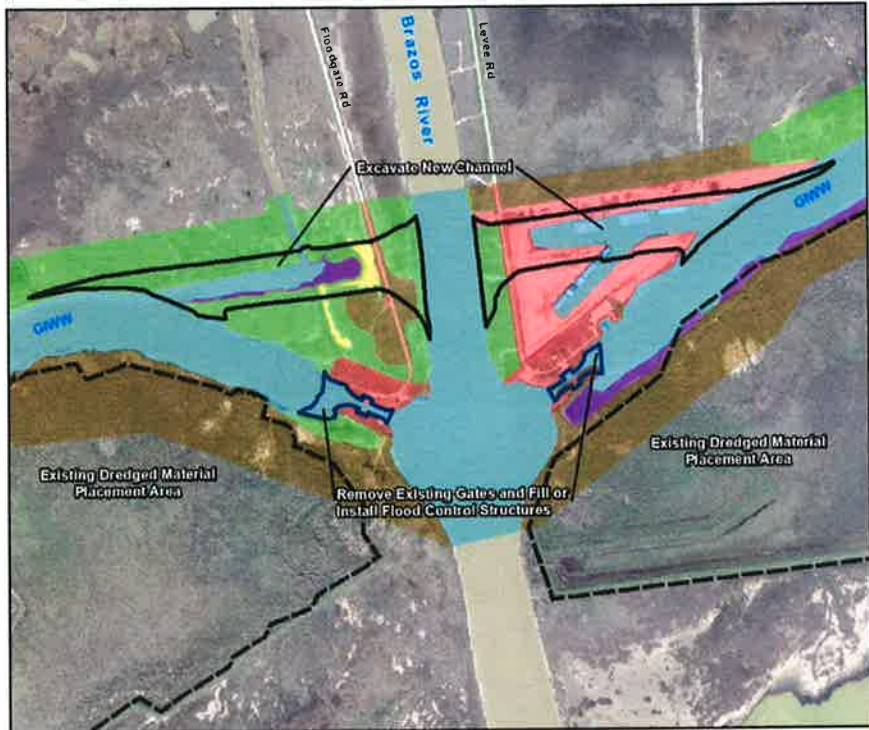


BRFG Alternative 3a: Gate Relocation on Existing Alignment



BRFG Alternative 3a.1: Open Channel West/East Gate Relocation

US Army Corps of Engineers
 Vegetation/Wildlife Habitats Affected
 Brazos River Floodgates - Alternative 9A



Legend

- Excavate New Channel
- Remove Existing Gates and Fill or Install Flood Control Structures
- Existing Dredged Material Placement Area

Habitat Type

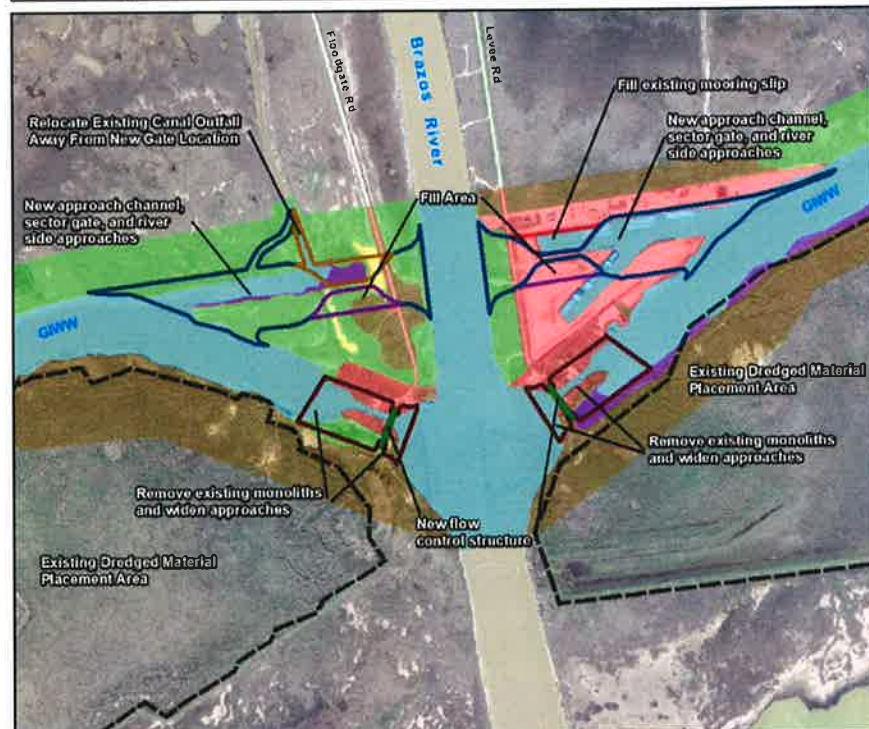
- Developed
- High Marsh (E2EM1N)
- Intertidal Marsh (E2EM1N)
- Tidal Flat (E2USP)
- Upland Shrub/Woods
- Open Water (E1UBLx)

Scale: 1:16,000
 0 500 1000 Feet
 Base Map: TOP Aerial Imagery 2015

Location Map

BFRG Alternative 9a: Open Channel

US Army Corps of Engineers
 Vegetation/Wildlife Habitats Affected
 Brazos River Floodgates - Alternative 9B/C



Legend

- Fill area
- Fill existing mooring slip
- New approach channel, sector gate and river side approaches
- New flow control structure
- Relocate existing canal outfall away from new gate location
- Remove existing monoliths and widen approaches
- Existing Dredged Material Placement Area

Habitat Type

- Developed
- High Marsh (E2EM1N)
- Intertidal Marsh (E2EM1N)
- Tidal Flat (E2USP)
- Upland Shrub/Woods
- Open Water (E1UBLx)

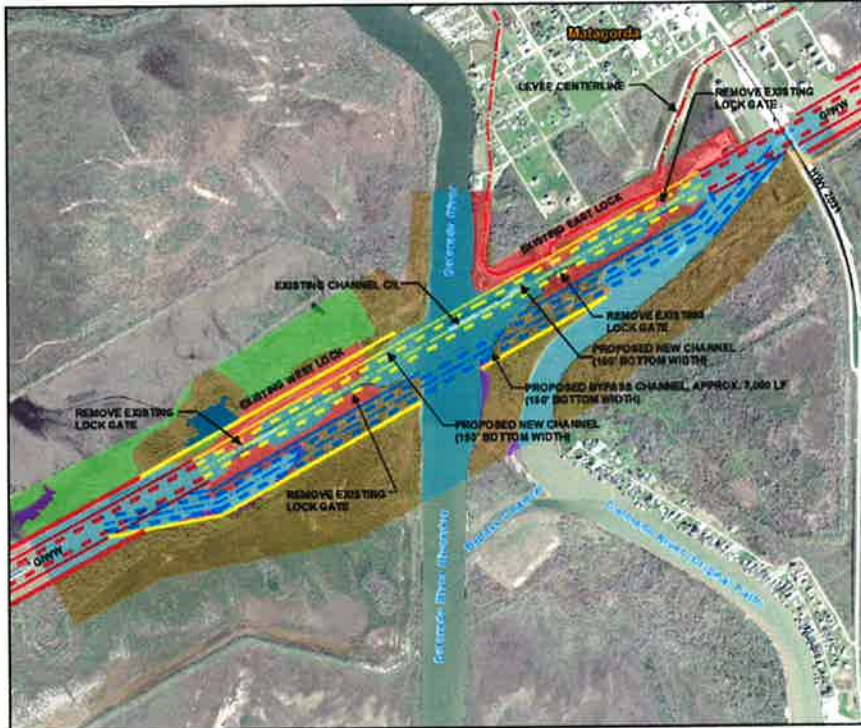
Scale: 1:16,000
 0 500 1000 Feet
 Base Map: TOP Aerial Imagery 2015

Location Map

BFRG Alternative 9b/c: New Alignment/Gates with Control Structures



Vegetation/Wildlife Habitats Affected Colorado River Locks - Alternative 3B



Legend

- TOP EDGE OF CUT
- BOTTOM EDGE OF CUT
- CHANNEL CENTERLINE
- BOTTOM EDGE OF CUT
- TOP EDGE OF CUT

- EXISTING NAVIGATION CHANNEL
- PROPOSED BYPASS NAVIGATION CHANNEL
- PROPOSED NEW NAVIGATION CHANNEL

Habitat Type

- Developed
- High Marsh (E2EM1N)
- Intertidal Marsh (E2EM1N)
- Tidal Flat (E2USP)
- Upland Shrub/Woods
- Open Water (E1UBx)

1:18,000
0 500 1,000 Feet

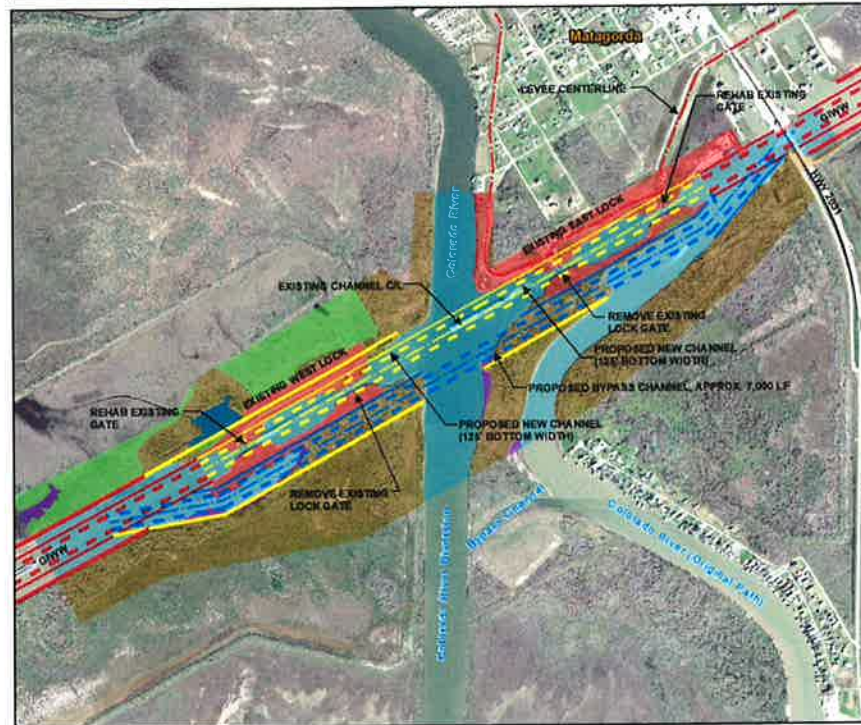
Base Map: TOP Aerial Imagery 2015

Location Map

CRL Alternative 3b: Open Channel



Vegetation/Wildlife Habitats Affected Colorado River Locks - Alternative 4b.1



Legend

- TOP EDGE OF CUT
- BOTTOM EDGE OF CUT
- CHANNEL CENTERLINE
- BOTTOM EDGE OF CUT
- TOP EDGE OF CUT

- EXISTING NAVIGATION CHANNEL
- PROPOSED BYPASS NAVIGATION CHANNEL
- PROPOSED NEW NAVIGATION CHANNEL

Habitat Type

- Developed
- High Marsh (E2EM1N)
- Intertidal Marsh (E2EM1N)
- Tidal Flat (E2USP)
- Upland Shrub/Woods
- Open Water (E1UBx)

1:18,000
0 500 1,000 Feet

Base Map: TOP Aerial Imagery 2015

Location Map

CRL Alternative 4a.1: Removal of Riverside Gates

Appendix B

Photographs of Habitat Evaluation Sites



Photo 1: Representative view of High Marsh evaluation site at BRFG, facing west



Photo 2: Representative view of High Marsh evaluation site at BRFG, facing north



Photo 3: Representative view of High Marsh evaluation site at BRFG, facing west



Photo 4: Representative view of Intertidal Marsh evaluation site at BRFG, facing south



Photo 5: Representative view of Intertidal Marsh evaluation site at BRFG, facing east



Photo 6: Representative view of Tidal Flat evaluation site at BRFG, facing north



Photo 7: Representative view of High Marsh evaluation site at CRL, facing south



Photo 8: Representative view of High Marsh evaluation site at CRL, facing north



Photo 9: Representative view of High Marsh evaluation site at CRL, facing north



Photo 10: Representative view of Intertidal Marsh evaluation site at CRL, facing west