Matagorda Ship Channel, Port Lavaca, Texas

Feasibility Report and Environmental Impact Statement,
Review of Completed Projects,
Calhoun and Matagorda Counties

August 2019

FINAL

US Army Corps of Engineers®
Galveston District

(NOTE: This page intentionally left blank.)

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

Matagorda Ship Channel, Port Lavaca, Texas

Feasibility Report and Environmental Impact Statement,

Review of Completed Projects,

Calhoun and Matagorda Counties

August 2019

FINAL

P2 - 451954

(NOTE: This page intentionally left blank.)

EXECUTIVE SUMMARY

STUDY DESCRIPTION

The Calhoun Port Authority, formerly known as the Calhoun County Navigation District, of Point Comfort, Texas, sent a letter of intent to the Galveston District's District Engineer in June of 2015. The letter contained their desire to initiate a study partnership to address water resource opportunities. A Feasibility Cost Share Agreement (FCSA) was signed between the USACE Galveston District and the Calhoun Port Authority (CPA) on August 5, 2016.

The Matagorda Ship Channel, Port Lavaca, Texas, Feasibility Report and Environmental Impact Statement, Review of Completed Projects, Calhoun and Matagorda Counties study, hereafter called "Study," is a Section 216 – Review of Completed Projects study.

Section 216 of the Flood Control Act of 1970, PL 91-611 authorizes the Secretary of the Army to review existing the USACE constructed projects due to changes in physical and / or economic conditions. The USACE then reports to Congress with recommendations on the advisability of modifying the project or its operation, and for improving the quality of the environment in the overall public interest.

CONSTRUCTION AUTHORITY

Public Law (PL) 85-500, RHA of July 3, 1958, Title 1 – Rivers and Harbors, Section 101 states:

> *"That the following works of improvement of rivers and harbors and other waterways for navigation…are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and supervision of the Chief of Engineers, in accordance with the plans and subject to the conditions recommended by the Chief of Engineers in the respective reports hereinafter designated:*
>
> *"Texas. Matagorda Ship Channel, Port Lavaca, Texas: House Document Numbered 388, Eighty-fourth Congress, at an estimated cost of $9,944,000"*

STUDY AUTHORITY

PL 91-611; Title II - River and Harbor and Flood Control Act of 1970, Section 216, dated December 31, 1970, 33 USC. § 549a, which states:

> *"The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of project the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest."*

EXECUTIVE SUMMARY

PURPOSE AND NEED

The purpose of this feasibility study is to evaluate Federal interest in alternative plans (including the No Action Plan) for reducing transportation costs while providing for safe, reliable navigation of the Matagorda Ship Channel (MSC). Per Engineer Regulation (ER) 1165-2-119 Modification to Completed Projects, dated 20 September 1982, Section 216 studies "The River and Harbor Act of 1915 (Section 5) provides an authority to increase channel dimensions, beyond those specified in project authorization documents, at entrances, bends, sidings, and turning places as necessary to allow the free movement of vessels." Therefore, the study will assess the effects of the alternatives on the natural system and human environment, including the economic development effects of existing inefficiencies. Economic conditions have changed significantly since the construction of the MSC. An increase in throughput tonnage and a significant shift in average fleet size render current channel dimensions incapable of accommodating the forecasted commodity and fleet growth without significant and system-wide inefficiencies. The study evaluates and recommends measures that address current and expected inefficiencies.

An Environmental Impact Statement (EIS) is being prepared for the MSC Project due to the unavoidable, significant, and adverse impacts to wetlands and oyster reefs. This feasibility report and environmental impact statement (EIS) provides recommendations for the modification of the existing MSC.

SCOPE

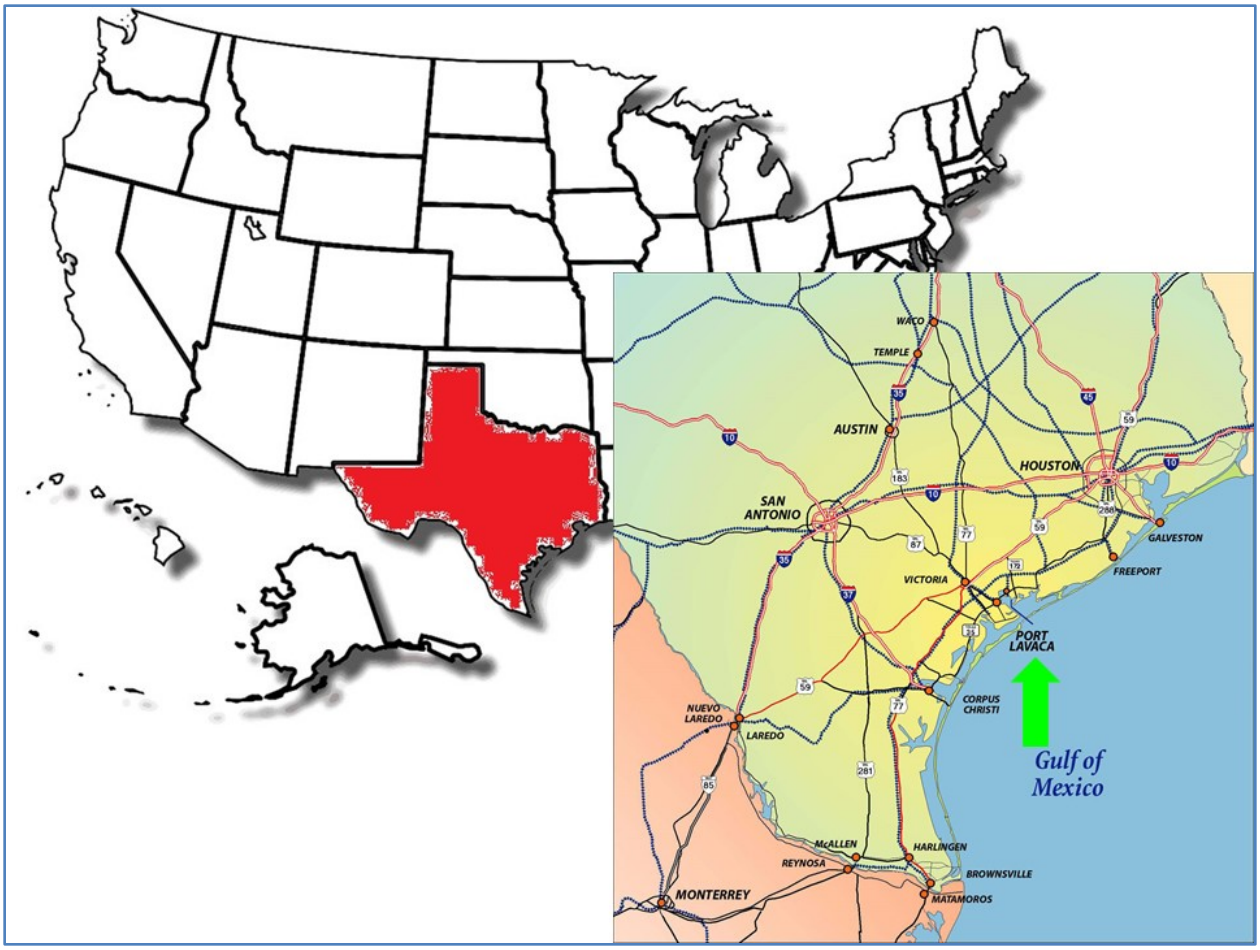
The scope of the study area includes the entire MSC, which will be evaluated for current and projected vessel size and traffic. Beginning at the Gulf of Mexico (Gulf) end of the MSC, the study will examine various management measures to provide for safe and efficient ship movement opportunities, including both non-structural and structural measures.

Additional analysis was conducted after selection of the Tentatively Selected Plan (TSP), including modeling, and refining of costs and benefits.

LOCATION

The 26-mile existing Federal MSC is located 125 miles southwest of Galveston, Texas and 80 miles northeast of Corpus Christi, Texas. The channel extends from offshore in the Gulf through Matagorda Bay and Lavaca Bay to the Port.

The study area lies within Calhoun County (west side) and Matagorda County (east side), Texas.



SPONSOR

The non-Federal sponsor (NFS) for this study is the CPA of Point Comfort, Texas. The CPA has been an active sponsor, securing public meeting sites, participating in every conference call, and meeting, coordinating with the Matagorda Bay Pilots Association, and providing comments on documentation.

PROBLEMS AND OPPORTUNITIES

Initial Problem Identification

- The existing designed channel depth limits channel use to vessels whose drafts are -38 feet (‘) Mean Lower Low Water (MLLW) or less.
    - Opportunities exist to modify the existing designed channel such that it can accept vessels whose drafts are greater than -38’ MLLW.
- Vessels that require deeper drafts cannot come into the Port fully loaded.
    - Opportunities exist to modify the existing designed channel such that deeper draft vessels can come into Port fully loaded.
    - Opportunities exist to modify the existing designed channel such that deeper draft vessels do not have split their cargoes before coming to Port.

- The existing designed channel bottom width is 200’ and limits channel use to a single vessel with a maximum width (beam) of 109’.
    - Opportunities exist to modify the existing designed channel such that it can accept vessels moving in both directions simultaneously.
- The existing designed channel bottom width is 200’ and leaves little room for pilot error during times of high winds, waves, or changes in shoaling. Pilots will only move vessels through the MSC with a length overall (LOA) of 639’ or longer during daylight.
    - Opportunities exist to modify the existing designed channel such that the Pilots feel it is safe for themselves, vessel’s crews and the environment to move these, and larger vessels, during nighttime hours.
- The existing designed turning basin (1,000’ by 1,000’) (Figure 9) limits the size of vessels which can call on the Port facilities.
    - Opportunities exist to modify the existing turning basin such that it can accept larger vessels with larger transport capacities.

SPECIFIC PLANNING OBJECTIVES

- Improve the navigational efficiency of the deep-draft navigation system over the period of analysis (2024 – 2073)
- Improve the operational safety of the deep-draft navigation system over the period of analysis (2024 – 2073)

ALTERNATIVE PLANS

Alternative	Depth Main / Entrance (MLLW)	Width Main / Entrance	Turning Basin	Passing Lane
No Action Plan	-38’ / -40’	200’ / 300’	~1,000’	NO
A	-41’ / -43’	350’ / 600’	1,200’	NO
	-43’ / -45’	350’ / 600’	1,200’	NO
	-45’ / -47’	350’ / 600’	1,200’	NO
	-47’ / -49’	350’ / 600’	1,200’	NO
	-49’ / -51’	350’ / 600’	1,200’	NO
	-51’ / -53’	350’ / 600’	1,200’	NO
B	-41’ / -43’	350’ / 600’	1,200’	YES
	-43’ / -45’	350’ / 600’	1,200’	YES
	-45’ / -47’	350’ / 600’	1,200’	YES
	-47’ / -49’	350’ / 600’	1,200’	YES
	-49’ / -51’	350’ / 600’	1,200’	YES
	-51’ / -53’	350’ / 600’	1,200’	YES

~ is used as a short form for the word approximate or approximately

TENTATIVELY SELECTED PLAN (TSP) at the DRAFT REPORT

Economic analyses indicate that Alternative Plan A at -47' MLLW is the National Economic Development (NED) Plan. It is the plan that reasonably maximizes net economic benefits consistent with protecting the Nation's environment. The NFS (CPA) is in agreement with the TSP and is not requesting a Locally Preferred Plan. Alternative Plan A at -47' MLLW is therefore the TSP.

Alternative	Depth Main / Entrance (MLLW)	Width Main / Gulf	Turning Basin
A	**-47' / -49'**	**350' / 600'**	**1,200'**

ENVIRONMENTAL COMPLIANCE

Agency coordination began at the initial Scoping meeting and continued through regularly scheduled resource agency meetings. Representatives from USFWS, National Marine Fisheries Service (NMFS), the Environmental Protection Agency (EPA), Texas Parks and Wildlife Department (TPWD), and Texas General Land Office (GLO), and Texas Commission on Environmental Quality (TCEQ) were all invited to attend the meetings. Initial meetings focused on the development of the alternatives of the project. Subsequent meetings discussed the Dredged Material Management Plan (DMMP) and the needs for mitigation of unavoidable impacts. The proposed models were agreed to by the resource agencies, as was the approach to propose a conceptualized mitigation plan with further refinements in the planning and construction phase. Locations of mitigation sites were discussed but not finalized.

BENEFITS AND COSTS OF THE TSP

The plan with the highest net benefits is Alternative Plan A at -47' MLLW, which provides $6,539,000 in total net benefits, with a benefit-to-cost ratio (BCR) of 1.3. Price levels are October 2017 and the discount rate is 2.75% ($ in thousands).

Alt A	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Increment Net Costs	Increment Net Benefits	BCR
-47' MLLW	**$24,051**	**$30,590**	**$6,539**	**$1,449**	**$3,664**	**1.3**

PUBLIC COORDINATION

The USACE published the Intent to Prepare a Draft EIS for the Matagorda Ship Channel, TX, Feasibility Study in the Federal Register, Vol. 81, No. 247, Friday, December 23, 2016.

The USACE and NFS held a public scoping meeting in Port Lavaca, Texas on January 24, 2017. Public concerns and comments were solicited. Public review of the draft integrated feasibility report and EIS began on May 7, 2018 with a public meeting held on May 15, 2018.

RECOMMENDED PLAN at the FINAL REPORT

Following the TSP milestone meeting, a ship simulation was performed to determine the channel width required to accommodate the design vessel, among other specifications. It was determined from the simulation that the design width of the ~21-mile inner-harbor channel could be decreased from 350' bottom width to 300' bottom width. This change in channel width combined with other refinements in feasibility level costs caused the project first cost estimate to decrease from $464,548,000 to $212,498,000.

Alternative	Depth Main / Entrance (MLLW)	Width Main / Gulf	Turning Basin
A	**-47' / -49'**	**300' / 550'**	**1,200'**

BENEFITS AND COSTS OF THE RECOMMENDED PLAN

Alt A	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Benefit / Cost Ratio
-47' MLLW	$15,886	$35,858	**$19,972**	**2.26**
Price levels are October 2018 and the discount rate is 2.875% ($ in thousands).				

RECOMMENDED PLAN – FIRST COSTS ALLOCATION

Table 1 - First Costs Allocation

Cost Account	Project Features	Federal (75%)	Non-Federal (25%)	Total
		October 2018 price levels		
	Construction General – General Navigation Features (GNF)			
12	Dredging	$91,121,000	$30,373,000	$121,494,000
06	Fish & Wildlife Facilities	$19,693,000	$6,564,000	$26,257,000
01	Lands and Damages (Non-Federal 100%)	$0	$1,554,000	$1,554,000
30	Planning, Engineering, and Design	$14,711,000	$4,904,000	$19,615,000
31	Construction Management	$9,388,000	$3,129,000	$12,517,000
02	Relocations	$0	$31,061,000	$31,061,000
	Total Cost	**$134,913,000**	**$77,585,000**	**$212,498,000**

Benefits were calculated using the USACE approved HarborSym model. Benefits and costs were calculated with a base year of 2024 and a 50-year period of analysis (2024-2073) using the FY19 discount rate of 2.875 percent. Construction of the Recommended Plan would generate total average annual benefits of $35,858,000 with total average annual costs of $15,886,000, producing a benefit-to-cost ratio (BCR) of 2.26 at the 2.875 percent discount rate.

Total First Costs of this project is $212,498,000 with a Federal share of $134,913,000, and a NFS cost share of $77,585,000. Total First Cost for Aids to Navigation are 100% Federal with funds going to the US Coast Guard for $1,883,000.

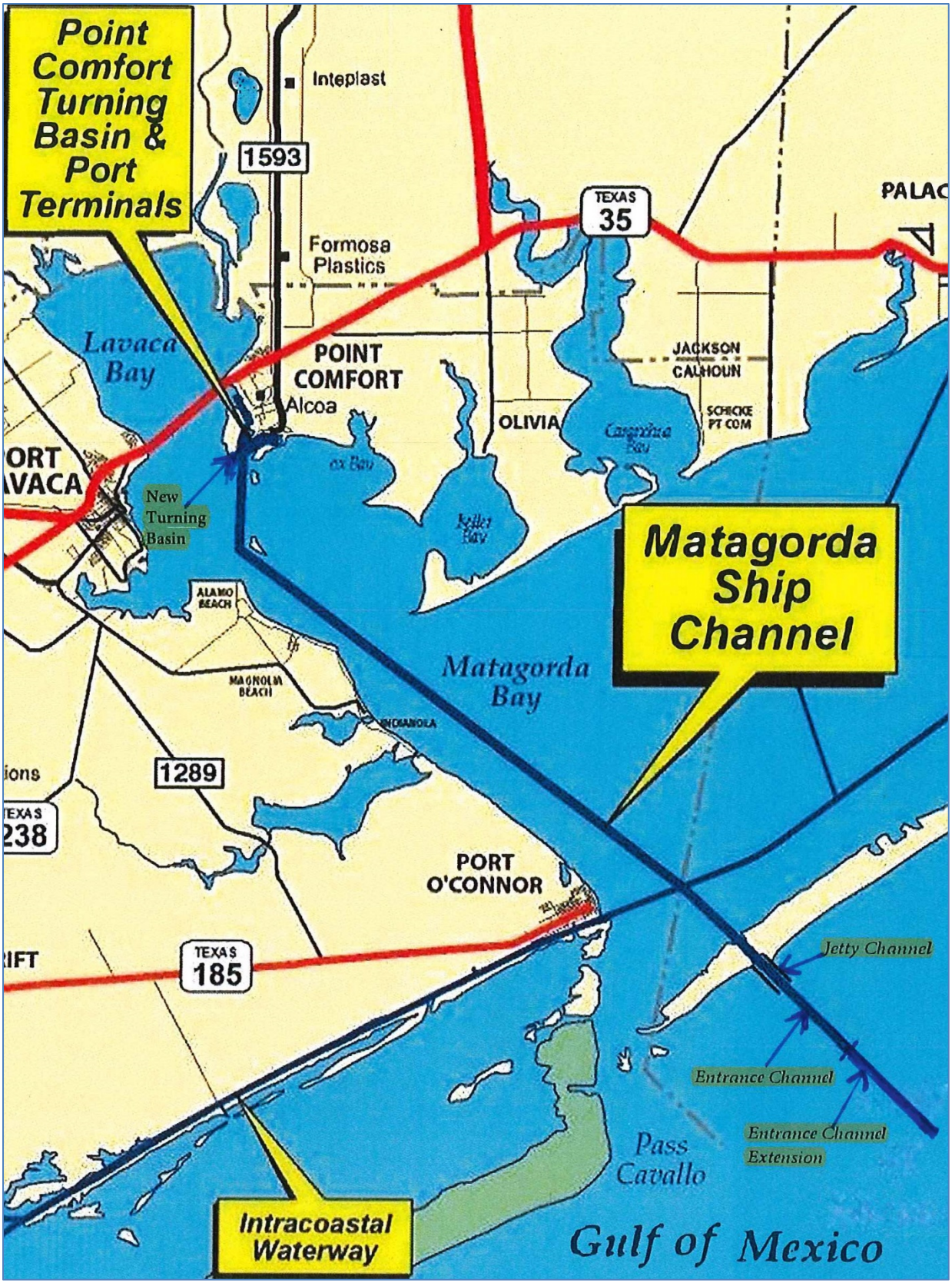


Figure 1 - Recommended Plan

Table 2 - General Cost Allocation

Feature	Federal Cost %[1]	Non-Federal Cost %[1]
General Navigation Features (GNF)	●90% from 0 feet to 20 feet ●**75% from 20 feet to 50 feet** ●50% for 46 feet and deeper	●10% from 0 feet to 20 feet ●**25% from 20 feet to 50 feet** ●50% for 46 feet and deeper
Mitigation	●**75%**	●**25%**
Navigation Aids	●**100% USCG**	●**0%**
Operation and Maintenance		
GNF	●**100% except cost share 50**% costs for maintenance > 50 feet	●0% except cost share 50% costs for maintenance > 50 feet

[1] *The non-Federal sponsor shall pay an additional 10% of the costs of GNF over a period of 30 years, at an interest rate determined pursuant to Section 106 of WRDA 86. Normally, the value of LERR shall be credited toward the additional 10% payment; however, there are no LERRs for this project.*

NON-FEDERAL SPONSOR SUPPORT

Texas Mid-Coast Region industries depend on the CPA to provide berths from which they can import and export their products all over the world. The widening and deepening of the MSC will aid in the movement of crude oil, natural gas condensate and other liquid petrochemical products. This project will allow both current and future Port users to have the ability to import and export products overseas in larger vessels, which in turn will decrease their transportation costs and will add to the growing economic activity in the State of Texas (State). The CPA is supportive of the features in the Recommended Plan.

DREDGED MATERIAL MANAGEMENT PLAN

The MSC DMMP (Appendix E) addresses the dredging needs, disposal capabilities, capacities of placement areas (PAs), environmental compliance requirements, and potential for beneficial use (BU) of dredged material, and indicators of continued economic justification. The MSC DMMPs will be updated periodically to identify any potentially changed conditions.

The MSC DMMP identifies specific measures necessary to manage the volume of material likely to be dredged over a 50-year period, from both construction and maintenance dredging. Non-Federal, permitted dredging within the related geographic area shall be considered in formulating Management Plans to the extent that disposal of material from these sources affects the size and capacity of PAs required for the MSC.

CONCLUSIONS

The selection of Alternative Plan A at -47' MLLW as the Recommended Plan reflects the information available during the study, and current Departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program, nor the perspective of higher review levels with the Executive Branch. Consequently, any recommendations may be modified before they are transmitted to the Congress as proposals for authorizations and implementation funding. However, prior to transmittal to the Congress, the NFS, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

REQUIRED LANGUAGE

The requirements of Section 404(r) of Public Law 92-500, as amended, have been met.

(NOTE: This page intentionally left blank.)

Table of Contents

APPENDICES

List of Figures

List of Tables

1 General Information

The Calhoun Port Authority (CPA), of Point Comfort, Texas, sent a letter of intent to the Galveston District's District Engineer in June of 2015. The letter contained their desire to initiate a study partnership to address water resource opportunities. A Feasibility Cost Share Agreement (FCSA) was signed between the United States Army Corps of Engineers (USACE) Galveston District and the CPA on August 5, 2016.

The Matagorda Ship Channel, Port Lavaca, Texas, Feasibility Report and Environmental Impact Statement, Review of Completed Projects, Calhoun and Matagorda Counties study, hereafter called "Study," is a single purpose, Section 216 – Review of Completed Projects study.

Section 216 of the Flood Control Act of 1970, Public Law (PL) 91-611 authorizes the Secretary of the Army to review existing the USACE constructed projects due to changes in physical and / or economic conditions. The USACE then reports to Congress with recommendations on the advisability of modifying the project or its operation, and for improving the quality of the environment in the overall public interest.

1.1 Construction Authority

Congress originally authorized navigation improvements in the Matagorda Bay area under the River and Harbor Act (RHA) of June 25, 1910. This authorization provided for an eight-mile long channel measuring seven feet deep and 80 feet (') wide from deep water in lower Matagorda Bay to Port Lavaca.

The RHA of August 30, 1935 authorized the upper end of the channel to be extended a distance of ~one mile to the shoreline at the entrance of Lynn Bayou.

The RHA of August 26, 1937 authorized the enlargement of the channel from Lynn Bayou at Port Lavaca to deep water in Matagorda Bay near Port O'Connor. This channel had a depth of nine feet and a width of 100' and was ~11 miles long. This Act provided for a channel extension 100' wide and 6' deep from Port Lavaca, via Lavaca Bay, Lavaca River, and Navidad River, to Red Bluff located at about mile three on the Navidad River, for a total distance of 20 miles.

The RHA of March 2, 1945 extended the channel provided for a "harbor of refuge" nine feet deep near Port Lavaca, with an approach channel 9' deep and 100' wide.

PL 85-500, RHA of July 3, 1958, Title 1 – Rivers and Harbors, Section 101 states:

> *"That the following works of improvement of rivers and harbors and other waterways for navigation…are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and supervision of the Chief of Engineers, in accordance with the plans and subject to the conditions recommended by the Chief of Engineers in the respective reports hereinafter designated:*
>
> *"Texas. Matagorda Ship Channel, Port Lavaca, Texas: House Document Numbered 388, Eighty-fourth Congress, at an estimated cost of $9,944,000"*

The RHA, as described in House Document 131, 84th Congress, 1st session, authorized the channel from Pass Cavallo to Port Lavaca to be deepened to 12' and widened to 125', from the then existing 12' depth in Matagorda Bay to the Turning Basin at Port Lavaca. Authorization was given for the channel to the Harbor of Refuge near Port Lavaca to be enlarged to 12' and 125 wide over a distance of 2.1 miles.

The RHA, as described in House Document 388, 84th Congress, 2nd session, authorized the construction of a deep-draft-navigation channel from the Gulf of Mexico (Gulf) through Pass Cavallo. This channel was -38' deep, 300' wide and approximately six miles long; an inner channel 36' deep, 200' wide and ~22 miles long across Matagorda and Lavaca Bay, a turning basin at Point Comfort, 36' deep and 1,000' square; and dual jetties at the channel entrance (these are the dimensions of the present day channel). During pre-construction project design, hydraulic modeling indicated the location of the entrance channel (also known as the Offshore) should be moved from Pass Cavallo to a man-made cut across Matagorda Peninsula. The relocated entrance channel would provide a shorter and straighter entrance channel, shorter jetties, a short length of channel, in which current velocities would be relatively high, and the probability that periodic maintenance requirements would be reduced.

1.1.1 Supplemental Project Authorities

The current project was a consolidation of the existing shallow-draft project for a "channel from Pass Cavallo to Port Lavaca, Texas" and the deep-draft improvements authorized under "Matagorda Ship Channel, Texas."

> *"To provide a deep-draft navigation channel from the Gulf of Mexico through Pass Cavallo to and including a turning basin at Point Comfort, Texas, consisting of an outer bar and jetty channel, 38 feet deep, 300 feet wide, and about 6 miles long, from the Gulf through Pass Cavallo; an inner channel 36 feet deep, 200 feet wide, and about 22 miles long, across Matagorda and Lavaca Bays to Point Comfort, Texas; a turning basin at Point Comfort 36 feet deep) and 1,000 feet square; and dual jetties at the entrance."*

1.2 Study Authority

PL 91-611; Title II - River and Harbor and Flood Control Act of 1970, Section 216, dated December 31, 1970, 33 USC. § 549a, which states:

> *"The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of project the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest."*

Following the initial appraisal, the Section 216 study process is the same as that for normal General Investigations studies.

1.3 Study Purpose and Need

The purpose of this feasibility study is to evaluate Federal interest in alternative plans (including the No Action Plan) for reducing transportation costs while providing for safe, reliable navigation of the Matagorda Ship Channel (MSC). Per Engineering Regulation (ER) 1165-2-119 Modification to Completed Projects, dated 20 September 1982, Section 216 studies "The River and Harbor Act of 1915 (Section 5) provides an authority to increase channel dimensions, beyond those specified in project authorization documents, at entrances, bends, sidings, and turning places as necessary to allow the free movement of vessels." Therefore, the study would assess the effects of the alternatives on the natural system and human environment, including the economic development effects of existing inefficiencies. Economic conditions have changed significantly since the construction of the MSC. The channel was built in the 1950s for a 25,000-30,000 deadweight ton (DWT) design vessel. Today, vessels up to 80,000 DWT use the channel. As such, the channel dimensions limit shipper's ability to efficiently load the vessels and/or use vessels with the most cost effective dimensions. The purpose and need of the project is to evaluate the economic efficiency of increasing the channel size to accommodate a new design vessel and allow current vessels to load more efficiently. An increase in throughput tonnage and a significant shift in average fleet size render current channel dimensions incapable of accommodating the forecasted commodity and fleet growth without significant and system-wide inefficiencies. The study evaluates and recommends measures that address current and expected inefficiencies.

An Environmental Impact Statement (EIS) is being prepared for the MSC Project due to the unavoidable, significant, and adverse impacts to wetlands and oyster reefs. This feasibility report and EIS provides recommendations for the modification of the existing MSC.

1.4 Federal Interest

This USACE study focuses on addressing the major problems contributing to MSC inefficiencies and transportation cost concerns by reviewing and analyzing alternative plans to address the insufficient channel depth and width, as determined by fleet forecasts and current and future users. The USACE has identified economic benefits, associated costs, and environmental and social impacts for proposed channel modifications, and recommendations are hereby made to maximize project benefits consistent with the project purpose.

1.5 Study Area Location

The 26-mile existing Federal MSC is located 125 miles southwest of Galveston, Texas and 80 miles northeast of Corpus Christi, Texas (Figure 2). The channel extends from offshore in the Gulf through Matagorda Bay and Lavaca Bay to the Port.

Matagorda Bay (Figure 3) is about 12 miles wide and 16 miles long, with natural depths of nine to 12'. A narrow arm of water, about four miles wide, extends 35 miles northeast from the main body of the bay. This is divided into two bays by the Colorado River Delta. Matagorda Bay is separated from the Gulf by the Matagorda Peninsula and tidal throughout. Pass Cavallo, located at the southwest corner of the bay, is the only permanent natural pass between the bay and the Gulf. Lavaca Bay is a small water body lying north of, and continuous to the northwest corner of Matagorda Bay.

In Matagorda and Lavaca Bays, the authorized channel depth is -36' Mean Low Tide (MLT), or -38' Mean Lower Low Water (MLLW), and the width is predominately 200'. Offshore, the channel

has a 300’ bottom width. It is maintained at a depth of -38’ MLT or -40’ MLLW. Maintenance dredging also includes increased depth to account for advance maintenance and allowable over-depth.

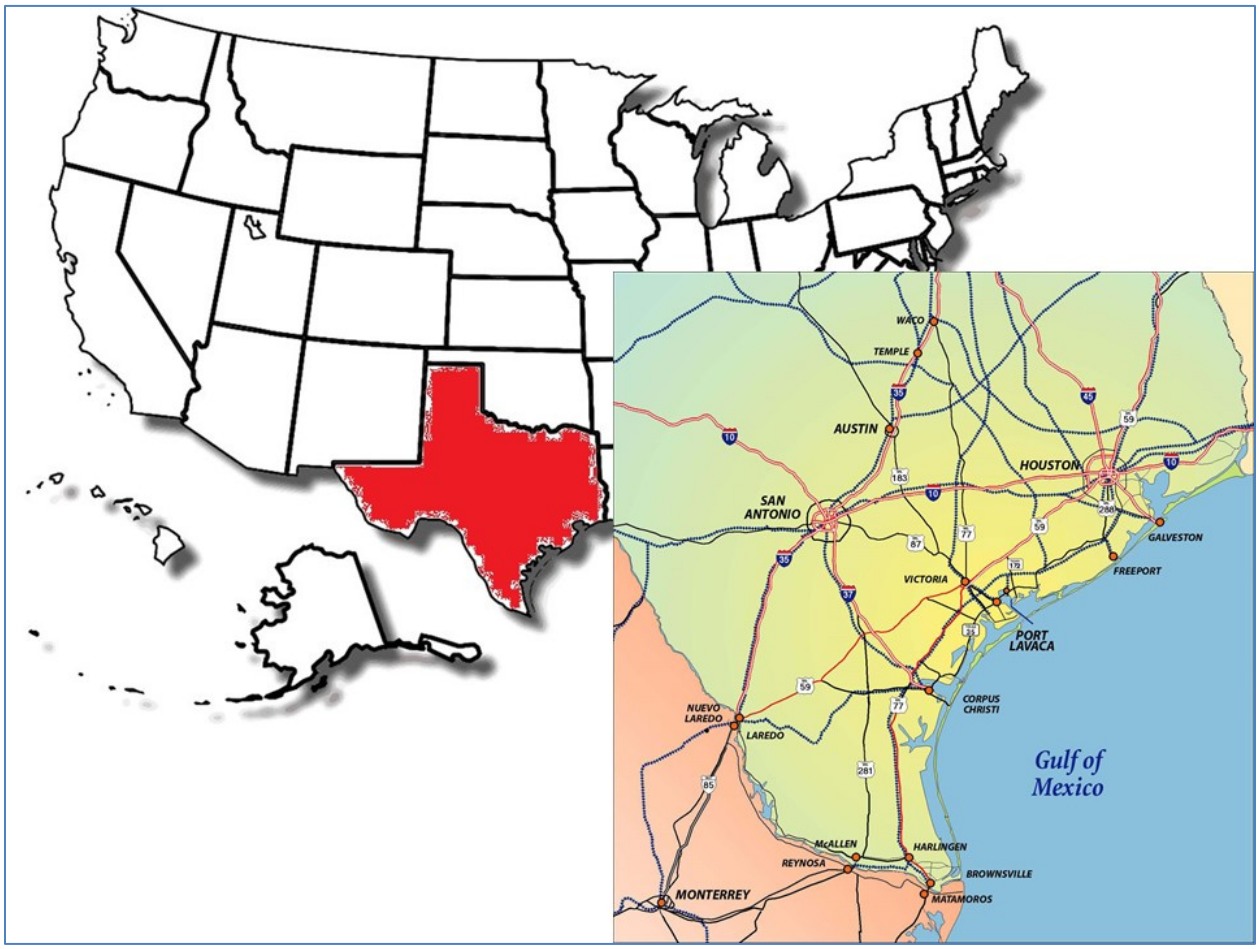


Figure 2 – MSC, Texas Location Map

Mean Low Tide (MLT) – The mean average of all the low tides (high-low tides and low-low tides) occurring over a certain period of time, usually 18.6 years (one lunar epoch) (Coastal States Organization 1997). MLT in the Galveston District was a locally defined navigation datum used for project authorization and construction. Historic projects are referenced to this datum. It has since been superseded by MLLW which is a tidal datum as described herein.

MLLW = MLT + .303’. Vertical datum conversion, MLT to MLLW per USACE Engineering Documentation Report dated July 2015.

NOTE: All depths will be presented in MLLW datum from this point forward unless specifically stated otherwise.

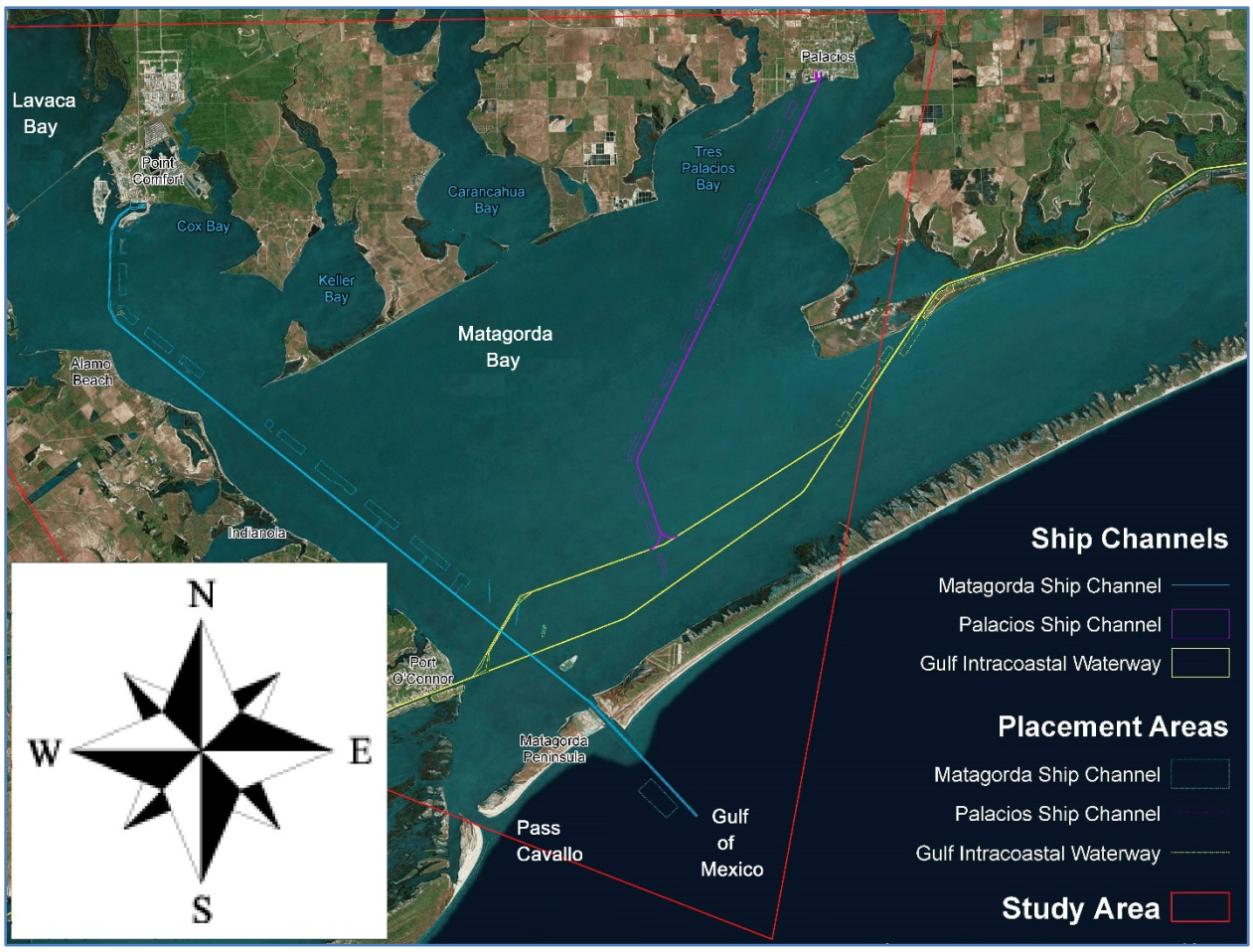


Figure 3 - MSC, Texas Study Area (aerial)

1.5.1 Non-Federal Sponsor

The non-Federal sponsor (NFS) for this study is the CPA of Point Comfort, Texas. The Texas State Legislature established the CPA in the Texas Water Code, Special District Local Laws Code, and Title 5, Transportation, Subtitle A "Navigation Districts and Port Authorities", Chapter 5003, Calhoun Port Authority, Sub-Chapter A. General Provisions.

The CPA has been an active sponsor, securing public meeting sites, participating in conference calls, meetings, and coordinating with the Matagorda Bay Pilots Association (pilots), and providing comments on documentation.

1.5.2 Congressional Representatives

Representatives to Congress from the Study Area / Project Area are:

- Texas State Senator John Cornyn
- Texas State Senator Ted Cruz, and
- Texas State Representative, 27th District, Michael Cloud

1.6 Existing Water Projects

This section describes the originally authorized MSC as constructed in the 1960s (Section 1.6.1), and then as it is currently (Section 1.6.2).

1.6.1 Description of the Originally Authorized Project

The originally authorized project provided for a channel depth of -36’ deep MLT, by 300’ wide from the -38’ MLT depth in the Gulf to the Gulf side of the Matagorda Peninsula; -36’ MLT deep by 300’ wide through the Peninsula; and -36’ MLT deep by 200’ wide from the bay side of the Peninsula to and including a -36’ MLT deep by 1,000’ square turning basin at Point Comfort, Texas (Figure 4).

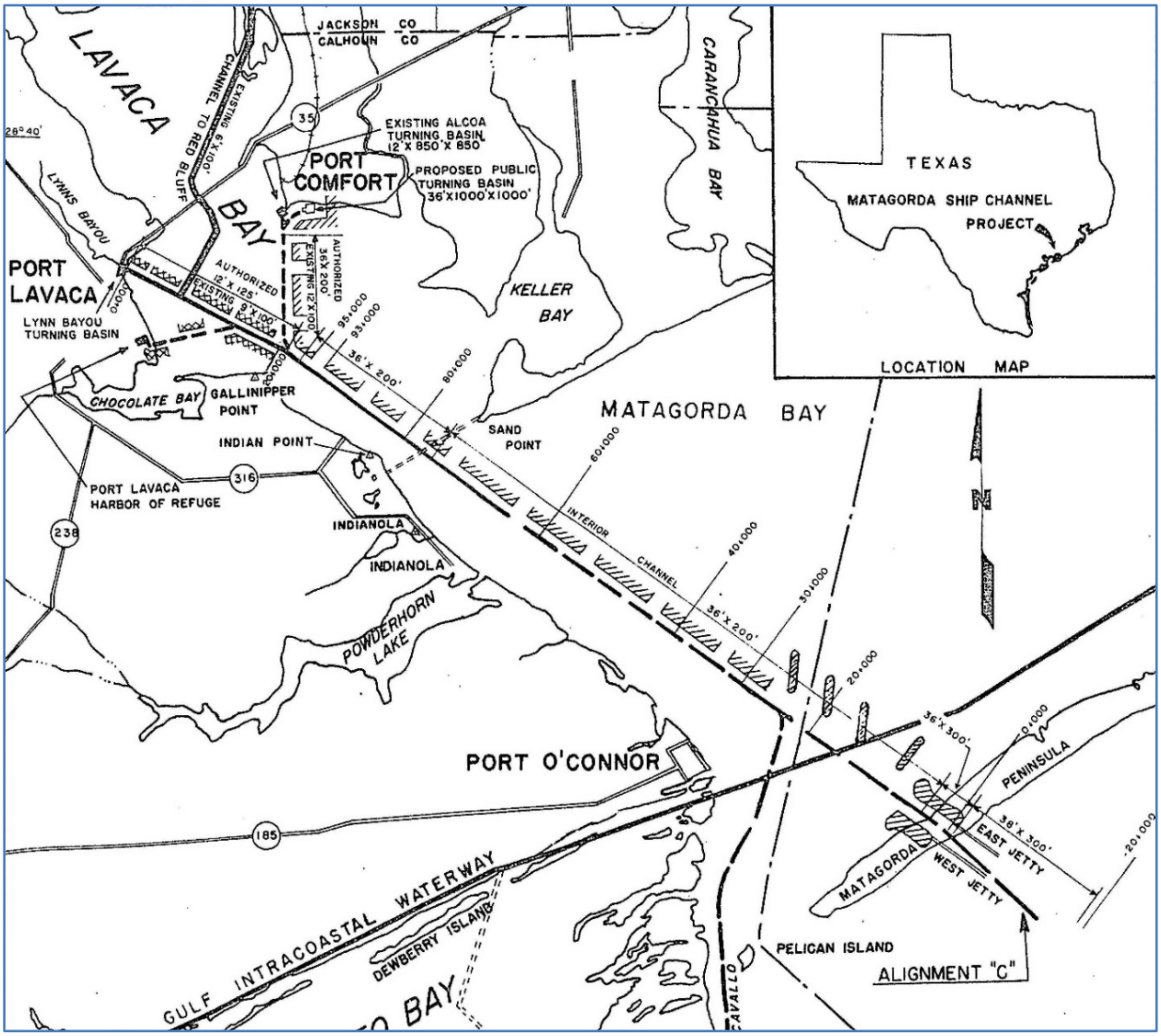


Figure 4 - General Map section from the 1963 General Design Memorandum No. 3

The project provided for the enlargement of the shallow-draft channels to and including the turning basin at Port Lavaca and to and including the Port Lavaca Harbor of Refuge. Dual rubble mound jetties were constructed from Matagorda Peninsula to the -24' MLT depth in the Gulf. Dredge material jetties were constructed to flank the channel across Matagorda Peninsula, extending into Matagorda Bay for 1,000'.

The deep-draft channel was cut through Matagorda Bay approximately four miles northeast of Pass Cavallo and to cross the Gulf Intracoastal Waterway (GIWW) in Matagorda Bay about 475 channel miles from New Orleans, Louisiana. From the GIWW, the channel extended in a direct line to and along the existing Port Lavaca Channel to the channel to Point Comfort and up this channel to a turning basin at Point Comfort (Figure 5).

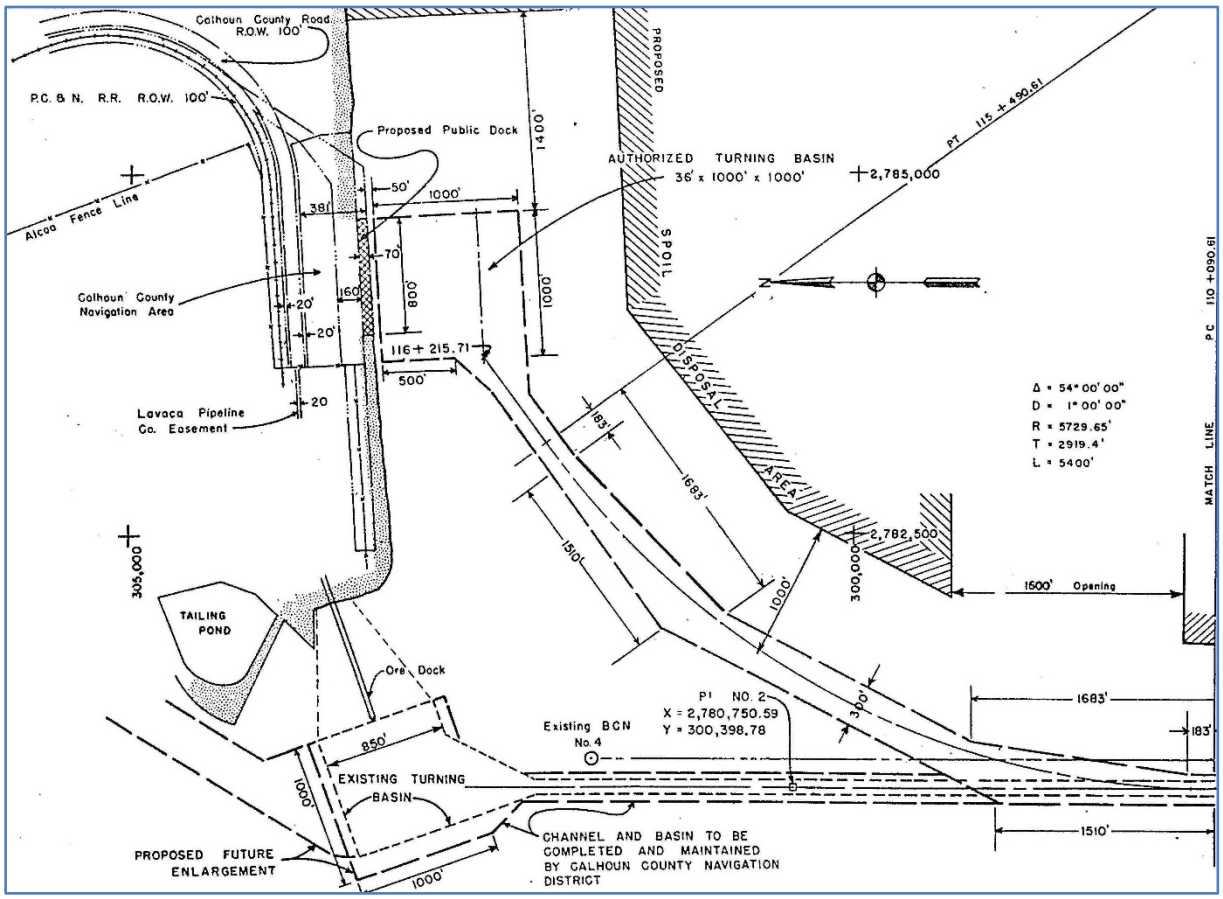


Figure 5 - Original MSC Turning Basin at Point Comfort, Texas

Channel side slopes through the peninsula were flatted to 1V:5H in lieu of the more usual 1V:3H. This was considered advisable because of the relatively high velocity of flow through the peninsula and the composition of the channel slope being of sand.

The initial recommendation called for a total of only two feet of over-depth to the proposed project. During the writing of the 1963 General Design Memorandum (GDM) No. 3, standard practices for the deep-draft navigation channel began to include an additional two feet of advanced maintenance. This additional depth was included in the final design.

The authorized public turning basin was constructed adjacent to a track of land containing ~13 acres (ac) owned by the Calhoun County Navigation District. Public wharf facilities were to be provided by local interests (Figure 5).

Operation and maintenance of the deep-draft channel from the Gulf to and including the turning basin at Point Comfort, Texas, as well as the jetties, were the responsibility of the USACE.

1.6.2 Description of the Currently Authorized Project

The 26-mile MSC is located 125 miles southwest of Galveston, Texas and 80 miles northeast of Corpus Christi, Texas (Figure 3). The northern reach of the MSC is located in Calhoun County and the southern reach and Entrance Channel are in Matagorda County. The MSC is comprised of an Entrance Channel (also known as the Offshore) about four miles long from the Gulf through a man-made cut across Matagorda Peninsula, with dual jetties at the entrance from the Gulf. The GIWW intersects the channel ~2.5 miles north of the cut through Matagorda Peninsula. The bayside channel is about 22 miles long across Matagorda and Lavaca Bays to Point Comfort with a turning basin at Point Comfort (Figure 6).

The current MSC was constructed for a 25,000-30,000 DWT design vessel. Today, vessels up to 80,000 DWT use the channel. As such, the channel dimensions limit shippers' ability to efficiently load the vessels and/or use vessels with the most cost effective dimensions. The largest vessel that is able to enter the channel is one with a 109' beam. The largest vessel to call regularly at the Port is a 750' long x 106' wide Panamax vessel. Due to the narrow width of the channel, larger classes of vessels cannot call, even with tug assist. Within the harbor, tugs are only used for berthing and un-berthing.

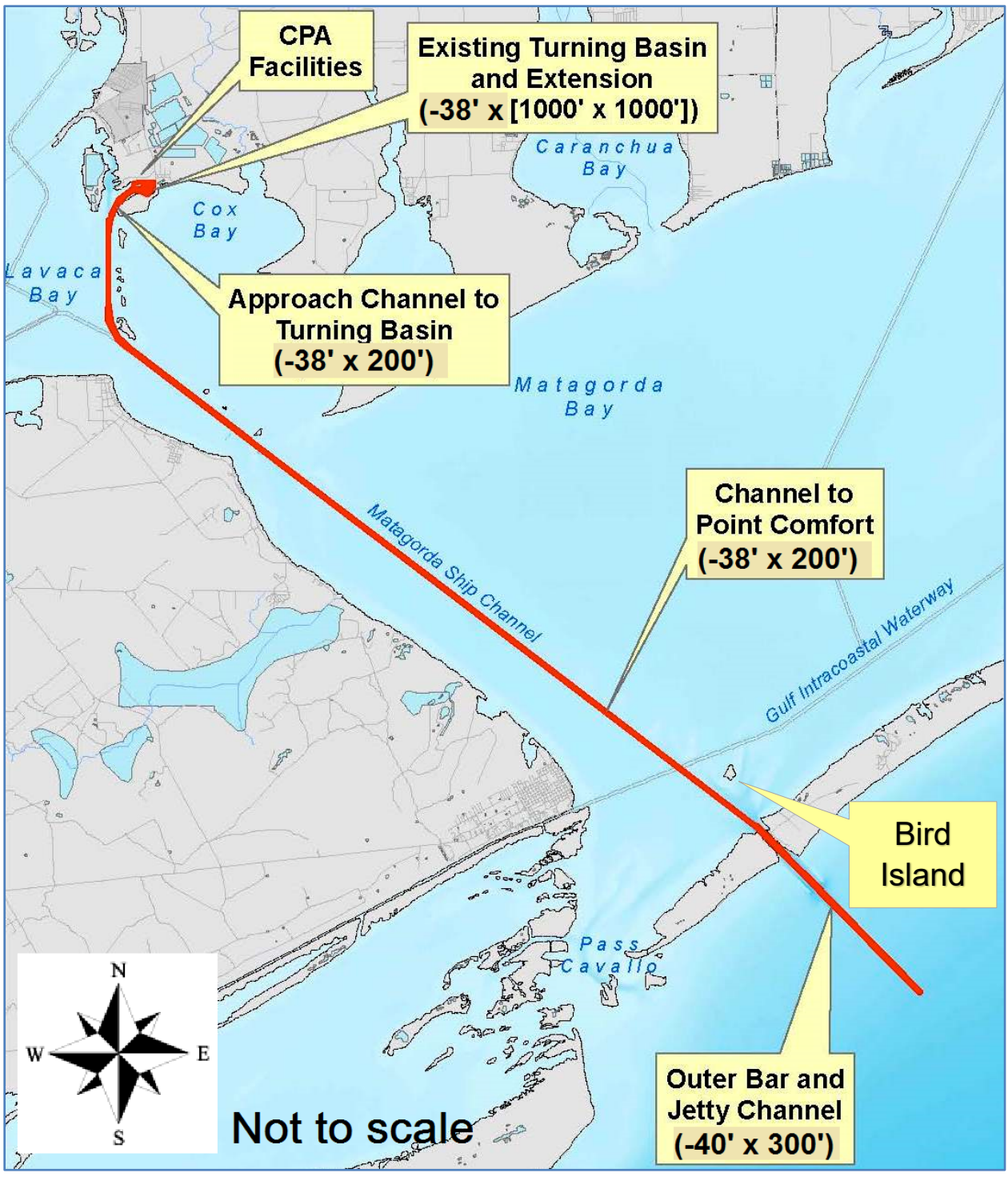


Figure 6 - MSC Current Path and Dimensions

Channel and Basin Descriptions and Maintenance

Offshore (Entrance Channel), the channel has a 300’ bottom width, 10H: 1V side-slopes (X’ horizontal by Y’ vertical), and is maintained at a depth of -40’ plus three feet of advance maintenance depth and two feet of allowable over-depth (Figure 7).

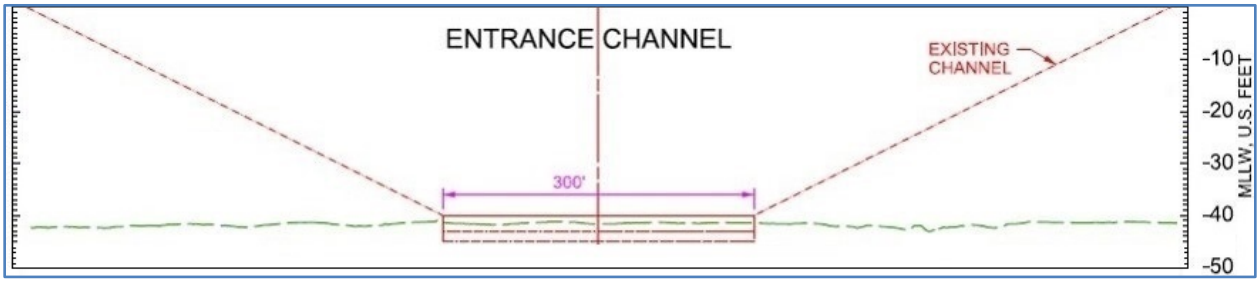


Figure 7 - Existing Entrance Channel Cross Section

Through Matagorda Peninsula, the MSC is authorized to a depth of -38’, with a 300’ bottom width. Generally, in Matagorda and Lavaca Bays, the channel has a 200’ wide bottom width with 3H:1V side-slopes and is authorized to a project depth of -38’, plus two feet of advance maintenance depth and an additional two feet of allowable over-depth outside the advance maintenance dredging prism (Figure 8).

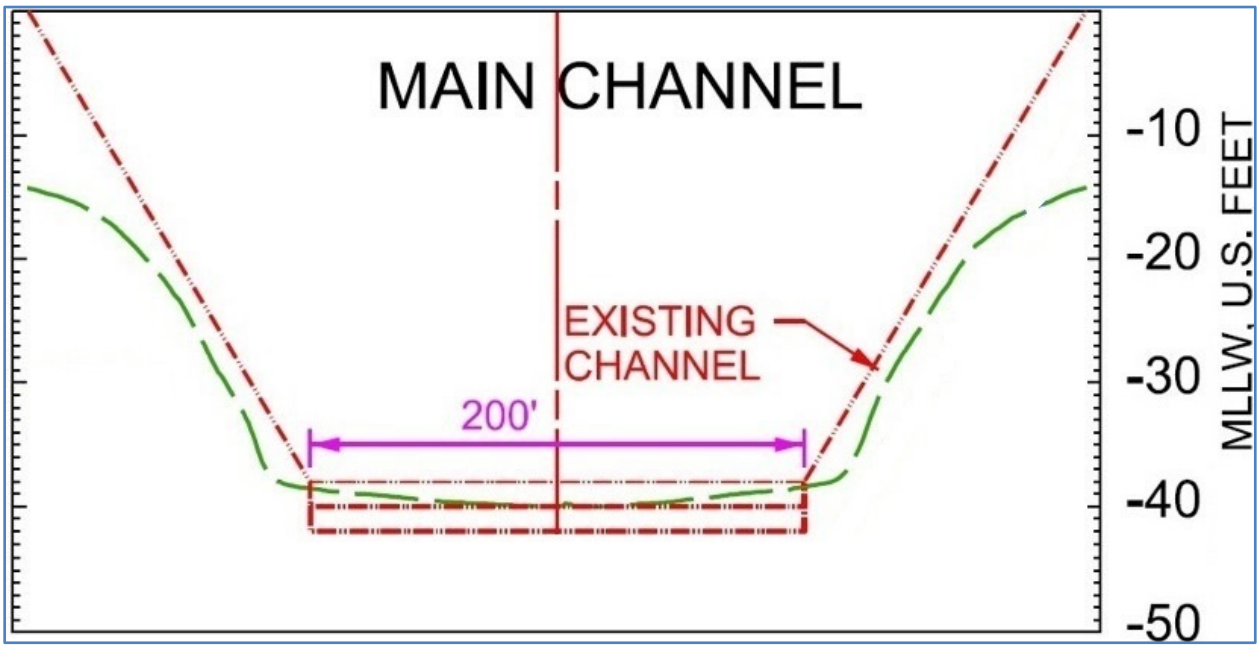


Figure 8 - Existing Main Channel Cross Section

The primary turning basin is maintained to a depth of -38', and is 1,000' by 1,000' (Figure 9).

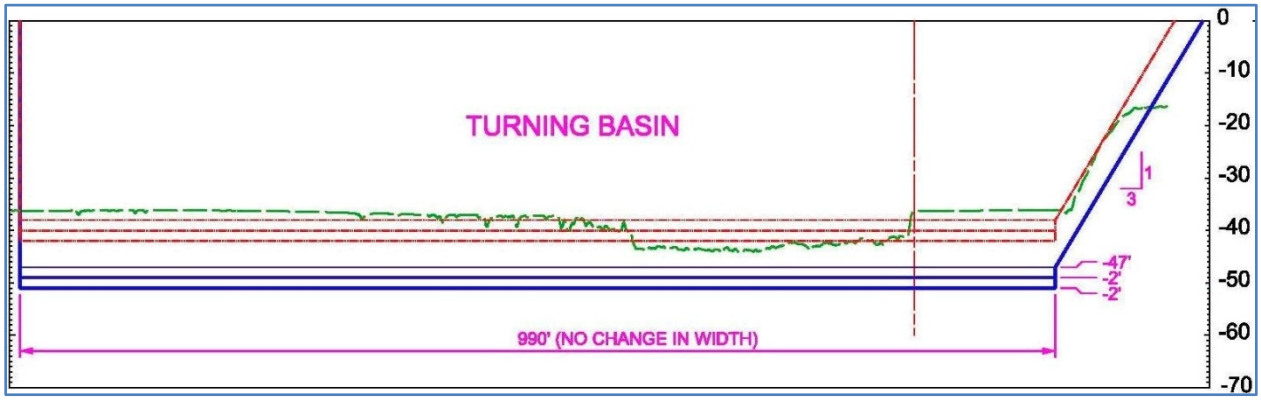


Figure 9 - Existing Turning Basin Cross Section

Dimensions of the channel segments, that are part of this study, are provided below (Table 3).

Table 3 – Currently Authorized MSC Sections and Dimensions (¹ Authorized depth referenced as MLLW)

Channel Section	Authorized Depth¹ (ft)	Width (ft)	Length (mi)
Offshore & Jetty Channel	**-40**	**300**	**3.2**
Channel to Point Comfort	**-38**	**200**	**20.9**
Approach Channel to Turning Basin	**-38**	**200**	**1.1**
Point Comfort Channel to Turning Basin	**-38**	**1,000**	**1,000'**
Point Comfort Turning Basin Extensions (North & South)	**-38**	**300**	**1,279'**

Based upon HQ guidance, the USACE is allowed to increase the authorized depth by rounding to the nearest foot in favor of safety. Therefore current authorized channel depth may be rounded from -36' MLT to -38' MLLW, rather than -37.697'.

Port of Point Comfort

The primary turning basin is maintained to a depth of -38', and is 1,000' by 1,000'.

The Port has facilities to handle break bulk, containerized, heavy-lift, dry bulk, and bulk liquid cargoes (Figure 10). There are no aerial restrictions (such as bridges) to vessels entering from the MSC or the GIWW. Principal cargoes imported are liquid fertilizer and petrochemical feed stocks, including naphtha, fluorspar, and anhydrous ammonia. Primary exports are petrochemical products. Much of the liquid cargos are either inputs or outputs of the nearby petrochemical and refining facilities.

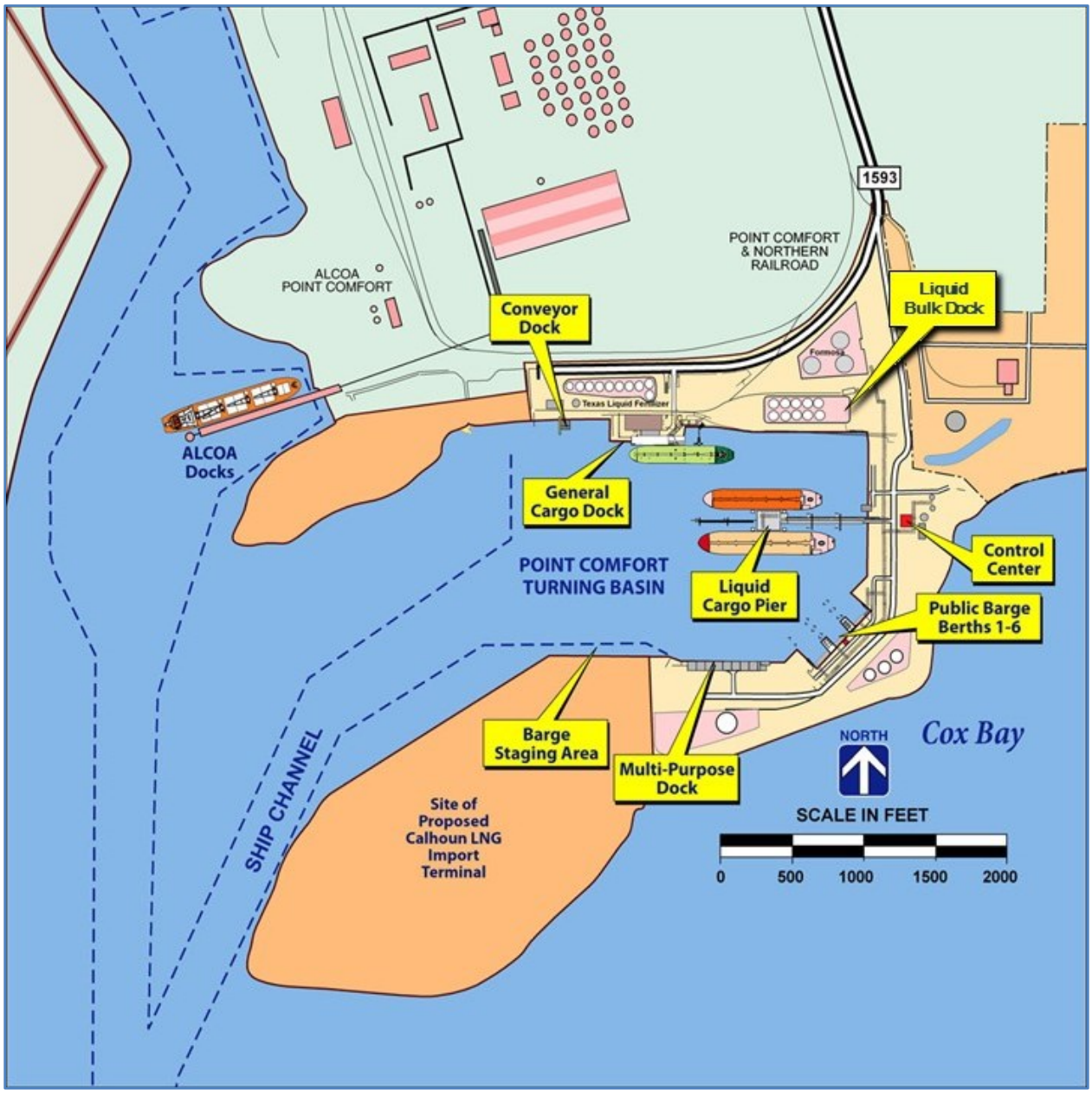


Figure 10 - Point Comfort Existing Facilities

The Point Comfort 1,100’ bulk liquid cargo pier allows for the loading and unloading of chemical, petroleum-related, liquid fertilizer, and other liquid bulk cargoes. The terminal includes two vessel berths at an operating depth of -38’, with positions for 12 marine liquid loading arms. The piers were constructed to accommodate a dredged berth depth of -47’ without modification. A new bulk dock was recently built in the northeast corner of the harbor to handle pet coke and limestone used at Formosa; however, Formosa no longer has need for dry bulk feedstock, so this dock was converted for liquid bulk.

Pilot’s Rules

The pilots were consulted during this study to provide input on the rules associated with the MSC. The Pilots indicated daylight restrictions, as well as the one-way nature of the channel, frequently cause transportation delays. Strong currents at the jetties can also restrict the movement of vessels drafting within four feet of the maximum allowable draft, though there is not a specific rule regarding currents.

The current restrictions placed on vessels transiting the MSC are:

- All ocean-going traffic is one way;
- Any vessel within 4’ of maximum allowable draft is restricted to daylight only;
- Any vessel 195 meters (639’) or greater in length is restricted to daylight;
- No passing of ocean-going vessels;
- No movement of any vessel that is drafting within 4’ of the maximum allowable draft when current is greater than four knots.

The USACE engineers have confirmed that the three feet under-keel (UKC) requirement is consistent with USACE UKC guidance in Engineer Manual (EM) 1110-2-1613. Therefore, a three-foot UKC requirement was used for this analysis.

Dredged Material Management Plan (DMMP)

The Galveston District uses the 2000 MSC Preliminary Project Assessment as the most current iteration of MSC DMMP. The USACE determined that there was no capacity, environmental, or economic limitations within the MSC to continued maintenance dredging of the existing project. The MSC was compliant with all environmental requirements.

A total of 19 placements areas (PAs) are used for maintaining the MSC. Additional PAs are used to maintain the channel to Port Lavaca and are not part of this study. The Entrance Channel is maintained by hopper dredge on a four-year maintenance dredging cycle with all material placed in PA-1, which is an offshore open water PA (Figure 11). The Matagorda Peninsula - Point Comfort Reach is maintained on a two-year cycle dredging cycle. This reach contains 13 open water PAs, three upland unconfined sites, and two open water emergent areas. These areas are all relatively small (10 - 140 ac), with nine of these areas in the process of becoming emergent wetlands.

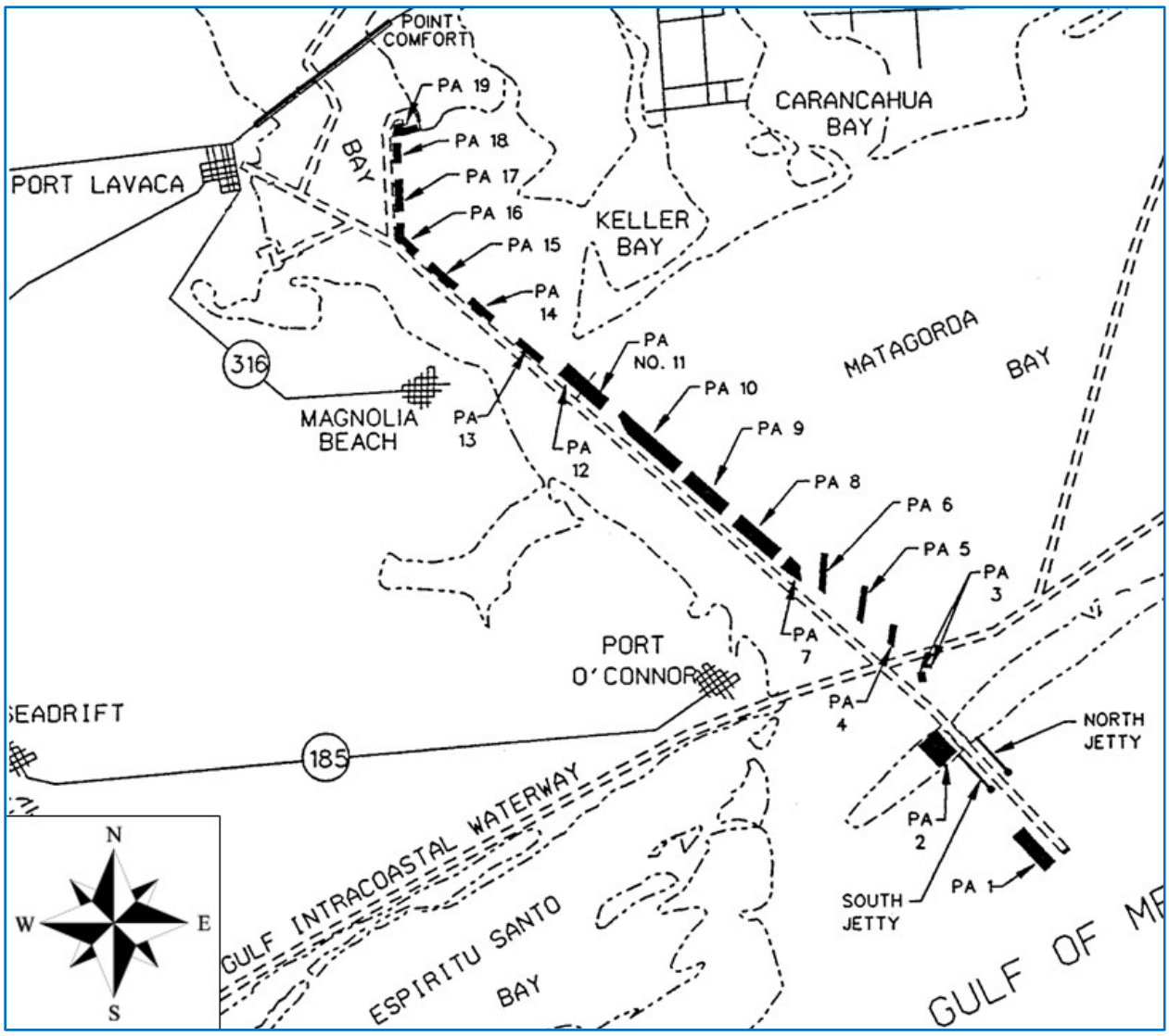


Figure 11 - Map of Current DMMP for the MSC

PA 3 is known by various names such as Bird Island, Chester Island, and Sundown Island.

1.7 Planning Process

The USACE plan formulation process, as specified in ER 1105-2-100 (Planning Guidance Notebook), was used to develop measures for problem solving and identifying opportunities, and ultimately to develop an array of comprehensive alternative plans from which a plan is recommended for implementation.

This section presents the rationale for the development of a TSP. It describes the USACE iterative six-step planning process used to develop, evaluate, and compare the array of management measures and preliminary alternative plans that have been considered. The six steps used in the alternative plan formulation process include:

1. **Identifying Problems and Opportunities:** The specific problems and opportunities to be addressed in the study are identified, and the causes of the problems are discussed and documented. Planning goals are set, objectives are established, and constraints are identified.
2. **Inventorying and Forecasting Resources:** Existing and future without-project (FWOP / No Action) conditions are identified, analyzed, and forecast for a 50-year period of analysis. The existing condition resources, problems, and opportunities critical to plan formulation, impact assessment, and evaluation are characterized and documented.
3. **Formulating Alternative Plans:** Alternative plans are formulated that address the alternative planning objectives. An initial set of alternative plans are developed and evaluated at a preliminary level of detail, and are subsequently screened into a more final array of alternative plans. Each plan is evaluated for its costs, potential effects, and benefits, and is compared with the No Action Plan for the 50-year period of analysis.
4. **Evaluating Alternative Plans:** Alternative plans are evaluated for their potential to meet specified objectives and constraints, effectiveness, efficiency, completeness, and acceptability. The impacts of alternative plans are evaluated using the system of accounts framework National Economic Development (NED), Environmental Quality, Regional Economic Development [RED], and Other Social Effects [OSE]) specified in the USACE' Principles and Guidelines (P&G) and ER 1105-2-100.
5. **Comparing Alternative Plans:** Alternative plans are compared with one another and with the No Action Plan (FWOP). Results of analyses are presented (e.g., benefits and costs, potential environmental effects, trade-offs, risks and uncertainties) to prioritize and rank alternative plans.
6. **Selecting the Recommended Plan:** A plan is selected for recommendation, and related responsibilities and cost allocations are identified for project approval and implementation.

1.7.1 Problems and Opportunities – Step 1

Water resources projects are planned and implemented to solve problems, meet challenges, and seize opportunities. In the alternative planning setting, a problem can be thought of as an undesirable condition, such as those expressed by the public in Section 7.3.1 Public Scoping. An opportunity offers a chance for progress or improvement of the situation. The identification of problems and opportunities gives focus to the alternative planning effort and aids in the development of planning objectives. Problems and opportunities can also be viewed as local and regional resource conditions that could be modified in response to expressed public concerns. This section identifies the problems and opportunities in the study area based on the assessment of existing and expected FWOP conditions.

The role of the USACE with respect to navigation is to provide safe, reliable, and efficient waterborne transportation systems (channels, harbors, and waterways) for movement of commerce, national security needs, and recreation. The USACE accomplishes this mission through a combination of capital improvements and the operation and maintenance of existing projects.

General Problem Statement: Analysis of the physical characteristics of the MSC, and of the economics of the goods shipping into and out of the Port, demonstrates that there have been significant changes in both the physical and economic conditions since the MSC was completed in 1966. Cargo vessels have continued to increase in size (length, beam, and displacement)

since the MSC was completed (Figure 12); with large numbers unable to use the existing channel and turning basin.

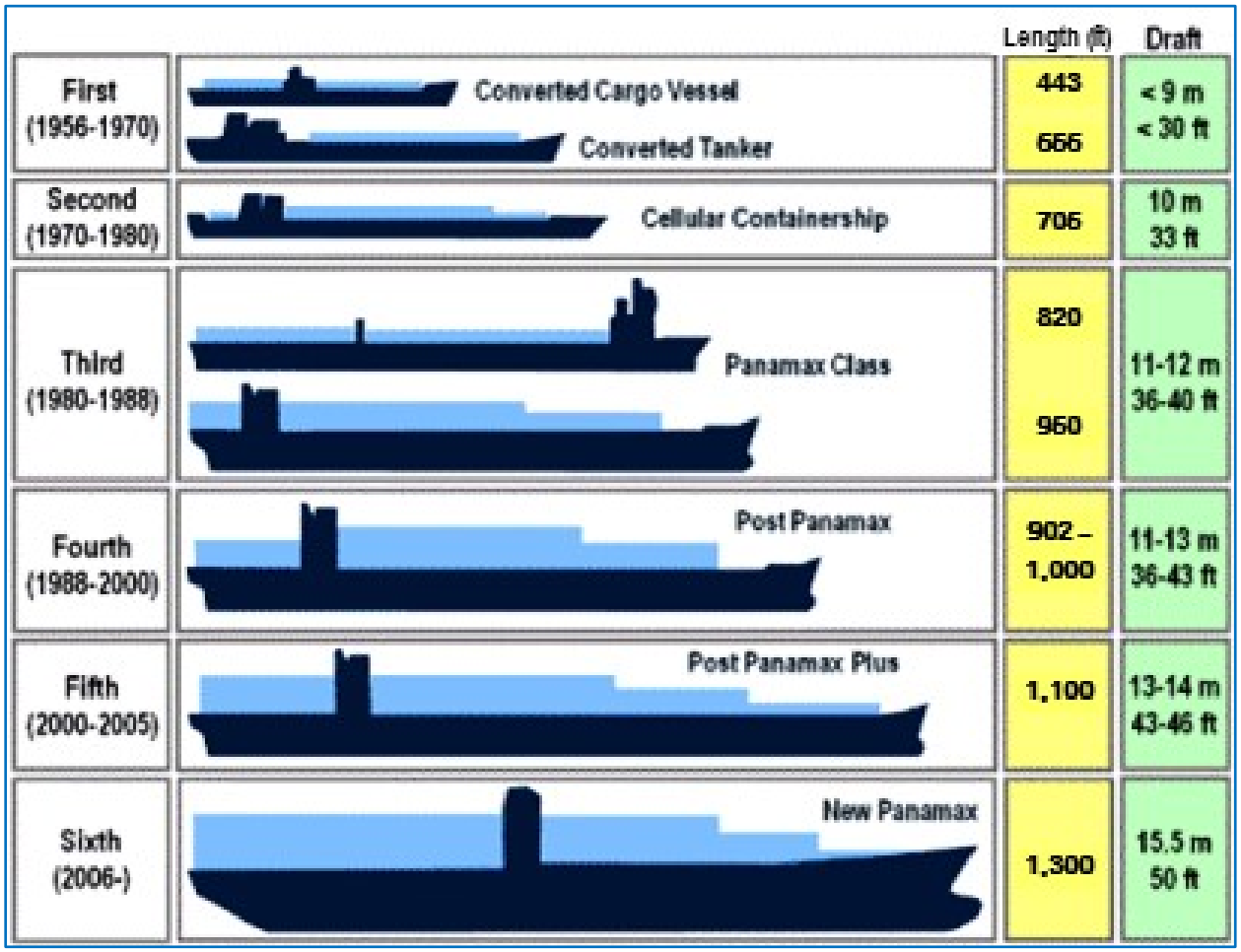


Figure 12 - Examples of changes in vessel size since the MSC was constructed

Specific Problem and Opportunity Statements

Initial Problem Identification – The USACE and NFS held a public scoping meeting in Port Lavaca, Texas on January 24, 2017. These problems, and their related opportunities, represent some of the public concerns communicated to the USACE and the NFS at that time.

- The existing designed channel depth limits channel use to vessels whose drafts are 35' or less.
    - Opportunities exist to modify the existing designed channel such that it can accept vessels whose drafts are greater than -38'.
- Vessels capable of deeper drafts cannot come into the Port fully loaded.
    - Opportunities exist to modify the existing designed channel such that deeper draft vessels can come into the Port fully loaded.
    - Opportunities exist to modify the existing designed channel such that deeper draft vessels do not have split their cargoes before coming to the Port.

- The existing designed channel bottom width is 200’ and limits channel use to a single vessel with a maximum width (beam) of 109’.
    - Opportunities exist to modify the existing designed channel such that it can accept vessels moving in both directions simultaneously.
    - Opportunities exist to modify the existing designed channel such that it can accept vessels with beams greater than 109’.
- The existing designed channel bottom width is 200’ and leaves little room for pilot error during times of high winds, waves, or changes in shoaling. Pilots only move vessels through the MSC with a length overall (LOA) of 639’ or longer during daylight.
    - Opportunities exist to modify the existing designed channel such that the Pilots feel it is safe for themselves, vessel’s crews and the environment to move these, and larger vessels, during nighttime hours.
- The existing designed turning basin (1,000’ by 1,000’) (Figure 10) limits the size of vessels which can call on the Port facilities.
    - Opportunities exist to modify the existing turning basin such that it can accept larger vessels with larger transport capacities.

1.7.2 Planning Objectives and Constraints

An objective is a statement of the intended purposes of the planning process; it is a statement of what an alternative plan should try to achieve. More specific than goals, a set of objectives effectively constitutes the mission statement of the Federal/non-Federal planning partnership.

Our planning partnerships exist in a world of scarcity where it is not possible to do everything. Our choices are constrained by a number of factors. Planning is no exception. An essential element of any planning study is the set of constraints confronting the planners. A constraint is basically a restriction that limits the extent of the planning process. Constraints, like objectives, are unique to each planning study.

1.7.2.1 Federal Goals

The Federal objective of water and related land resources project planning is to contribute to NED consistent with protecting the Nation’s environment, pursuant to national environmental statutes, applicable executive orders (EOs), and other Federal planning requirements.

1.7.2.2 Specific Study Planning Objectives for the MSC

- Improve the navigational efficiency of the deep-draft navigation system over the period of analysis (2024 – 2073)
- Improve the operational safety of the deep-draft navigation system over the period of analysis (2024 – 2073)

1.7.2.3 Specific Planning and Institutional Constraints

Planning Constraints

- Avoid the Alcoa Corporation (Alcoa) Superfund Site (Figure 13)

Institutional Constraints

- Plans must be consistent with existing Federal, State, and local laws
- Plans must include a Least Cost DMMP in which activities are performed in an environmentally acceptable manner, use sound engineering techniques, are economically warranted, and that include sufficient confined disposal facilities available for at least the next 20 years.

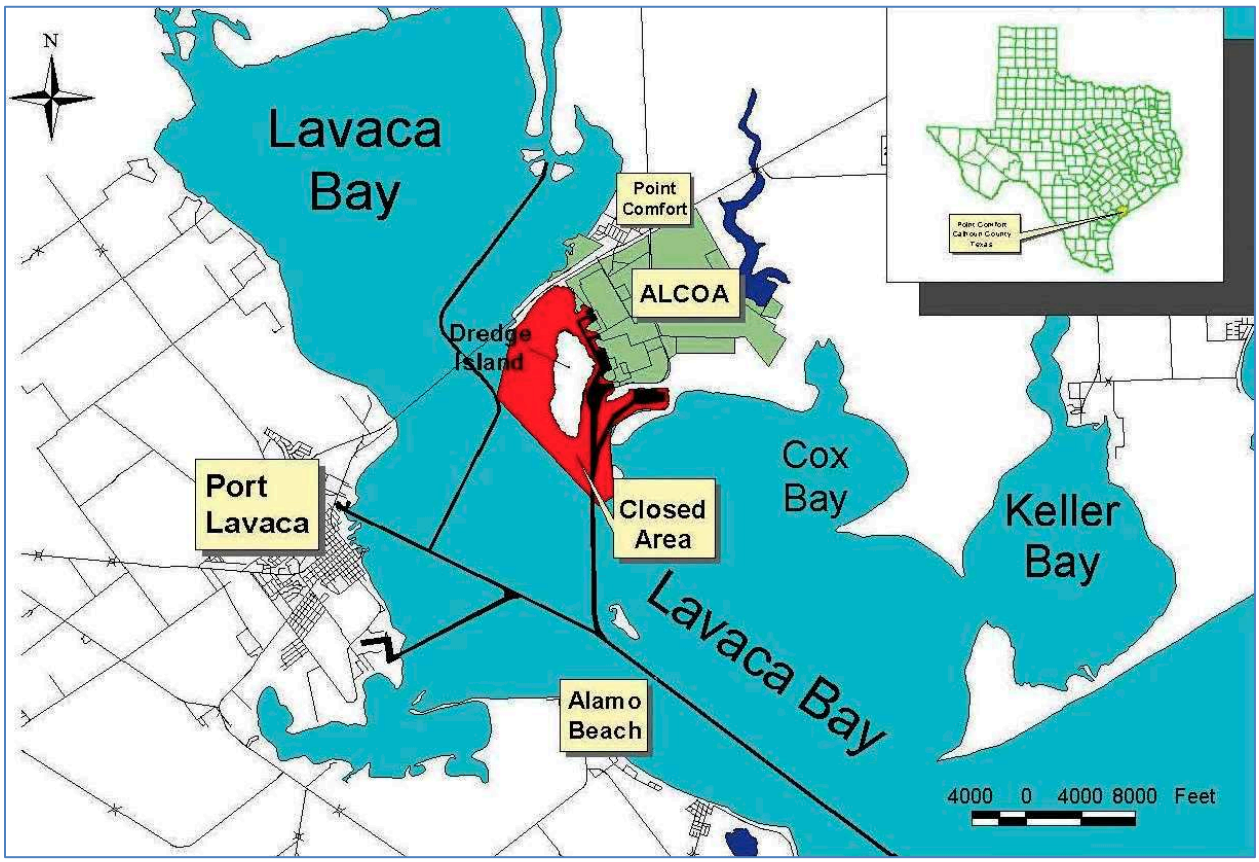


Figure 13 - Area of Alcoa's Dredge Island and area closed to fishing

1.7.3 Key Assumptions

Since these assumptions are consistent across all three alternatives, no single assumption, or combination of assumptions, nor the risks associated with them, will change plan selection.

Economics

Benefits of the deepening project would be based in part on a new type of activity, crude oil, and condensate exports, from the Port. Due to the lack of historical tonnage data for petroleum product exports from the Port, an assumption about throughput tonnage was made based on the users' capacity. The assumptions were as follows:

1. Users would operate at 75% of capacity; and
2. Fifty percent of this capacity would benefit by the channel deepening.

The design vessel for this study (mid-sized Aframax tanker of 110,000 DWT) is not calling in the existing condition, and cannot call in the FWOP condition due to its displacement and its beam. The assumption is that the design vessel (a mid-sized Aframax tanker) would begin calling in the future with-project (FWP). Reasons for the assumption are as follows:

1. The Aframax tanker's cost per ton is cheaper than that of the smaller, Panamax tanker,
2. The percentage of new-build Aframax tankers, as compared to the rest of the tanker fleet, is increasing, and
3. Aframax tankers call at the other ports on the Texas Gulf Coast, and are available for backhaul, since the United States (US) is becoming a net energy exporter.

Since it is new activity, the loading practices of crude oil and condensate exports at Point Comfort were based on the loading practices of petroleum product exports from a nearby Gulf port, Corpus Christi. The Port of Corpus Christi (PCC) was chosen as the representative port based on:

1. Its location on the Gulf and proximity to the MSC;
2. Its commodity profile, which is similar to the Port, consisting of mainly petroleum and petroleum products, chemicals and related products, and crude materials; and
3. Discussions with the MSC users.

Assumption	Planning Risk	Management
Throughput Tonnage based on User Capacity	Low	Use PCC as model

Transportation Cost Savings Analysis Methodology

Channel improvements result in reduced transportation cost by allowing a more efficient future fleet mix and less wait time when traversing the channel, resulting in at-sea and in port cost savings.

Channel restrictions limit a vessels capacity by limiting its draft. Deepening the channel reduces this constraint and the vessel's maximum practicable capacity increases towards its design capacity. This increase in vessel capacity results in fewer vessel trips being required to transport the forecasted cargo.

HarborSym was setup with the basic required variables. To estimate origin-destination (OD) cost saving benefits, the Bulk Loading Tool (BLT), was used to generate a vessel call list based on the commodity forecast at the MSC for a given year and available channel depth. The resulting vessel traffic was simulated, producing average annual vessel OD transportation costs. The TSP was identified by considering the highest net benefit based on the OD transportation cost saving benefits.

Assumption	Planning Risk	Management
Origin-Destination	Medium	Use of BLT

Environmental

The environmental and cultural resource analysis of alternative plans made extensive use of the 2009 EIS and the draft 2014 Section 204(f) Assumption of Maintenance Report for the similar permitted project, with updates as needed. Consultants were required to update the air emissions and hazardous materials analysis provided in the previous reports. This assistance is provided by the NFS as a work-in-kind contribution.

An existing Ocean Dredged Material Disposal Site (ODMDS) designated for maintenance material would continue to be used as needed for maintenance dredging.

Assumption	Planning Risk	Management
2009 & 2014 data still good	Low	Resource Agency Coordination

Geotechnical Engineering

There is no new geotechnical data for this study. All stability, and design analyses would be conducted using the existing geotechnical information (USACE. 1962a).

Between boring locations in the existing information, it is assumed that depths of material layers changed linearly. In some locations, the boring logs did not show vertically for the depths extending fully to the bottom of the proposed channel. In these instances, it would be assumed that the last shown material layer continued to the proposed depth. In areas where there is laterally limited information, it would be assumed that the soil conditions are similar to the closest available boring log. Stability analyses for the channel cuts and the PAs would be performed with the GeoStudio 2016 Slope/W computer program using the Modified Bishop method. The required shear strength parameters for these analyses would be obtained from correlations with soil index properties provided in the existing geotechnical information. Additional geotechnical investigation and analyses would be necessary for detailed design during the Pre-Construction, Engineering, and Design (PED) phase. The USACE, including the vertical team, have agreed that samples need to be collected in PED to verify the assumptions of soil conditions and finalize the geotechnical feature design

Assumption	Planning Risk	Management
1962 data still good	Medium	Borings during PED

Real Estate

Based on available information, ~22 pipelines would need to be removed or relocated. (Post-TSP, the number of pipelines for removal, or relocation, was reduced to 16.)

Clearance requirements for underground pipelines, cables, and conduits crossing deep-draft channels are given in the USACE Galveston District (SWG) (1998) Operations and Maintenance (OM) 1145-2-15: “Regulatory Permit Insurance, Inspection, Reporting, and Clearance Requirements Deep-Draft Channels District Policies and Practices.” Galveston District’s policy states that existing pipelines (measured from the top of the pipe) shall have, “a minimum of 20’ below the authorized project depth of the channel, plus a distance of 50’ on each side of the channel measured from the bottom edge of cut and perpendicular to the

centerline." Any of the items that are not deep enough to comply with the District's clearance requirements with the proposed channel template would have to be removed or relocated.

Assumption	Planning Risk	Management
Numbers of pipelines	High	New Research post-TSP

Design

- Construction occurs between 2020 and 2024
- Project design life is 50-years
- Design vessel is a mid-sized Aframax 110,000 DWT petroleum tanker with average dimensions of 800' LOA, 138' beam, and a -49' design draft
- Vessel traffic is one-way
- This project is not dependent upon implementation of the Jetty Deficiency project (Main Report, Section 3.1.2 and Section 5.4.2.1)

Assumption	Planning Risk	Management
Jetty Deficiency is part of FWOP	Low	Coordination with New Orleans District to match designs

1.7.4 Key Uncertainties

One of the key economic uncertainties can be attributed to developing the crude oil and condensate portion of the commodity forecast. The HarborSym model (Section 4.8.3) results show that 68% of benefits come from the new crude oil and condensate activity, while 32% of benefits come from other, existing, activity for the TSP in the most likely scenario. Since there was no baseline upon which to forecast growth of the new activity, and since it comprises the majority of transportation cost savings for the project, it is a source of risk and uncertainty.

On December 18, 2015, the US enacted legislation authorizing the export of US crude oil without a license. Prior to December 2015, there were restrictions on crude oil exports to overseas locations. Given that this type of export activity is new and there is uncertainty about how the country as well as the global economy would respond long term to the lifting of the ban, there is likewise uncertainty surrounding the new activity at the Port. The outlook for the US as an exporter of crude oil looks strong for the near future. In 2016, the year after the crude oil export ban was lifted; exports from the US averaged 591,000 barrels per day (bpd). In 2017, that average increased to 1.037 million bpd, reaching its all-time high in October 2017 with 2.13 million bpd. This trade is largely attributed to the advancement in output from shale fields. Given the Port's proximity to the Eagle Ford and Permian Basin shale, it is expected that it would receive NED benefits from this new activity. However, it is also accepted that there is a large level of uncertainty surrounding the amount of tonnage (i.e., benefits) that would be realized from the widening and deepening project. This under- or over-estimation of tonnage is not expected to change the TSP, but could potentially under- or over-estimate net benefits, and therefore the BCR ratio.

The width of the channel in this study was calculated based on the design vessel, a mid-sized Aframax tanker, which is to be used for the new crude oil traffic, as described above. Should this activity not emerge as expected, the project width could be over-designed. Conversely, if the activity proves to be more substantial than expected, it could attract even larger vessels than the Aframax, as other ports along the Texas Gulf have, and the project could potentially be under-designed.

At one time, Alcoa was the world's sixth largest producer of aluminum with operations in 10 countries. The Alcoa dock, which began operating in 1948, was considered to produce zero benefits for this project. The indefinite idling of this plant is tied to the price of alumina. If the price of alumina rebounds and the alternative plant opens in the future, or if the alternative plant closes and the dock are sold to another tenant, it is possible that benefits could be realized from this dock and NED benefits of the improvement project could be under-estimated.

1.8 Prior Studies and Reports

- US Army Corps of Engineers. 1963. *Matagorda Ship Channel, Texas Design Memorandum No. 3 (General Design Memorandum or GDM)*. Investigations included hydrographic surveys, soil investigations, earth borings, engineering, and economic studies including cost estimates. Public hearings and conferences with local interests were held to determine the views and desires of local interests for developing the most feasible project for a deep-draft navigation channel to the Gulf from the Matagorda Bay area.
- USACE. 1964. *Problems in Connection with Matagorda Ship Channel Project.* Model testing indicated that water velocities would reach six feet per second; the sides of the channel through Matagorda Peninsula would rapidly erode. Westerly ebb currents would concentrate the ebb flows along the west side of the channel between the bay shore of Matagorda Peninsula and the center of the land cut. The land cut through the peninsula was opened on 24 September 1963, and by January 1964 the bank line in some reaches had receded by as much as 150'. Some erosion had cut completely through the peninsula. A decision was reached to revet both side of the complete length of the land cut through the peninsula.
- USACE. 2000. *Matagorda Ship Channel, Texas, Preliminary Project Assessment.* The purposed to the Preliminary Project Assessment (PPA) was to establish whether a more detailed DMMP study was required and to provide the information necessary to permit its prioritization in the District's budget and work plan. Conclusion: There are no capacity, environmental, or economic limitations with the MSC to continued maintenance dredging. The project is currently compliant with all environmental requirements. However, major environmental concerns are evident based upon the mercury contamination of bay bottoms.
- URS Corporation. 2006. *Matagorda Ship Channel Improvement Project – Sedimentation Analysis.* The model results indicate that the increase in the dredging rate, and consequently the amount of dredged sediment placed to the east of the channel, would not increase the anticipated dredging rate any further. Thus, the shoaling rate would continue to be about 30.5 centimeters per year (12" per year). The results do indicate that the percentage of dredged material that returns to the channel would increase from approximately six – 11%. The increase is not dependent on whether the dredged material is confined to the existing area or spread out over a wider PA that is twice the existing PA.

- USACE. 2006. *Matagorda Ship Channel, Texas: Jetty Stability Study.* The entrance of the MSC, connecting the Gulf to Matagorda Bay, Texas, has experienced strong currents since its construction in 1963-1964. The current has produced a large area of scour on the bay side of the inlet adjacent to the west jetty, and vessels encountering a strong along-channel and cross-channel current at the entrance experience difficulty in navigation. This study was performed to understand the hydrodynamics of the existing condition and evaluate alternative plans for stabilizing the jetties to reduce the current velocity, thereby reducing the scour, and improving navigation reliability. Recommendations included: preserving Pass Cavallo to avoid an increase in discharge through the MSC (especially during storms), and that minimum annual monitoring be conducted. Monitoring would consist of: 1) High-resolution bathymetry surveys of the scour-hole regions on the northwest side (bay side of south jetty), inside of the south jetty, and at the tips of both jetties. 2) Comparisons to the previous years (difference maps) should be made to assess rates of change in depth and location. Color vertical aerial photography of the MSC entrance and Pass Cavallo to assess changes in the general condition of the jetty, the positions of the shoreline for two miles adjacent to the jetties on both the gulf and bay sides of the entrance, and the width and geomorphology of Pass Cavallo. 3) Long-term measurements of water level and wind at Port Lavaca and Port O'Connor in continuation of Texas Coastal Ocean Observation Network (TCOON) support by the Galveston District.
- Moffatt & Nichol. 2007. *Matagorda Ship Channel Improvement Project, Point Comfort, Texas – Sedimentation Study*. This study presents estimates of sedimentation rates for the proposed improvements to the MSC. These improvements include widening and deepening the offshore and inshore portions of the channel and expanding the turning basin. Those estimates are:

  Present rate – 3,044,000 CY/yr
  Post project rate – 5,845,000 CY/yr based on existing dredging records—92% increase
  Post project rate – 5,151,000 CY/yr based on cutting off suspected "short-circuiting"—70% increase
- USACE. 2009. *Final Environmental Impact Statement for the Proposed Matagorda Ship Channel Improvement Project, Calhoun, and Matagorda Counties, Texas.* This Final EIS was prepared as required by the National Environmental Policy Act (NEPA) to present an evaluation of potential impacts of the CPA's proposed MSC Improvement Project (MSCIP). The proposed MSCIP included widening and deepening the MSC from the Port marine slips and existing Point Comfort Turning Basin in Lavaca Bay through Matagorda Bay and offshore into the Gulf and dredging of a new turning basin in Lavaca Bay. The Final EIS addressed the potential impacts of the proposed MSCIP on the human environment, as identified during the public interest review, including placement of dredged material. Factors relevant to the proposed project were considered. Among those factors were: dredged material management, ecological impact, salinity changes, protected species, historic resources, water and sediment quality, hazardous materials, shoreline erosion, economics, navigation, recreation, energy needs, safety, and, in general, the welfare of the people.
- USACE. 2012. *Matagorda Ship Channel, Texas – Studies on the Entrance Channel through Matagorda Peninsula*. Conclusion: Due to implicit and invalid assumptions of fixed channel dimensions, this due to limited channel erodability, a deficiency exists in the MSC Project. To provide the intended project function safely and reliably, the identified deficiencies may require corrective action.

- USACE. 2013. *Regional Sediment Management Studies of Matagorda Ship Channel and Matagorda Bay System, Texas.* Abstract: Extensive shoaling in the upper reach of the MSC in recent years has resulted in the need for annual maintenance dredging. The increasing channel-shoaling rate is likely due to the placement of dredged material into adjacent open water sites west of the channel and the migration of these fluidized sediments back into the channel. It is suspected that active sedimentation in upper Lavaca Bay also contributes to the high shoaling rate in the MSC. The study identified alternative plans that could effectively reduce the channel-shoaling rate.
- Maritime Institute of Technology and Graduate Studies. 2014. *Proposed Deepening and Widening of the Matagorda Ship Channel, Texas – A Ship Maneuvering Simulation Study.* The purpose of the ship maneuvering simulation modeling development and navigation study was to evaluate the safety and efficiency of ship maneuvering operations to and from the proposed Port Lavaca Liquid Natural Gas (LNG) terminal in the proposed “350’ wide by 44’ deep” widening and deepening project.

2 Existing Conditions – Step 2, Part 1

Existing conditions are defined as those conditions that would exist within the study area, at the time of the study. The term baseline is also often used to refer to the existing conditions at the time of a measurement, observation, or calculation, and may be used occasionally throughout this report.

A quantitative and qualitative description of resources within the study area is characterized, for both existing and future conditions. The second step of plan formulation, and the starting point in any the USACE analysis, is to develop an accurate picture of the existing conditions (Chapter 2) and FWOP conditions (Chapter 3).

The resources discussed in Step 2, and again as part of the FWP condition (Chapter 5), are:

1. Hydrology and Hydraulic Engineering
2. Economics
3. Environmental Resources
4. Cultural Resources
5. Environmental Engineering, including Hazardous, Toxic, and Radioactive Waste
6. Geology and the Structural Setting, and
7. Socioeconomics

2.1 Hydrology, Hydraulics and Sedimentation

Mean natural water depth in Matagorda Bay is ~13’ while depth in the adjacent bays ranges from seven to eight feet.

2.1.1 Hydraulic Conditions

Existing hydraulic conditions at this site present several unique challenges (Appendix F – Engineering, Section 2.1.1):

- Dangerous currents between the jetties (greater than four knots at the peak of every tidal cycle),
    - The Coast Guard’s Ports and Waterways Safety Assessment (PAWSA) panel of experts has classified the MSC as: 1) The third most dangerous ship channel in the US, and 2) The ship channel with the most dangerous currents (US Coast Guard 2001).
- Strong cross-channel currents between Matagorda Peninsula and Bird Island,
- Currents between the jetties continue to scour the bed, in places more than -140ft deep,
- Winter waves routinely exceeding 10’ at the entrance,
- An offshore bar, which is unsurveyed, limiting the draft of vessels entering the channel,
    - Although the bar has not been surveyed since Hurricane Harvey (August 26, 2017), several pre-hurricane surveys have been located. A shoaling analysis using one set of field measurements from test pits dug in the Gulf at Matagorda

and three different analytical methods has been performed to estimate existing shoaling rates and a rate for the new deeper channel. (Permanent International Association of Navigation Congresses (PIANC) Report #102, p. 21, "Minimising harbour siltation"). Three solutions were evaluated: 1) More frequent dredging, 2) Deeper dredging, or 3) A sediment trap north of the channel. The method selected was to dig deeper at the location where the channel intersects the offshore shoal.

- No wave measurements between the jetties or offshore (only Sep-Dec 2005 in the Bay), and
- Current-meter datasets that disagree with each other.

2.1.2 Waves

Wave measurements at the Entrance Channel do not appear in public or the USACE databases (Appendix F – Engineering, Section 2.2). Two Wave Information Studies (WIS) hindcast stations (points at which wind data are used to estimate the resulting waves) were used in this analysis: #73051 and #73050.

The Coast of Texas project is using the Advanced Circulation Model (ADCIRC) numerical model to produce shoaled waves along the entire Texas coast. Wind data from the entire Gulf of Mexico were shoaled into shallow water.

CONCLUSION from hindcast model: Wave height Hmo = 1.2m = 3.94’ and Tp = 5s, both offshore and at the jetties’ end.

Conclusion from the Pilots: “I would say our significant wave height is much larger than 4’. The ebb (outbound) currents are also a contributing factor in sea height. While it may only be 6’ wave height out in the gulf, a strong ebb would increase the height of those waves to eight or 9’ in the jetties and the Entrance Channel, sometimes even out two miles past the entrance buoy. I would say, in the winter, our predominant wave height is 5’ while the significant wave height can be 10’.” (Appendix F – Engineering, Section 2.2)

2.1.3 Ship Generated Waves and Drawdown

Wise (2006) performed an analysis of ship-generated waves between the jetties for three scenarios (Existing Vessel in Existing Channel, Existing Vessel in Proposed Ship Channel, and Proposed LNG Vessel in Proposed Ship Channel). In Chapter 6, ship-generated waves and wind waves were compared. The conclusion was that “The relative wave energy from wind waves is estimated to comprise 97% to 99% of the total wave energy. Only ~1% - 3% of the total wave energy is from the existing ship traffic.”

CONCLUSION: Wave Heights at the Entrance Channel are much greater than ship- generated Drawdown. Thus wave heights (over the offshore bar) will be the limiting factor in depth design, and ship drawdown can be ignored (Appendix F – Engineering, Section 2.2.4).

2.1.4 Currents

Unfortunately, the only overlap in the measurements was the ongoing measurements at the Bird Island and the newly installed (November 2018) Entrance Channel sites (Figure 14). Thus, there was only one inter-comparison possible. Currents were measured only briefly in test mode in

November 2017. Routine broadcasting of the currents to the pilots began in 2018 (Appendix F - Engineering, Section 2.3).

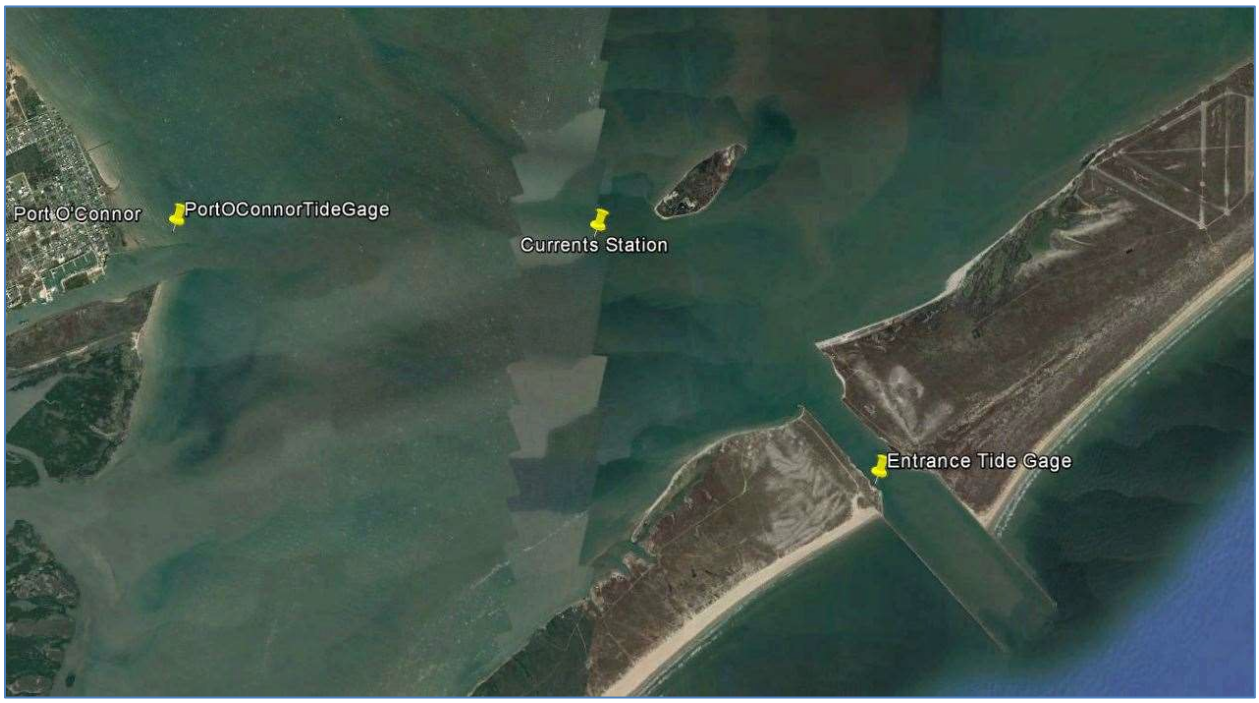


Figure 14 - Map showing locations of Current Gages

2.1.5 Tides

The tidal range in the Gulf is very small, approximately one foot on a diurnal cycle. The meteorologically driven tide can be greater than the astronomically driven tide, especially during frequent winter cold fronts that may depress the water level up to three feet (Appendix F – Engineering, Section 2.4).

2.2 Economics

2.2.1 Proximity to the Port of Corpus Christi

The PCC is another deep-draft port along South Texas Gulf Coast with similar proximity to the Eagle Ford Shale as the Port (Figure 20). The Corpus Christi Ship Channel (CCSC), which provides access to the port, is a 36-mile, -47’ channel that handles both international and domestic marine commerce. Like the MSC, the CCSC handles liquid chemicals and petroleum products, among other commodities (Appendix A – Economics, Section 2.1.4).

To assist with assumptions that will be discussed in detail later in this appendix, the PCC was used as a reference port on which to base some of the economic inputs in both the future with- and without-project conditions. This was considered reasonable based on the close proximity, similar commodities, and the fact that the CCSC’s current channel depth is within the range being analyzed for the MSC deepening.

2.2.2 History

Historically, the three main commodity groups handled by the MSC are Crude Materials, Chemicals and Related Products, and Petroleum/Petroleum Products. The Crude Materials category is made up almost exclusively of aluminum ore shipped to the Alcoa docks in the form of bauxite. The rest of the tonnage handled within the Port of Point Comfort is in the form of liquid bulk. Annual throughput tonnage levels by commodity for the latest available years of Waterborne Commerce (WCSC) data (2004-2016) (Figure 15).

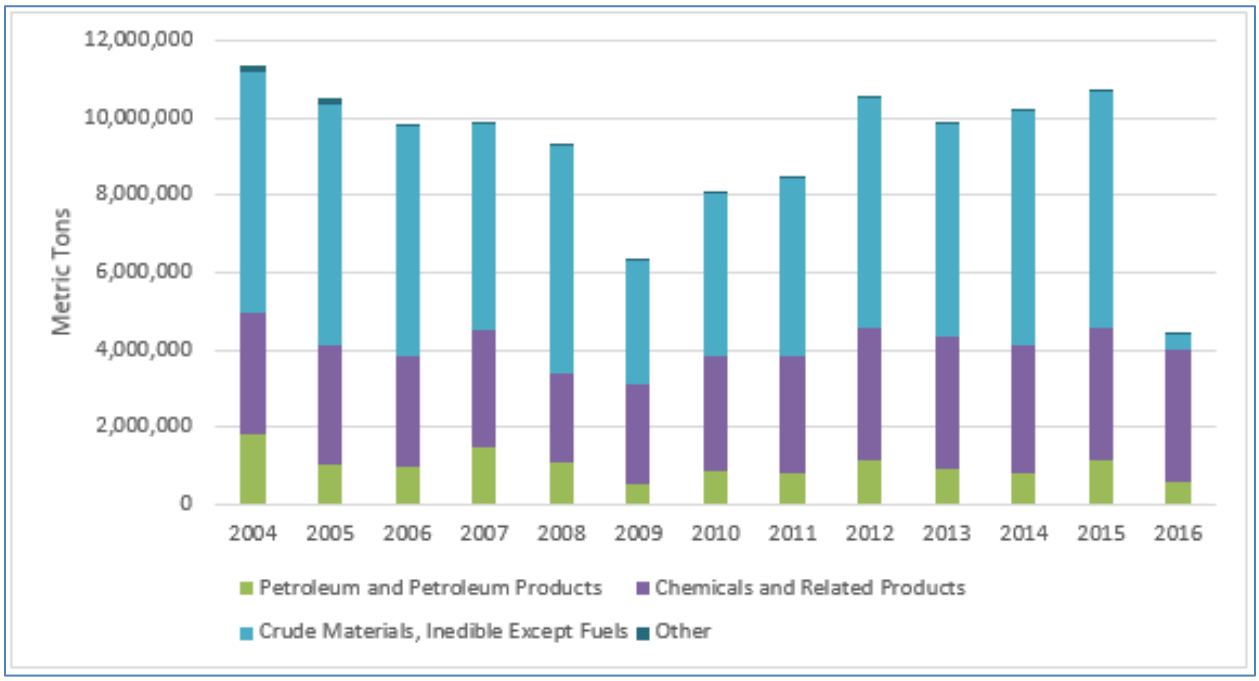


Figure 15 - MSC Tonnage by Commodity (Receipts and Shipments 2004 - 2016)

Despite a decline in tonnage spurred by the 2008 global economic recession, tonnage levels have steadily increased until 2016 when a cease in production by Alcoa caused a drop in tonnage levels (Appendix A – Economics, Section 2.3).

2.2.2.1 Crude Oil Export History

Following the 1973 Arab oil embargo, the US passed a law that prohibited the exportation of crude oil. Following the removal of restrictions on US crude oil exports in December 2015, the US exported crude oil to 26 different countries in 2016, compared with 10 countries the previous year. In 2015, 92% of US crude oil exports went to Canada, which was exempt from US, crude oil export restrictions. After restrictions were lifted, Canada remained the top destination but received only 58% of US crude exports in 2016 (Appendix A – Economics, Section 2.4.4).

Figure 16 displays a recent history of crude oil exports from the US in terms of thousands of bpd. For the time period December 2016 through September 2017, exports of crude oil averaged 55% of foreign shipments out of the MSC.

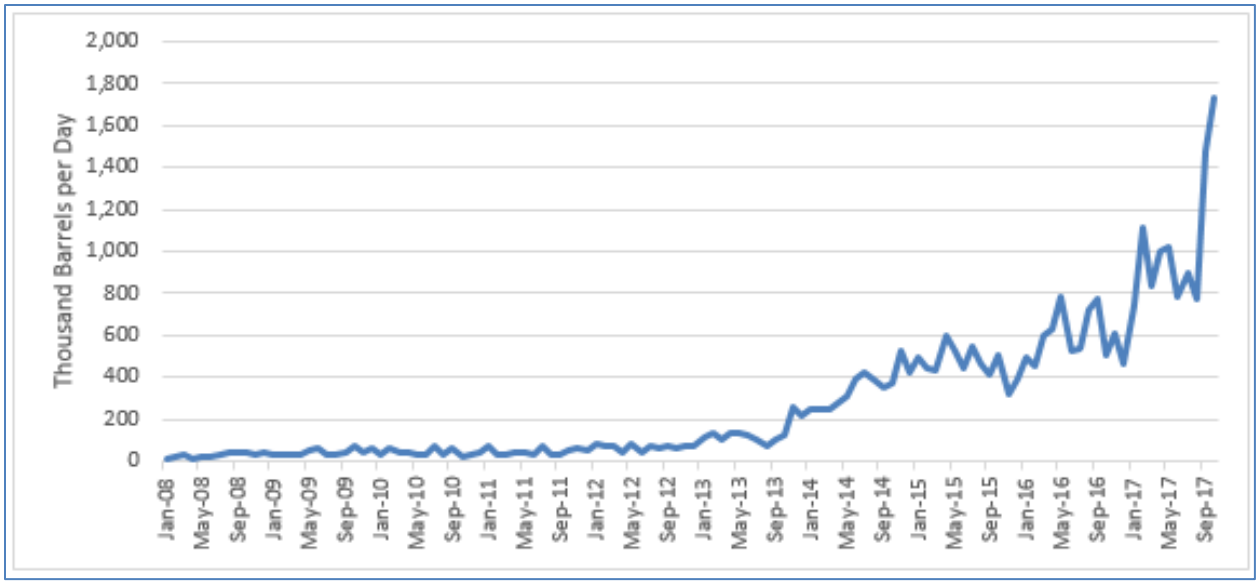


Figure 16 - US Exports of Crude Oil January 2008 - September 2017 (1,000 barrels per day or bpd)

After the crude oil ban was lifted, foreign exports of crude oil gradually outpaced domestic shipments as a result of the ban being lifted. For the last twelve months of available data, foreign exports have accounted for 55% of crude oil and condensate shipped via the CCSC (Figure 17).

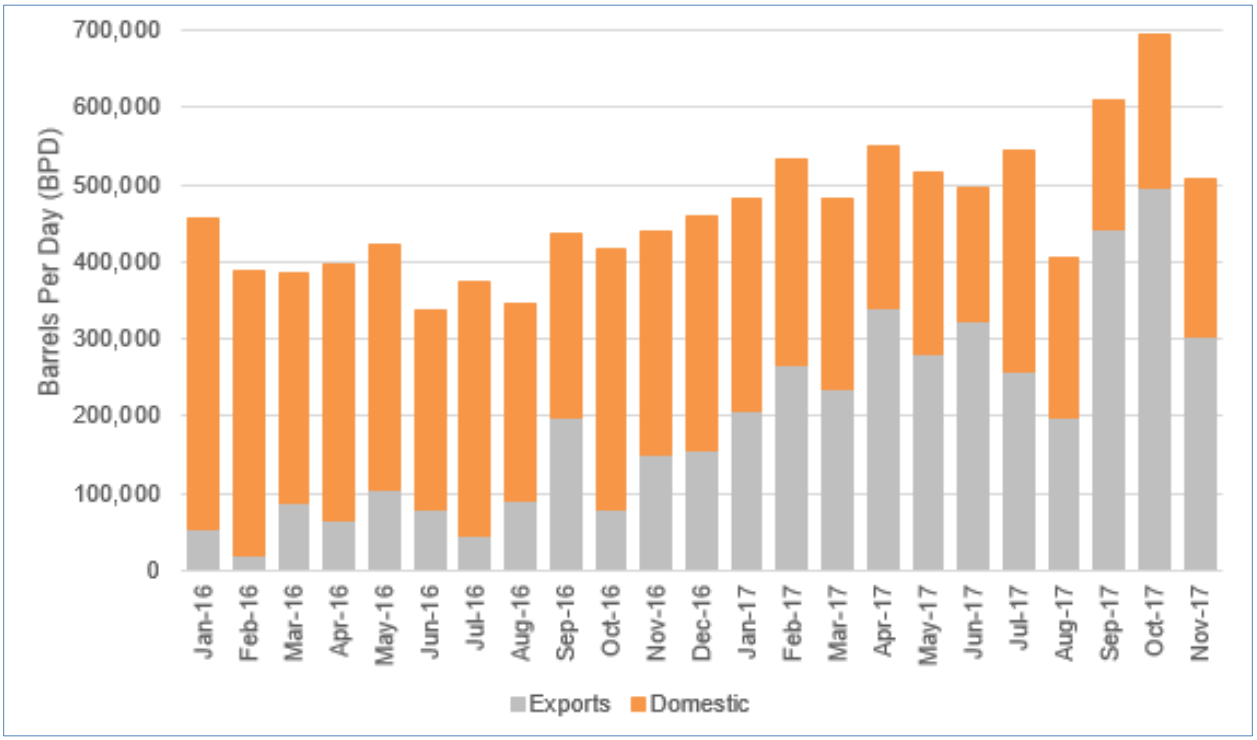


Figure 17 - Crude Oil & Condensate Shipments January 2016 - November 2017 (bpd)

2.2.3 Existing Fleet

This study focuses on the various Panamax petroleum tankers, and the mid-sized Aframax petroleum tanker. Information on other sized tankers is presented for comparison purposes only (Appendix A – Economics, Section 2.5).

The vast majority of deep-draft tonnage moved via the MSC is carried on tankers (petroleum/chemical), with the occasional ocean-going barge. Data on the existing fleet was obtained from the Waterborne Commerce Statistical Center (WCSC) and verified by the Pilot's log provided by the Port of Point Comfort. The data obtained from WCSC was for the three most recent years available, 2013 through 2015, at the time of the analysis. The year 2015 was isolated and used to analyze vessel characteristics, as it was considered to be a reasonable representative year after comparing it to the previous years' data. Where historical data did not exist for a new type of commodity traffic, i.e., crude oil, WCSC data for the Port of Corpus Christi was obtained and used as a proxy for developing the existing fleet.

Vessels are distinguished based on physical and operation characteristics, LOA, design draft, beam, and tons per inch (TPI) data.

2.2.3.1 Chemical Fleet

Vessels carrying chemicals range in size from 4,500 to 60,000 DWTs and are split into three classes (Table 4) (Appendix A – Economics, Section 2.5.1).

Table 4 - Chemical Tanker Vessel Class Attributes

Vessel Class Name	Vessel Class ID	DWT Range	Min Design Draft	Max Design Draft	Min Beam	Max Beam	Min LOA	Max LOA
Sub-Panamax 1	SPX1	0 -20,000	-20'	-34'	49'	97'	326'	529'
Sub-Panamax 2	SPX2	20,000 - 40,000	-30'	-42'	77'	105'	459'	604'
Panamax 1	PX1	40,000 - 60,000	-36'	-44'	101'	108'	577'	673'

Annually, ~45% of tonnage is moved on Sub-Panamax 1 (SPX1) tankers, 28% is moved on Sub-Panamax 2 (SPX2) tankers, and 31% is moved on Panamax tankers (Figure 18).

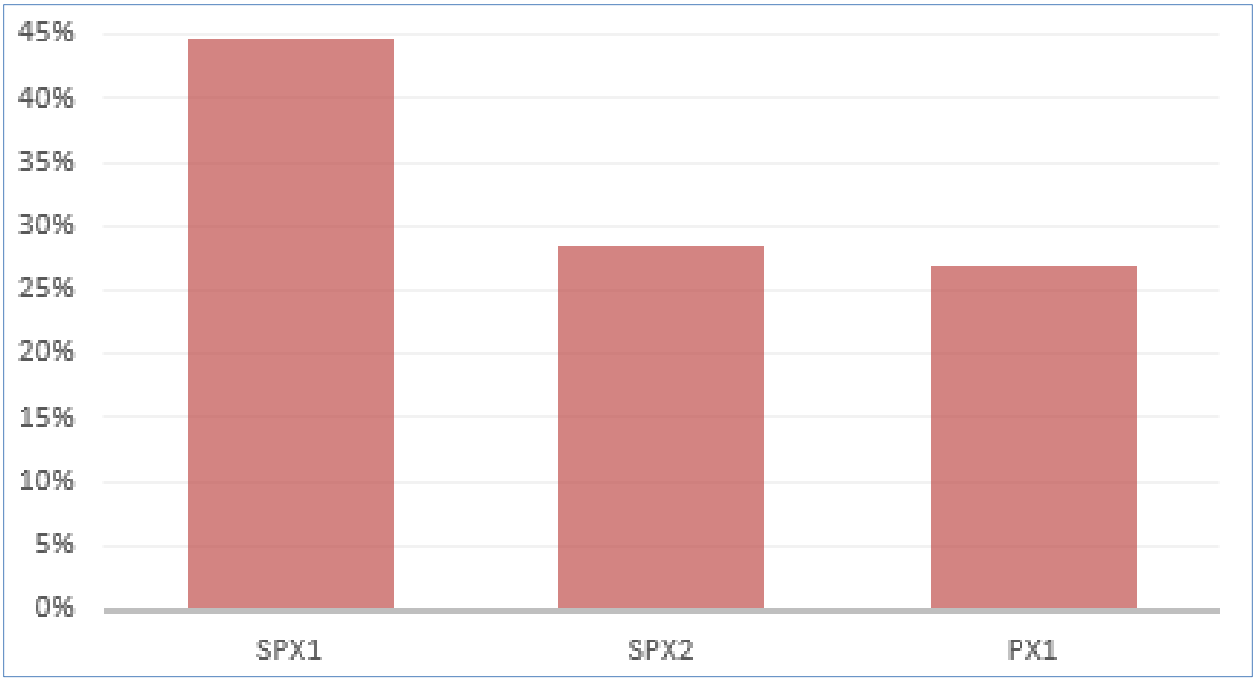


Figure 18 - MSC Chemical Tonnage Distribution by Vessel Type (2015)

2.2.3.2 Petroleum Product Fleet

Because exports of crude oil and condensate is a new type of traffic for the MSC, the CCSC was used as a proxy to develop a baseline fleet distribution for the new activity. Since Point Comfort's users were not anticipating any receipt of crude oil and condensate at the time interviews were conducted, only petroleum product exports from Corpus Christi were analyzed for development of the fleet forecast (Appendix A – Economics, Section 2.5.2). Petroleum Products are exported from Corpus Christi on vessels ranging in size from 6,000 to 116,000 DWT. Petroleum tankers were split in to five categories, or vessel classes, for this analysis (Table 5). Like chemical tankers, DWT was used to categorize the vessels into classes.

In 2015, ~82% of CCSC's petroleum product exports were moved on Panamax tankers, 9% were on Aframax tankers, and another 9% were on sub-Panamax tankers (Figure 19).

The USACE determined that 2015 is an acceptable representative year for Corpus Christi from which a vessel fleet distribution could be extrapolated for the MSC. However, it is important to note that the composition of the petroleum-product tanker fleet utilizing the CCSC for exports is likely to change. These changes were taken in to account when developing the future vessel fleet-forecast. A major contributor to the changing vessel fleet can be attributed to the lifting of the crude oil ban at the end of calendar year 2015. According to a September 2017 article from Global Trade Magazine, the PCC is the number one exporter of crude oil in the nation. Given the efficiencies of Aframax tankers for exporting crude oil, it is anticipated that a larger portion of Corpus Christi's petroleum products would be exported on Aframax tankers in the future.

Table 5 - Petroleum Tanker Vessel Class Attributes

Vessel Class Name	Vessel Class ID	DWT Range	Min Design Draft	Max Design Draft	Min Beam	Max Beam	Min LOA	Max LOA
PT Sub-Panamax 1	PT-SPX1	0 – 20,000	-21’	-29’	57’	75’	350’	529’
PT Sub-Panamax 2	PT-SPX2	20,000 - 40,000	-30’	-43’	78’	104’	462’	605’
PT Panamax 1	PT-PX1	40,000 - 60,000	-33’	-45’	86’	105’	557’	655’
PT Panamax 2	PT-PX2	60,000 - 80,000	-41’	-48’	104’	121’	656’	752’
PT Aframax	PT-Afra1	80,000 - 110,000	-43’	-51’	137’	138’	750’	810’

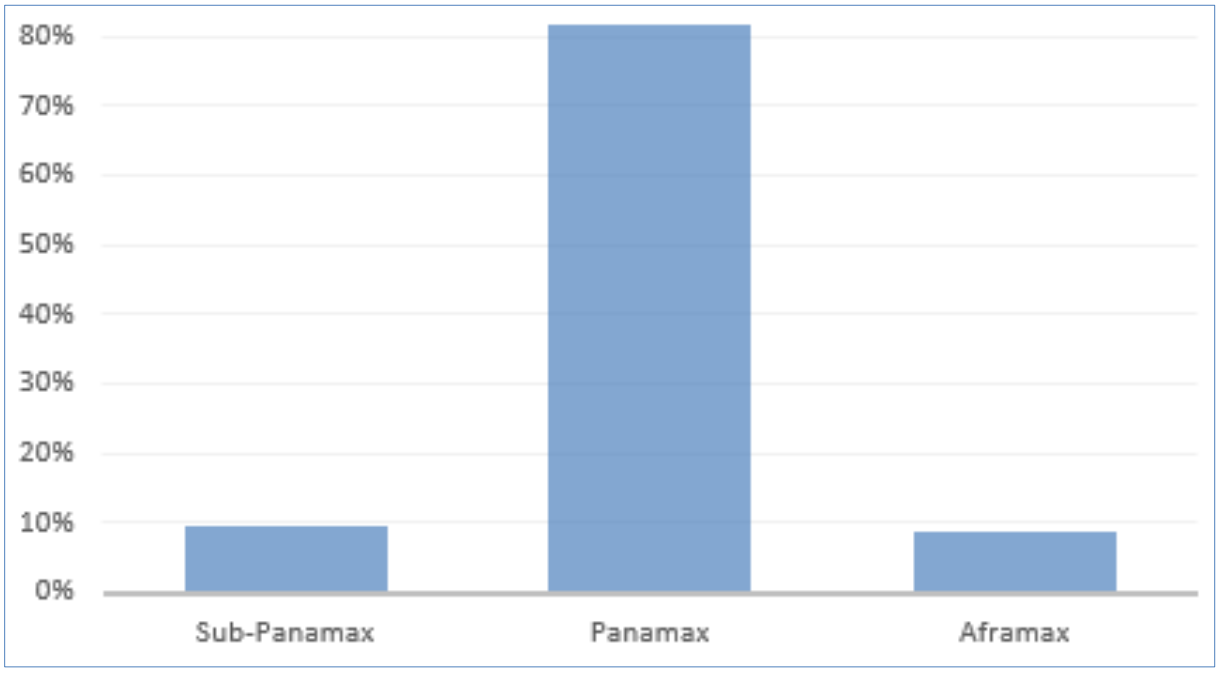


Figure 19 – CCSC Petroluem Product Tonnage Distribution by Vessel Type, 2015

2.2.4 Existing Commerce

The composition of Point Comfort's commodity profile has changed in recent years (Appendix A – Economics, Section 2.4). These changes began in 2015, when the first energy user acquired land at the Port, and continued with the addition of two more energy companies in 2016. Also in 2016, the primary user of the MSC, Alcoa, ceased production due to the decline in the price of alumina.

2.2.4.1 Chemical Traffic

Chemical products in the form of liquid bulk have a long history at the Port. Therefore, historical tonnage was used to develop a baseline tonnage number upon which to forecast growth for chemical tonnage. The Port is a net exporter of chemical products, typically importing ~25% of its foreign chemical tonnage and exporting ~75%. Most of the chemicals imported to the Port are used as raw materials for specialty chemicals produced and exported by the Port users (Appendix A – Economics, Section 2.4.1).

2.2.4.2 Dry Bulk Traffic

Dry bulk traffic moved via the MSC has been attributed almost exclusively to Alcoa since 1948. As of 2017, there is no cargo moving to or from the plant. This can be attributed to the downturn in the alumina price index in 2015 and the ending of production at the plant in 2016 (Appendix A – Economics, Section 2.4.2).

2.2.4.3 Crude Oil and Condensate Traffic (Petroleum Products)

Crude oil and condensate export is a new type of commerce at the Port beginning in 2015 (Appendix A – Economics, Section 2.4.3). Capacity projections from each facility were collected via interviews with representatives of the three new companies that would be using the MSC to ship petroleum products. These companies are Arrowhead Offshore, NGL Energy Partners (NGL), and NorthStar Midstream.

The projections were combined to develop a baseline crude oil and condensate tonnage level for the year 2018 (i.e., the first year in which all three facilities would be done with construction and in full operation). To protect proprietary information of these companies, the forecasts from the three companies will remain aggregated in this report.

Using the projections provided by the new channel users, three baseline scenarios were developed to estimate the amount of benefitting tonnage that would be moved via the MSC in the form of petroleum products (crude oil and condensate). The tonnage levels for these three scenarios, low, medium, and high are displayed in Table 6. The high scenario was estimated by obtaining the three users' capacity forecasts, combining them, and multiplying them by 75%. The median scenario is 50% of the high scenario, and the low scenario is 25% of the high scenario. For purposes of this analysis, the median scenario was considered to be the most likely, and it is the baseline upon which growth rates are applied.

Table 6 - Project Baseline for Crude Oil & Condensate Tonnage (2018)

Scenario	Low 25% of High Scenario	Median 50% of High Scenario	High 75% of Capacity
Metric Tons	**1,412,444**	**2,576,546**	**4,904,751**

2.2.4.4 Eagle Ford Shale

Discovered in 2008, the Eagle Ford Shale in South Texas spans northeast from the United States-Mexico border to just below Houston. The formation is ~50 miles wide by 400-miles long, covering a 23-county, mostly rural, area. The shale produces natural gas, condensate, oil, and natural gas liquids, adding billions of dollars annually to the South Texas economy and supporting thousands of jobs. Operators expect that the shale play will continue to be developed for decades (http://eaglefordshale.com/). Eagle Ford Shale's proximity to the Port of Port Lavaca/Point Comfort, shown in Figure 20, positions the Port to be an efficient exporter of commodities produced by the Shale (Appendix A – Economics, Section 2.1.2.).

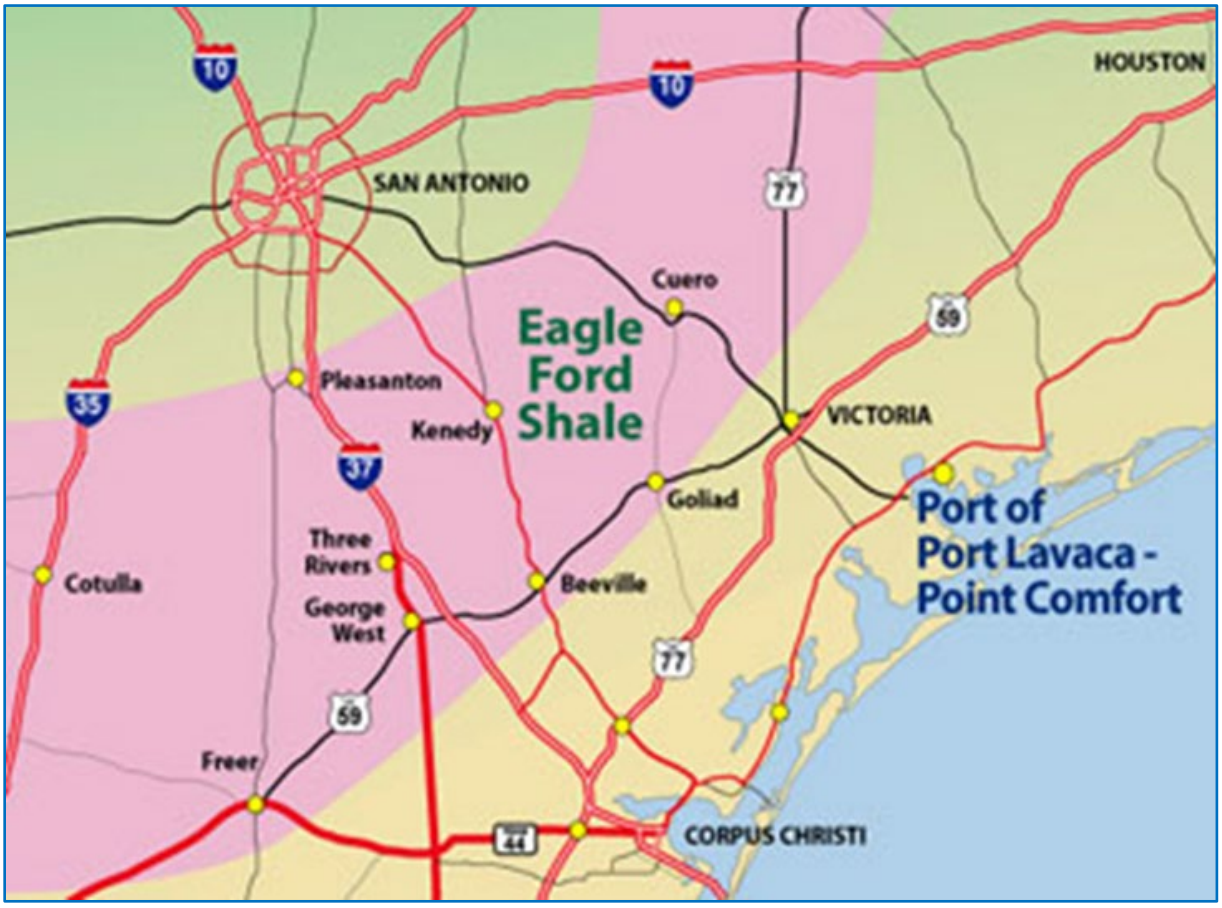


Figure 20 - Map of Eagle Ford Shale Area

2.2.4.5 Petra Nova Project

The Petra Nova Project (Figure 21) came online in 2016 and is the world's largest post-combustion carbon capture facility that is installed on an existing coal-fueled power plant. The proven carbon capture process utilized by the project captures carbon dioxide emissions produced by the power plant as part of the Clean Coal Power Initiative Program (CCPI). Once captured, the oil is compressed and transported 80 miles via pipeline to the West Ranch oil field near Vanderbilt, Texas, only 15 miles from Point Comfort. At the oil field, the compressed carbon dioxide will be used in a process called Enhanced Oil Recovery (EOR) to recover previously unreachable oil and then will be stored permanently underground. Oil production at the West Ranch oil field is expected to increase from 300 barrels per day (bpd) to 15,000 as a result of the project.[1]

Arrowhead Offshore is an affiliate of Hilcorp's Harvest Pipeline, a midstream service provider that operates various crude oil and natural gas gathering, storage, transportation, and treatment services. Arrowhead Offshore, a new tenant at Point Comfort, along with its parent company is responsible for moving the oil recovered from the Petra Nova Project by ship and has positioned itself at the Port of Point Comfort based on its proximity to the West Ranch oil field. The crude oil estimated to be recovered and transported from the Petra Nova project accounts for a portion of crude oil tonnage in the baseline forecast (Appendix A – Economics, Section 3.2.1).

Figure 21 - Petra Nova Project

[1] NRG Energy, http://www.nrg.com/generation/projects/petra-nova/, accessed November 2017

2.3 Environmental Resources – Affected Environment

2.3.1 Introduction – The Eco-Region

The study area lies within the Western Gulf Coastal Plain ecoregion, which extends along the Texas Gulf Coast form the Sabine River south to the Rio Grande. The prominent features of this coastal ecosystem include fresh, intermediate, brackish, and saline marshes; bays and lagoons with sea grass beds, tidal flats, and oyster reef complexes; barrier islands; riparian forests; and dense brush habitats. (Appendix B – Environmental Resources, Section 2.3.1)

The ecoregion is shaped by natural forces, including the dominant south to southeast winds, tropical weather systems, and a substantial amount of rainfall. Flooding and freshwater inflows are key systemic processes, which buffer salinity and provide nutrients and sediments to extensive estuaries in the Matagorda region.

2.3.2 Wetlands

Terrestrial lands bordering aquatic areas along the coast are known as coastal wetlands (saline to freshwater) when the water table is at or near the surface of the land. These areas may be covered by shallow water and emergent vegetation may or may not be present. The wetlands provide essential habitat for fish, shellfish, and other wildlife. Coastal wetlands help to filter runoff and provide a buffer to coastal areas limiting storm and wave damage. Factors influencing the condition and distribution of wetlands include water depth, frequency of inundation, salinity, and erosive/accretive forces.

The estuarine system extends from the open waters of the estuary, inland to freshwater areas (salinity <0.5 during average annual low flow). The estuarine system includes a number of distinct wetland communities. Estuarine tidal flats are comprised of coastal wetlands periodically flooded by tidal waters and have less than 30% vegetation cover, by area. Tidal flats can include sandbars, mud flats, and salt flats. Salt flats may be sparsely vegetated by glasswort, saltwort, and shoregrass. The salt flats serve provide feeding grounds for coastal shorebirds, including the threatened piping plover, fish and invertebrates.

The extent of barrier island tidal flats, in the study region, has decreased in areal coverage since the 1950s. Some of the loss may be due to “an accelerated rate of relative sea-level rise from the 1960s through the late 1970s.” These tidal flats have converted to estuarine marsh, seagrass, or remained as unvegetated open water.

The estuarine wetlands comprise the majority of the wetlands in the Matagorda Bay system. The areal coverage of estuarine marsh on, and near, the barrier islands has increased since the 1950s in West Matagorda Peninsula due to washover fans deposited by Hurricane Carla in 1961 and from accretion into Pass Cavallo due to longshore drift.

Fresh/intermediate marsh can be found on the mainland, on the barrier islands, and along shorelines in upstream drainages areas and in depressional areas or swales. Common species in low fresh-intermediate marshes include coastal cattail, California bulrush, southern reed, swamp smartweed, Gulfcoast spikesedge, large spike spikerush, green flat-sedge, sand spikerush, and many others. High marsh, also known as “wet meadow,” supports many of the same species, but will not include species such as cattails, California bulrush, or southern reed. Awl-leaf aster, deep-rooted sedge, green flat-sedge, and caric-sedge are also common in the wet meadows. The fresh/intermediate scrub-shrub wetlands are found in the same general

areas as the fresh/intermediate marshes. Common scrub-shrub species include buttonbush, Chinese tallow tree, and coastal cattails. (Appendix B – Environment Resources, Section 2.3.2)

2.3.3 Submerged Aquatic Vegetation

The Matagorda Bay System is the third largest estuary on the Texas coast. The substrate is composed of unvegetated bottom regions, oyster reefs, and patches of submerged aquatic vegetation (SAVs). Estuarine SAV includes the true seagrasses such as shoalgrasses, turtlegrass, manateegrass, and clovergrass, but also includes widgeongrass, which is not considered a true seagrass because it also grows in freshwater environments.

The presence of estuarine SAV beds are highly dependent on water clarity and thus tend to occur in shallow areas (generally <6 ft. water depth). Shoalgrass, widgeongrass, and turtlegrass have been documented in the Matagorda Bay system. Shoalgrass was mapped along the southern shoreline of Keller Bay, in Boggy Bayou north of Port O'Connor, near the bayside marshes of the barrier island (Matagorda Peninsula) north of the MSC cut, and associated with the marshes west of Pass Cavallo where turtlegrass was also noted. The Seagrass Conservation Plan of Texas lists shoalgrass, widgeongrass, and clovergrass in the Matagorda Bay system. (Appendix B – Environment Resources, Section 2.3.3)

2.3.4 Aquatic Resources

The Matagorda Bay System is the third largest estuary on the Texas coast. The substrate is composed of unvegetated bottom regions, oyster reefs, and patches of SAVs. The open-water habitats support communities of benthic organisms, plankton, nekton, and numerous fish species.

Phytoplankton is the primary producers in the open-bay and are fed upon by zooplankton, fishes, and benthic organisms. The phytoplankton of Lavaca Bay is dominated by diatom species. Zooplankton is animals that cannot swim against the current. Their abundances are determined largely by phytoplankton abundance and tend to increase after increases in phytoplankton. Zooplankton forms the basis of the food chain for larval and juvenile fish.

Nekton assemblages (organisms that swim freely in the water column) consist mainly of secondary consumers feeding on zooplankton or juvenile and smaller nekton species. The Matagorda Bay system supports a diverse nekton population including fish, shrimp, and crabs. The community composition of nekton changes throughout the year as some spend their entire life in the bay (residents) and other species may only spend a portion of their life cycle in the estuary (migrants). The dominant nekton species inhabiting the Matagorda Bay estuary are bay anchovy, Atlantic croaker, white shrimp, brown shrimp,and spot.

Matagorda Bay has one of the lowest percentages of the total finfish harvest of all the Texas bay systems, contributing less than five percent of the coastwide landings from 1997 to 2001. Commercially caught species include black drum, flounder, striped mullet, and sheepshead.

The main commercially harvested shellfish species in Matagorda Bay are brown, white shrimp and blue crabs. A commercial fishery for eastern oysters does exist in Matagorda Bay; however the harvest makes up only about five percent of all oysters landed in Texas.

The open-bay bottom is an important component of the aquatic environment, as it is comprised of flat areas of mud and sand that contribute large quantities of nutrients and food. The distribution of the benthic macroinvertebrates within the bay is influenced by both bathymetry and sediment type. Benthic macroinvertebrates found in the sediments of the Matagorda Bay

are primarily polychaetes, bivalves, gastropods, and crustaceans. The dominant bivalves include the dwarf surf clam, the concentric nut clam, and the scorched mussel. The dominant gastropods are the Eastern white slipper shell, the channeled barrel-bubble, and the beautiful little caecum. (Appendix B – Environment Resources, Section 2.3.3)

2.3.4.1 Oysters

The Matagorda Bay system is home to numerous Eastern oyster reefs. The reefs form in areas of hard substrate and beneficial currents. Most of these reefs are in sub-tidal or intertidal areas near passes, cuts, or the edge of marshes.

While oyster reefs are prominent in parts of Lavaca Bay and Matagorda Bay, the full extent of oyster reef distribution has not been mapped. Oysters are commercially harvested from the Matagorda Bay system. The Texas Department of State Health Services (TDSHS) has classified shellfish-harvesting areas in Lavaca and Matagorda bays. Shellfish-harvesting areas are classified as approved (an area where harvesting is allowed), conditionally approved (status changes based upon meteorological or hydrological conditions), or restricted (no harvesting allowed). Much of the Matagorda Bay estuary is approved or conditionally approved; however there are some restricted areas within the bay system. Most of the restricted areas are located in the upper portion of Lavaca, Keller, Carancahua, and Tres Palacios bays. (Appendix B – Environment Resources, Section 2.3.3)

2.3.5 Wildlife Resources

Matagorda Bay is located along the Central Flyway for waterfowl and is one of the most significant waterbird wintering regions in North America. The Matagorda Island National Wildlife Refuge and State Natural Area is home to numerous species of resident and migrant birds. Some common species that occur within the project area include little blue heron, sanderlings, least sandpiper, great blue heron, white ibis, roseate spoonbill land many others. Other bird species that are associated with the prairies and marshes region include a variety of raptors, songbirds, and migratory waterfowl.

The Texas Colonial Waterbird Census (TCWC) database has documented nesting habitat in the project area for multiple species of colonial waterbirds (USFWS, 2017b). The annual census, conducted in May and June, began in 1973 and includes location data for colonies along the Texas coast, along with an estimated number of breeding pairs per colony. The census data are collected by volunteers from State and Federal agencies, as well as nonprofit organizations. The database is maintained by the USFWS Clear Lake Ecological Services Field Office.

The project area is within the TPWD's Coastal Survey Zone, which includes the Gulf Prairies and Marshes region. The TPWD Midwinter Waterfowl Survey (2016) documented 5,992,094 birds in 2016, representing at least 26 species. The Coastal Zone accounted for 23% (1,380,528 birds, at least 18 species) of this total. Waterfowl species expected to migrate through the project area include the blue-winged teal, mallard, gadwall, green-winged teal, Canada goose, and wood duck. (Appendix B – Environmental Resources, Section 2.3.4)

2.3.6 Threatened and Endangered Species

Threatened and endangered (T&E) species considered in this analysis were identified from county species list provided by the US Fish and Wildlife Service (USFWS). Information regarding the potential occurrence of a species in this area was obtained from the literature. It

should be noted that inclusion on the list does not imply that a species is known to occur in the project area, but only acknowledges the potential for occurrence.

USFWS and National Marine Fisheries Service (NMFS) have identified twelve federally listed T&E species and four candidate species as *potentially* occurring in the project area (Calhoun and Matagorda counties, TX) (Appendix B – Environmental Resources, Section 2.3.5).

There are five T&E species of sea turtle that may be found in the project area – Kemp's ridley, green, leatherback, loggerhead, and hawksbill). Hopper dredging may result in the mortality of Kemp's ridley sea turtles, but no Kemp's ridleys have been reported taken during dredging maintenance operations of the MSC since before October 2008 (USACE, 2018). Sea turtle avoidance measures would include an avoidance plan for hopper dredge impacts to sea turtles. This avoidance plan includes reasonable and prudent measures that have largely been incorporated in USACE regulatory and civil works projects throughout the Gulf for more than a decade. These measures include use of temporary dredging windows, when possible; intake and overflow screening; use of sea turtle deflector dragheads; observer reporting requirements; and sea turtle relocation/abundance trawling. The likelihood of adverse effects (incidental take) of sea turtles due to dredging activities is greatly reduced by implementation and adherence to the conservation measures. Adverse effects are not expected to jeopardize the continued survival or recovery of the species.

Even though candidate species are not protected under the Endangered Species Act (ESA), they would be provided the full protection of the ESA if listed after the Section 7 consultation is completed. Critical habitat has been designated near the project area for the Piping plover and the Whooping crane.

Piping plovers are potential winter residents (November – March), and spring and fall migrants in the project area. This species has been observed in the project area. Critical habitats have been designated along the Texas coast, including portions of the Lavaca and Matagorda bays system.

Critical habitats have been designated for the Whooping crane in Calhoun County, but are restricted to the Aransas National Wildlife Refuge and adjacent areas. The whooping crane has not been recorded in the project area, but cranes overwintering in the Aransas National Wildlife Refuge could move through or utilize habitats in Matagorda and Lavaca bays.

There are no federally listed T&E plant species in the project area.

2.3.7 Essential Fish Habitat

NMFS and the Gulf of Mexico Fisheries Management Council have identified the project area as Essential Fish Habitat (EFH) for brown shrimp, pink shrimp, red drum, gray triggerfish, greater amberjack, lesser amberjack, cobia, dolphin, king mackerel, Spanish mackerel, bluefish, little tunny, Atlantic bluefin tuna, lane snapper, red snapper, bonnethead shark, blacktip shark, and Atlantic sharpnose shark.

The categories of EFH that occur within the project area include estuarine water column, estuarine sand and mud bottoms (unvegetated estuarine benthic habitats), estuarine shell substrate (oyster reefs and shell substrate), estuarine emergent wetlands, and seagrasses. Additionally, portions of the project located in marine waters include the marine water column, unconsolidated marine water bottoms, and natural structural features. (Appendix B – Environmental Resources, Section 2.3.5.2)

2.3.8 Air Quality

The Matagorda region is in the Corpus Christi – Victoria Air Quality Control Region (AQCR) consisting of Aransas, Bee, Brooks, Calhoun, De Witt, Duval, Goliad, Gonzales, Jackson, Jim Wells, Kenedy, Kleberg, Lavaca, Live Oak, McMullen, Nueces, Refugio, San Patricio, and Victoria Counties. This AQCR meets all of the EPA NAAQS and is in compliance with the Clean Air Act.

The Texas Commission on Environmental Quality (TCEQ) is tasked with monitoring air quality within the State and making that information available to the public. This AQCR is in attainment area for all National Ambient Air Quality Standards (NAAQS).

Nitrogen oxide (NO_x) emissions are mostly attributed to fuel combustion equipment at industrial facilities. The majority of sulfur dioxide ($SO_{2)}$ emissions in the project area can be attributed to marine vessels, with the amount of emissions in direct proportion to the sulfur concentration in the diesel fuel and the size of the engines. The major non-point sources that affect air quality in the surrounding area are dust from agricultural activities, vehicle emissions, commercial, industrial, and manufacturing activities.

Matagorda Bay activities that contribute air contaminants include air emissions derived from waterborne traffic, including vessels, barges, tugs, dredged, and other recreational and noncommercial vessels. Port activities, including the loading and unloading of bulk cargo vessels and tankers, also contribute to air emissions effecting air quality. (Appendix B – Environmental Resources, Section 2.2.8)

2.3.9 Noise

Noise is defined as unwanted sound that disrupts or interferes with normal activities or that diminishes the quality of the environment. Noise is typically linked to human activity and an additional layer along with the natural acoustic setting of an area. (Appendix B – Environmental Resources, Section 2.2.9)

Sensitive receptors are located in the City of Port Lavaca and the communities of Port O'Connor, Magnolia Beach, Indianola, Alamo Beach, and Point Comfort. The existing noise environment of these communities is primarily affected by waterborne transportation activities (vessel traffic, barges, commercial and recreation vessels, and maintenance dredging of the channel). Measured ambient noise levels, at sensitive receptors in communities with a similar degree of activity, range between 60.9 and 65.1 Day-Night Sound Level (L_{dn}).

2.3.10 Climate

The Matagorda Bay region climate (Appendix B – Environment Resources, Section 2.1) is classified as humid subtropical and is primarily affected by the intensity and direction of the winds (National Climatic Data Center (NCDC), 2016a)). Southeasterly winds dominate from March to November with a typical range of eight to 12 miles per hour (mph). Throughout the rest of the year, the region is dominated by northerly winds ranging from 10 to 11 mph. The average annual wind speed is ~10 mph (NCDC, 2016b).

The monthly mean temperatures in Point Comfort range from a low of 54.4° F (Fahrenheit) in January to a high of 84.6° F in August. Sea breezes from the Gulf help to ease the effect of the high temperatures as a result of the dominant maritime tropical air mass (NCDC, 2016b). Winters have considerable day-to-day variation between modified continental polar and

maritime polar air masses and the tropical air mass providing for more moderate conditions (URS, 2006).

The Matagorda Bay region can expect precipitation throughout the year with no consistent seasonal pattern in rainfall totals apparent. No consistent trend is shown concerning mean monthly precipitation values. Mean monthly precipitation ranges from a low of 2.3 inches in April to a high 4.8” in November. Annual rainfall averages 42.4” per year (NCDC, 2016b).

As a humid subtropical climate regime the humidity is typically above 50%, with an average annual humidity fluctuating between 66% in the afternoon and 90% in the morning (NCDC, 2016b). The highest percentages of sunlight occur in the summer months, with an overall average of sunlight present for 59% of all possible daylight hours. (NCDC, 2016a).

2.3.11 Soils and Prime and Other Important Unique Farmland

The US Department of Agriculture National Resource Conservation Service (NRCS) maintains a national database of prime and other important farmlands that is organized by county. The two counties in the study area are Calhoun and Matagorda. The Calhoun County Soil Survey lists seven mapping units as prime farmland, one prime farmland, if drained, and no other types of important farmland. The Matagorda County Soil Survey lists 17 mapping units as prime farmland, one prime farmland, if drained, and no other types of important farmland. Prime farmland is defined by the Farmland Protection Policy Act of 1981 (FPPA) as land that is best suited for producing food, feed, forage, fiber, and oilseed crops and is not urban or built-up land or water areas. No prime farmland will be impacted by the TSP. (Appendix B – Environmental Resources, Section 2.2.5)

2.3.12 Energy and Mineral Resources

The project area has numerous natural resources, including oil and gas, sulfur, salt, shell, clay, sand, magnesium, and bromine. The most significant of these is oil and gas. Oil, natural gas, and natural gas liquids are important drivers of the local economy of the area and used in refineries and as a raw material in many petrochemical processes.

Sulfur generally occurs in the cap rock of salt domes, but it can also be extracted from sour gas. Sulfur is primarily used in the manufacture of a variety of other industrial products, such as sulfuric acid. The abundance of salt domes in the area provides for an abundant supply of high-grade sodium chloride. Salt is another important resource in Texas, with the bulk of Texas salt production occurring in the Texas coastal zone.

Sand deposits in the area have the potential for industry or specialty uses, such as foundry sands, glass sands, and chemical silica. Common clays are used in the manufacture of brick and tile. (Appendix B – Environmental Resources, Section 2.2.6)

2.3.13 Significance

The mid-coast of Texas, which is located within the Central Flyway for waterfowl, is one of the most significant water bird wintering regions in North America. Peak populations of duck and geese, on this and nearby sites, normally exceeds 100,000 birds during the late wintering periods. During migratory periods, the prairies, marshes, and agricultural fields along the Texas Gulf coast provide important stopover habitat for numerous migrating shorebirds, raptors, and songbirds. The consumptive and non-consumptive activities related to these birds provide an

important economic resource for the local communities. (Appendix B – Environmental Resources, Section 2.3.4)

2.4 Cultural Resources

The proposed project area for the MSC Improvement project is located along the central Texas coast and has been occupied by humans for the last 7,500 years. The study area is characterized by upland coastal prairies dissected by streams and rivers and extensive bay and estuarine systems along the coast. The Colorado, Lavaca, San Antonio, and Guadalupe rivers are the major drainages in the region. Sediments in the region consist of fluvial deposits and delta formations overlying Pleistocene aged clay. Prehistoric sites are commonly found within these upper sediments along streams and rivers and adjacent to brackish estuarine systems, close to prime areas for resource exploitation. These sites include campsites, dense shell middens, and cemeteries, containing projectile points, stone, bone, and shell tools, aquatic and terrestrial faunal remains, hearth features, ceramics, and in some cases human remains and associated funerary objects. Shell midden sites are especially common in the region along the shorelines and upland areas adjacent to rivers and bays and on the barrier islands. Historic age resources in the region consist of farmsteads, plantations, and ranches, houses, buildings, bridges, cemeteries, lighthouses, shipwrecks, and the ruins of these buildings and structures.

Although historic age resources can occur anywhere, these sites tend to be concentrated in small towns and urban areas, along roads, and within current and historic navigation paths. Shipwrecks may also occur in numerous locales due to the dynamic nature of the sea floor and bay bottoms and the lack of navigation improvements until the latter part of the 19th century. These dynamic conditions can result in shifting shoals and reefs that endanger ships as well as bury their wrecks as shorelines and bars migrate through time.

There are over 600-recorded prehistoric and historic archeological sites located within this region of the central Texas Coast. These cultural resources include National Register of Historic Places (NRHP) listed properties, archeological sites, cemeteries, historical markers, and shipwrecks and submerged resources. A preliminary assessment of the cultural resources within five miles of the project area was conducted using a desktop review of the databases maintained by the Texas Historical Commission and the Texas Archeological Research Laboratory for terrestrial and marine cultural resources as well as the shipwreck and obstruction databases of the National Oceanic and Atmospheric Administration and the Bureau of Ocean Energy Management. This assessment identified 113 previously recorded cultural resources including 42 archeological sites, five cemeteries, 31 historical markers, and 35 possible marine resources. There are no recorded National Register properties or State Historic Landmarks within the study area.

Within the areas of the proposed new dredging and dredged material PA construction, a study area was examined within 500’ of the proposed work for existing cultural resources. There are no previously recorded cultural resources located within this study area. However, a 2006 marine archeological survey of the channel identified 39 magnetic anomalies and four associated sonar targets along the ship channel (Borgens et al. 2007). Another survey conducted in 2013 of the portions of the channel identified seven magnetic anomalies within the project area (Tuttle 2018).

The primary considerations concerning cultural resources are threats from direct impacts to intact terrestrial and marine archeological sites from new construction and improvements. A portion of the study area, primarily around Point Comfort has been altered for industrial and commercial use. Additionally, shoreline areas, especially along the western shorelines of

Matagorda and Lavaca Bays have suffered from erosion from coastal storms and wind and wave action.

However, based on the previous investigations, there is a high probability for shipwrecks to occur anywhere in Matagorda and Lavaca Bays. There is also a high probability for archeological sites to occur in the newly proposed dredged material PA P1. Due to the minimal impacts to upland areas, there is little likelihood of impacting historic buildings or structures and there are no cemeteries located within the project area.

2.5 Environmental Engineering

2.5.1 Water and Sediment Quality

The TCEQ has designated water quality segments for the Matagorda Bay system. Segment 2451_02 encompasses all of Matagorda Bay and segment 2542_01 encompasses Tres Palacios Bay, the northern portion of the channel. The designated uses for the waters of the system are contact recreation (activities involving a significant risk of ingesting water) and support of aquatic life (TCEQ, 2000). All Matagorda Bay segments are assigned an Exceptional (E) Aquatic Life Use Subcategory and Oyster Waters (O) (waters producing edible oysters). The Aquatic Life Use Subcategory establishes a numerical criterion that is dependent on desired use, sensitivities of aquatic communities, and chemical and physical characteristics. The categories include limited, intermediate, high, and exceptional aquatic life and oyster waters. Under TCEQ procedures, the E/O designation translates to a DO criterion for saltwater of an average of five milligram per liter (mg/L) and a minimum of four mg/L. The O designation criterion for bay and gulf waters is a fecal coliform (FC) median concentration not to exceed 14 cfu/dL (colony forming units per deciliter, or 100 mL, with no more than 10% of all samples exceeding 43 cfu/dL). (Appendix B – Environmental Resources, Section 2.2.3)

In addition to the averages of the periodic longer-term monitoring, the TCEQ conducts water quality assessments with a special set of procedures every two years, to determine whether the uses are being attained (TCEQ, 2004). Lavaca Bay/Chocolate Bayou and Keller Bay are both listed by TCEQ as impaired for oyster use.

Physical Oceanography

Matagorda Bay is a broad, shallow estuary, separated from the Gulf by the Matagorda Peninsula and a barrier island complex. The bay is interspersed with multiple dredged navigation channels, the largest of which are the MSC and GIWW. Freshwater sources for the estuary include the Lavaca-Navidad River system and several smaller rivers and creeks. Matagorda Bay is connected to the Gulf primarily through Pass Cavallo, the MSC land cut, and the Colorado River Mouth Complex.

US Geological Survey (USGS) mapping shows the surface topography of the study area to be flat to gently rolling and sloping to the southwest (USGS, 1951, 1989a, 1989b, 1995). A bay head delta is formed by the draining of the Lavaca-Navidad River to the north of the study area into Lavaca Bay. The bayside of the barrier islands and peninsulas, and parts of the mainland shoreline contain fringing marshes (McGowen et al., 1976). Along the bay shorelines are bluff banks, ranging from five to 10’. in elevation that form by wave erosion from prevailing southeasterly winds. The study area has been experiencing shoreline erosion, primarily from wind waves, as described by McGowen and Brewton (1975). The authors suggested ~8,450 acres of land of bay and Gulf shorelines were lost to natural erosion between 1856 and 1957 compared to ~615 acres by natural accretion.

The Lavaca delta is characterized by a variety of marsh types, salt, intermediate and freshwater (McGowen et al., 1976). Marsh areas expand in conjunction with delta growth. Woody vegetation is sparse at most places, but oak clusters and other vegetation can be found in the more sandy areas and in the riparian uplands. Broad areas of coastal prairies, pastureland, and farmland occur inland from the Gulf.

2.5.1.1 Currents and Circulation

The study area contains one major estuarine system (Matagorda Bay) and three rivers (Lavaca River, Colorado River, and Tres Palacios River). The GIWW flows through the study area creating a complex movement of water. The study area also encompasses a portion of the northern Gulf.

Area	Tidal Range
Matagorda Bay Entrance Channel	**1.25**
Port O'Connor, Texas	**0.80**
Port Lavaca, Texas	**0.92**

The study area has been modified by human activity by channel dredging, jetty construction, dredged material PAs. The entrance channel is a high-energy environment flanked by two man-made rock jetties. The barrier islands and peninsula help make the Matagorda Bay system a relatively low-energy environment. (Appendix B – Environmental Resources, Section 2.2.2.2)

2.5.1.2 Salinity

The salinity regimes within the Matagorda Bay system from 1952 to 1980 were studied by Ward and Armstrong (1980). Their study showed the mean salinity in the bay area ranged between eight and 31 parts per thousand (ppt). Areas of lower salinity were located near the mouths of the rivers (freshwater inflows) and higher salinities were found in areas more tidally influenced (saltwater inflows). Lavaca Bay, influenced by the Lavaca River, was consistently the freshest bay area, while the open water areas of Matagorda Bay and the western half of eastern Matagorda Bay were the most saline.

Vertical stratification was generally absent due to the average shallow depth and mixing strongly induced by winds, except for the MSC (Ward and Armstrong, 1980). Stratification in the MSC was normally associated with differences in freshwater inflow, with stronger stratification resulting from higher freshwater inflow. Vertical stratification, though infrequent outside of the MSC, did occur in the areas where saltwater inflow was high, such as the MSC land cut. A seasonal pattern of salinity variation was related to seasonal inflows of freshwater. High freshwater inflows in the spring resulted in lower salinities. The gradual decrease in inflows from late fall and winter resulted in increases in salinity until a maximum in March is observed. The areas of the bay system more directly impacted by inflows showed more pronounced seasonal variation in salinity. Ward and Armstrong (1980) noted a significant increase in salinities after October 1963, which corresponds to the MSC land cut through Matagorda Peninsula, with an increase that ranged from two to five ppt in adjacent areas.

The Texas Water Development Board has been using datasondes to collect water quality data, including salinity, in Matagorda and Lavaca bays since fall 1986. The data for three years (1988, 2010, and 2011) with complete monthly data available were downloaded for comparison. In 1988 both the station at the mouth of the entrance channel, and at Point Comfort, were similar in salinity ranges. The station at the mouth of the entrance channel ranged from 24.8-33.6, while the station at Point Comfort ranged from 23.4-33.1. 2010 appears to be an anomalous year with very low salinities at the Point Comfort station, ranging from 4.1-22.9, while the station at the mouth of the entrance channel ranged from 23.6-31.9. In 2011 the salinities at the different stations were again closer to each other. The station at the mouth of the entrance channel ranged from 26.7-36.9, while the station at Point Comfort ranged from 21.0-37.6. (Appendix B – Environmental Resources, Section 2.2.2.3)

2.5.2 Hazardous, Toxic, and Radioactive Waste (HTRW) Concerns

The region is home to multiple port facilities and a large ALCOA refining / smelting facility. The ALCOA facility was established in 1948. It has been used as an aluminum smelting facility, and as a refinery for chlorine-alkali processor. Mercury is one of the byproducts of work undertaken at the ALCOA facility. The mercury was discharged into Lavaca Bay and subsequent high levels of mercury in the Bay led to fishing restrictions in 1988. The site was listed on the National Priorities List (NPL) for the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) in 1994. A Natural Resources Damage Assessment (NRDA) was performed at the site and restoration and remediation work was undertaken to compensate for environmental damages. The Preliminary Closeout Report for the site was signed in July 2007. Long-term monitoring of the sediments, red drum, and blue crab are ongoing.

A Formosa facility at Point Comfort was listed among the Resource Conservation and Recovery Act (RCRA) list of sites. A RCRA Facility Investigation was deemed to be necessary in 1990 and the work plan was approved in 1992. The subsequent groundwater monitoring determined the migration of contaminated groundwater is under control.

TCEQ GIS database shows 23 petroleum storage tanks in the area (one in Point Comfort and 22 in Port Lavaca). (Appendix B – Environmental Resources, Section 2.2.7)

2.6 Geology and the Structural Setting

All existing or available geotechnical information within the USACE, or from others including the non-Federal sponsor, was collected and reviewed in order to determine its relevance to the feasibility of this study. Emphasis was placed on using existing data; however, should sufficient data not be available for final design, then additional field studies may be required in PED. This section contains various discussions regarding the available geotechnical information and geotechnical investigations for the project. Based on these discussions, the appropriate design features along with the geotechnical considerations related to the dredged material and PAs are described. In addition, results of the geotechnical analyses performed in an existing report (URS 2014) were referred to presume physical and engineering characteristics of the anticipated new work materials from channel excavation, which is necessary to determine proper placement schemes in existing or proposed upland or BU sites.

2.6.1 Review and Inventory of Existing Subsurface Data

Data was obtained from both public and private sources. The original channel geotechnical investigation (USACE 1962a) provides a boring log database (80 total); including boring

identification, station (STA) locations, elevation, and strata descriptions. Based on the STAs, all locations of the above 80 borings can be distributed in the three reaches as follow:

This information can be used to confirm side slopes and estimate quantities for the improved channel. (Appendix F – Engineering, Section 4.2.1)

2.6.2 Cone Penetrometer Testing

Three Cone Penetrometer Tests (CPTs) were performed to confirm the soil descriptions provided in the USACE (1962a) in May of 2006 (URS 2014). The locations of the CPTs are shown in Appendix F. The tests were performed at locations that indicated very soft material near the surface, with stiffer material at greater depth. The investigation confirmed the information in the USACE (1962a) and provided a good correlation for use of this information for the design of the channel improvements. However, there were no CPT tests covering Offshore Reach areas. Thus, additional CPT tests are needed around these offshore areas to verify existing soil data in PED. (Appendix F – Engineering, Section 4.2.2)

2.6.3 Placement Area Probing

This method was selected by URS which prepared the Section 204(f) Feasibility Report for CPA (URS 2014). According to this report, probing was performed to estimate the foundation conditions at the locations of the levees for the proposed PAs in Matagorda Bay and Lavaca Bay. Potential levee displacement was estimated based on probing results using a 5-ft-long, 3-inch-diameter hollow steel pipe, which was welded to a 15-ft-long, 0.75-inch-diameter pipe. The total length of the tool was ~20ft as shown in the Appendix F – Engineering Appendix, Plate G-01.

However, this probing method was not identified as a reliable field method for generating engineering parameters regarding displacement of soil foundation because there have been no specific research papers or reports supporting the concept used in this method. Thus, a test method such as the Self-Weight Consolidation Test that has been trusted by public may be required to obtain adequate soil engineering parameters to design or analyze displacement of soil foundation. (Appendix F – Engineering, Section 4.2.3)

2.6.4 Sampling and Testing of Shoaled Sediments

Sediment samples were taken at three locations within the MSC, and the Turning Basin in May of 2006 to characterize the material that would be placed in confined PAs (URS 2014). The three samples were obtained using an Ekman sampler. The Ekman sampler was selected as the most appropriate method of sampling the soft sediments while maintaining their in situ moisture content and excluding the addition of extraneous water from the overlying water column into the sampler. The samples were submitted to a geotechnical testing laboratory to determine moisture content, specific gravity, Atterberg limits, and percentage passing the No. 200 sieve. The dry densities of the samples were calculated using the moisture content and specific gravity, under the assumption that the samples were saturated. Table 7 displays the test results for these sediment samples and the calculated dry densities. (Appendix F – Engineering, Section 4.2.4)

Table 7 - Geotechnical Laboratory Testing for Samples of Sediment Obtained

Sample Number	Moisture Content (%) ASTM D- 2216	Specific Gravity	Atterberg Limits ASTM D=4318			Percentage Passing No 200 Sieve (%)	Unified Soil Classification ASTM D-2487	Dry Density Calculated (pcf)	Calculated Void Ratio
			Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)				
Sta. 85+000	164	2.65	68	25	43	92.7	Gray Fat Clay(CH)	30.94	4.35
Sta. 90+000	226.6	2.72	75	30	45	-	Gray Fat Clay(CH)	23.7	6.17
Sta. 118+000	268.4	2.69	82	34	48	-	Gray Fat Clay(CH)	20.42	7.22

2.6.5 Quality of Dredged Material

The subsurface soil conditions of the project dictate the type of dredge that would be utilized to perform the excavation for DMMP (Appendix E – DMMP, Section 5). The physical characteristics of the soil affect its placement options due to varying strength and compressibility. The subsurface soils in the turning basin and channel consist of soft clays, very stiff to hard clays, and sand. The type of dredging equipment considered depends on the type of material, the depth of the channel, the depth of access to the disposal area or PA, the amount of material, the distance to the disposal or PA, the wave-energy environment, and so forth. Based on these considerations, three types of dredging equipment will be utilized as follows:

- Hydraulic Pipeline Dredges in Lavaca Bay including Turning Basin and Matagorda Bay Reaches;
- Hopper dredge or clamshell dredge with dump scows in portions of the Matagorda Bay Reach; and
- Hopper dredges in the Offshore Reach.

A detailed description of the types of dredging equipment can be found in EM 1110-2-5025, Dredging and Dredged Material M. (Appendix F – Engineering, Section 4.3.3)

2.7 Real Estate

2.7.1 Existing USACE Interests

The following real estate interests are currently held by the USACE (Appendix D – Real Estate, Section 4.1.1):

- A perpetual easement and right-of-way for navigation purposes (Figure 22) to construct, dredge, reconstruct, enlarge, replace, maintain, operate and repair a navigation channel and waterway and jetties and related facilities and dredged material – disposal areas

(DAs) for the deposit of sand, silt and dredged material from the original construction and future maintenance, enlargement, reconstruction and repair of said project in, over, on, along and across tract MSC3 100E-1 was acquired 9 August 1967 from the Matagorda County Navigation District No. 2.

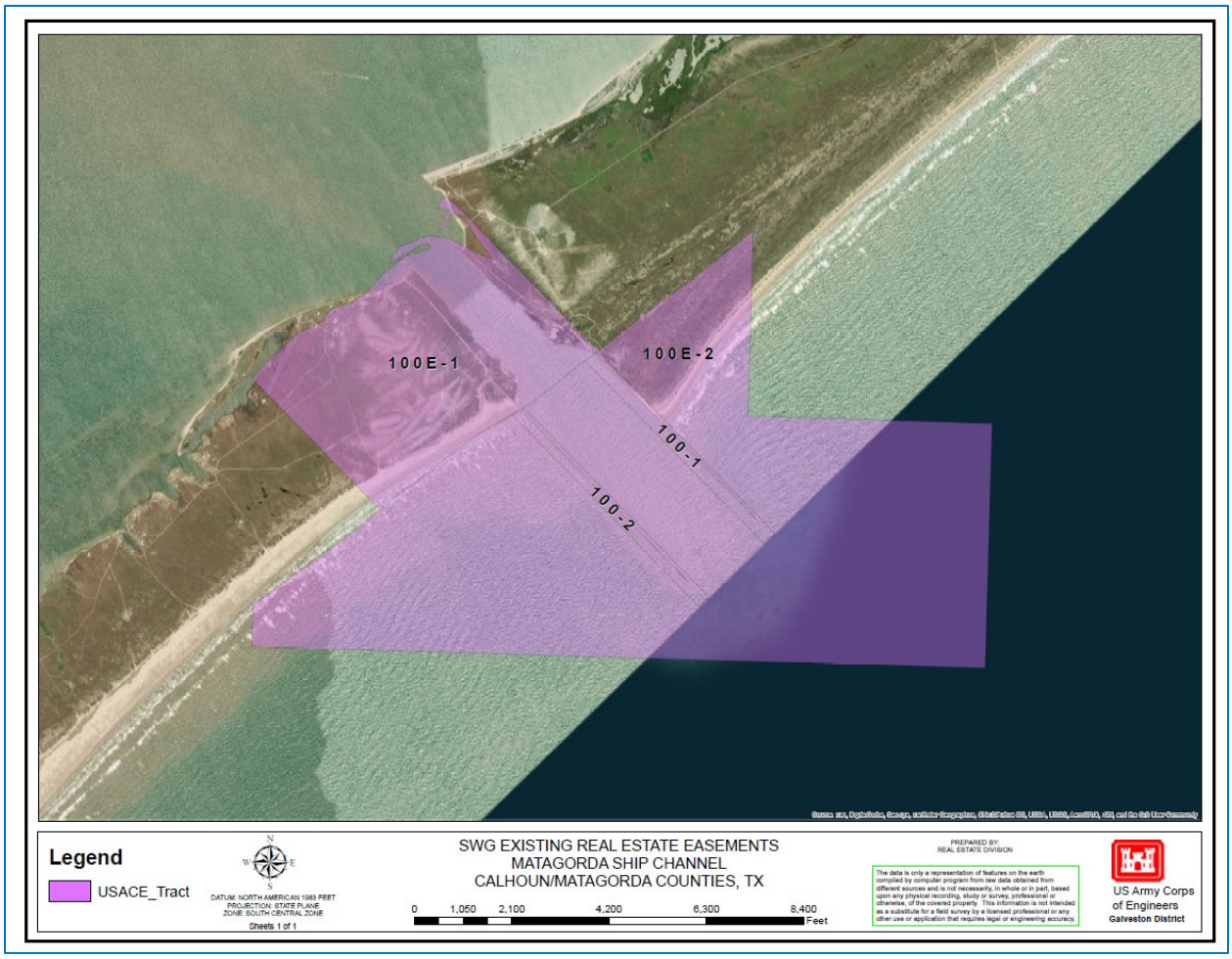


Figure 22 - USACE Existing Interests

- A perpetual right and easement to enter upon, dig or cut away and removed on tract MSC3 100E-2 in the prosecution of the work of constructing, maintaining or improving the MSC, or any enlargement thereof, and to maintain the portion so cut away and remove as a part of the navigable waters was acquired 7 August 1963 from Matagorda County Navigation District No. 2.
- A perpetual easement to prosecute the work of constructing, maintaining or improving the MSC on tracts MSC3 100-1 and MSC3 100-2 was acquired 7 August 1963 form Matagorda County Navigation District No. 2.

2.7.2 Existing Placement Areas

Most existing USACE placement areas (PAs) currently in use for maintenance-dredge material-placement will be excluded from this project as a result of a new DMMP (Appendix E). Existing

PAs owned by USACE that will be included in this project are shown in Figure 23 (Appendix D – Real Estate, Section 4.1.2):

- Sundown Island, totaling 442 acres, is a designated PA used for both MSC and GIWW maintenance material disposal, located near the MSC Entrance. Sundown Island has a capacity of 2.3 mcy of new and 12.9 mcy of work maintenance dredged material.

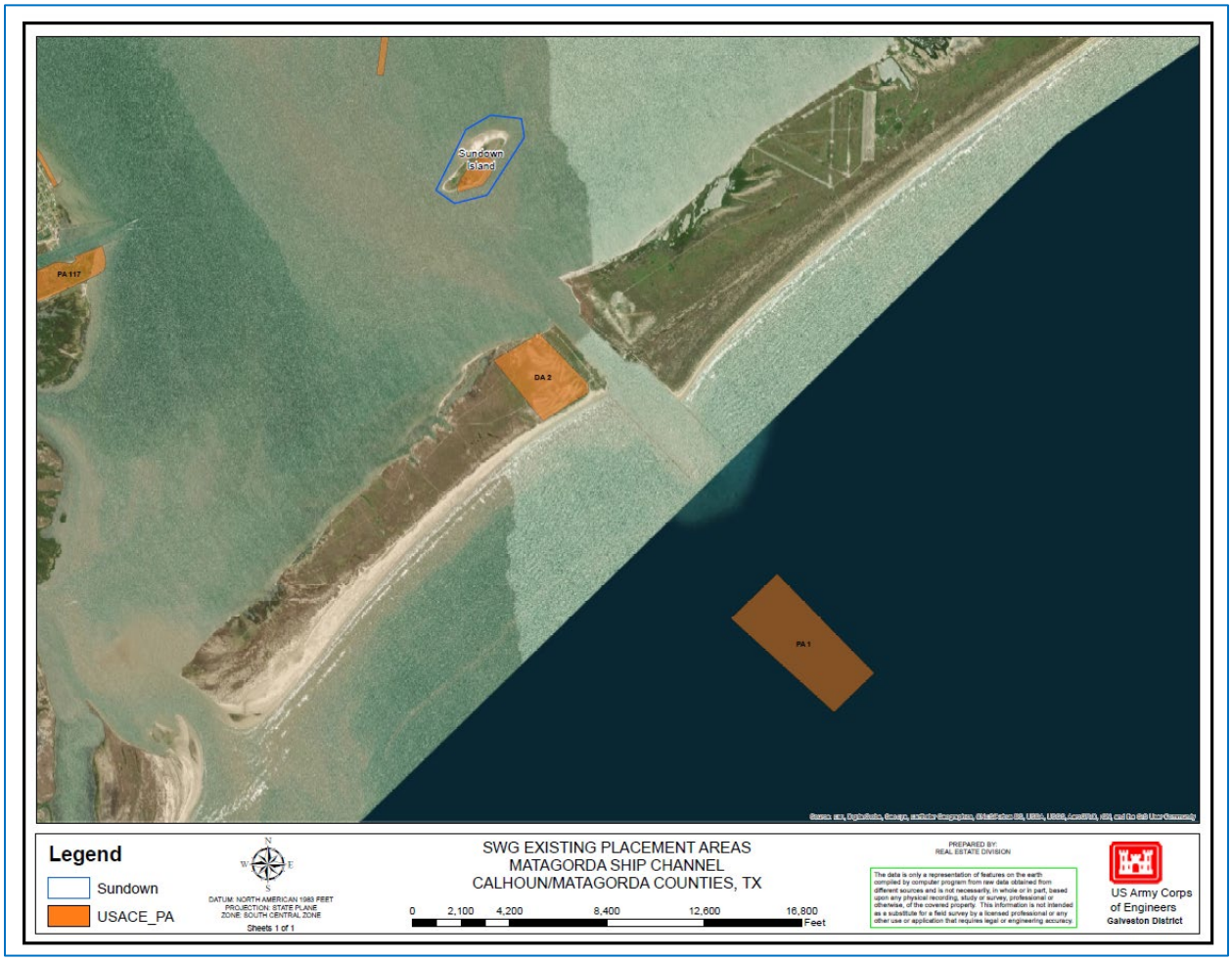


Figure 23 - USACE Existing PAs

- PA 1 is an Ocean Dredged Material Disposal Site (ODMDS) located approximately two miles offshore of the Matagorda Peninsula, and about 1,000’ southeast of the centerline of the MSC Entrance Channel. This rectangular site occupies an area of ~457 acres, with depths ranging from 25’ to 40’ and a capacity of 17.9 mcy of work maintenance.

2.8 Socioeconomics

This section addresses the socioeconomics of the community surrounding the MSC and the Port of Point Comfort (Appendix A – Economics, Section 8). This are includes the four counties that surround the Port, which are Calhoun, Jackson, Victoria, and Matagorda Counties, Texas. These four counties will be referred to as the “Matagorda Ship Channel (MSC) region” (Figure 24). The parameters used to describe the demographics and socioeconomics environment include population trends, private sector employment, and wage earnings. Other social characteristics such as race composition, age distribution, and poverty will be examined in order to recognize any potential environmental justice issues that the improvement project may induce.

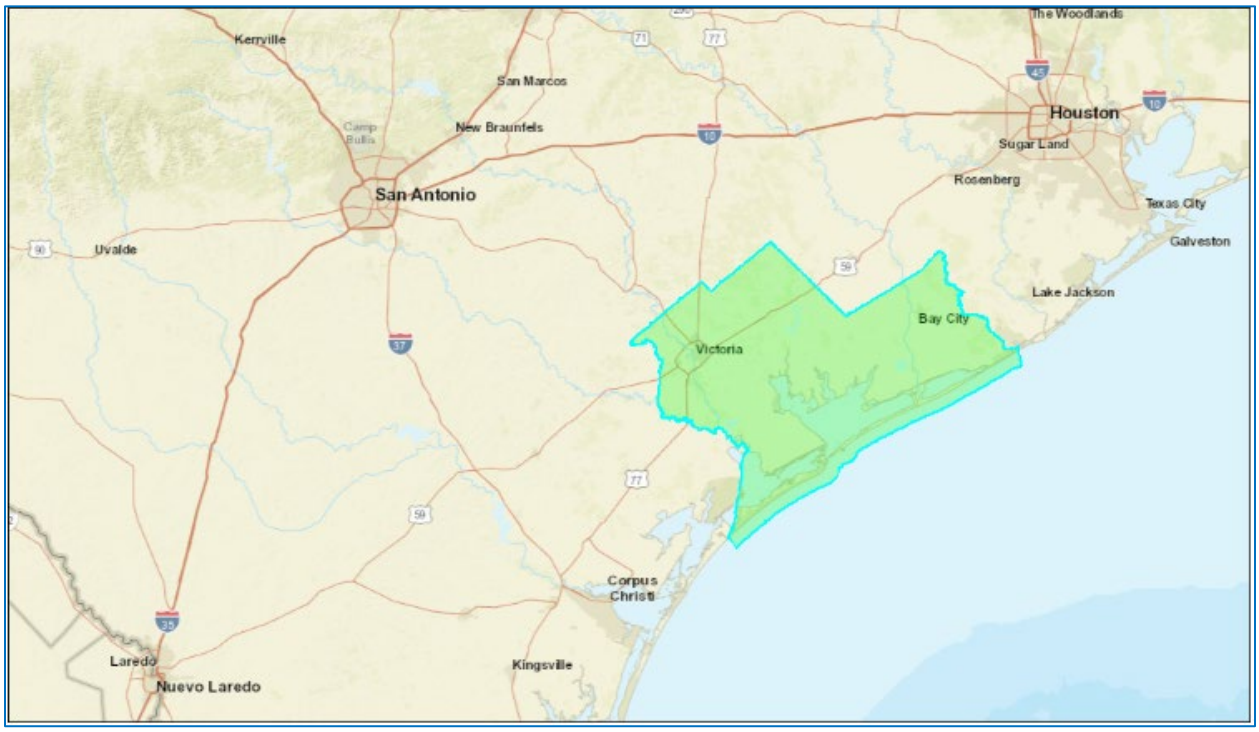


Figure 24 - Socio-economic Area of Interest

The economies of Calhoun, Victoria, Jackson, and Matagorda counties are based primarily on the petrochemical industry, commercial fishing, agriculture and livestock, construction, and mineral extraction. Tourism and recreation, including hunting, fishing, and boating also play a significant economic role. Calhoun County is also home to large industrial facilities, including the Carbon/Graphite Group, Union Carbide, and INEOS Nitriles, as well as assorted smaller industry supportive firms.

2.8.1 Population

Table 8 - Population Estimates and Projections (200, 2016, 2050)[2]

Geographical Area	2000 Population Estimate	2010 Population Estimate	2016 Population Estimate	2050 Population Projection
Texas	20,851,820	25,145,561	26,956,435	40,502,749
Calhoun County	20,647	21,381	21,805	31,666
Jackson County	14,391	14,075	14,678	15,649
Matagorda County	37,957	36,702	36,719	44,774
Victoria County	84,088	86,793	90,989	110,868
MSC Region Total	157,083	158,951	164,191	202,957

For a textual description of Table 8, see Appendix A – Economics, Section 8.1.1.

[2] Source: U.S. Census Bureau, Population Division (2000, 2010 Estimates); U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates (2016 Estimate); Texas State Data Center, The University of Texas at San Antonio (2050 Projections)

2.8.2 Employment by Industry

Table 9 - Employment by Sector[3]

Industry	Texas	Calhoun County	Jackson County	Matagorda County	Victoria County	MSC Region
Agriculture, forestry, fishing and hunting, and mining	3.3%	6.1%	11.5%	6.3%	7.3%	7.3%
Construction	8.0%	12.0%	10.0%	10.4%	8.1%	9.3%
Manufacturing	8.9%	25.1%	19.2%	12.0%	11.3%	13.9%
Wholesale trade	3.0%	3.1%	0.6%	2.4%	2.9%	2.6%
Retail trade	11.5%	8.7%	9.0%	11.2%	13.7%	12.1%
Transportation and Warehousing, and utilities	5.5%	2.6%	7.1%	10.1%	4.3%	5.6%
Information	1.8%	0.5%	0.6%	0.6%	0.6%	0.6%
Finance and insurance, and real estate and rental and leasing:	6.6%	4.3%	4.5%	2.5%	4.7%	4.1%
Professional, scientific, and management, and administrative, and waste management services	11.2%	9.4%	5.5%	9.0%	7.5%	7.9%
Educational services, and health care and social assistance	21.6%	18.9%	18.6%	21.1%	22.8%	21.6%
Arts, entertainment, and recreation, and accommodation and food services	9.0%	4.7%	7.0%	7.3%	8.0%	7.4%
Other services, except public administration	5.3%	2.5%	3.3%	5.3%	5.2%	4.7%
Public administration	4.2%	2.0%	3.2%	1.8%	3.5%	2.9%

For a textual description of Table 9, see Appendix A – Economics, Section 8.1.2.

[3] Source: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates (2016 Estimate)

2.8.3 Income and Poverty

Table 10 - Median, Per Capita Income and Poverty Data (2016)[4]

Geographical Area	Median Household Income	% of Families with Incomes Below Poverty Level (Last 12 months)	Per Capita Income	% of People with Incomes Below Poverty Level (Last 12 months)
Texas	$54,727	13.0%	$27,828	16.7%
Calhoun County	$54,167	14.4%	$25,181	18.1%
Jackson County	$56,601	8.8%	$25,594	13.0%
Matagorda County	$41,253	18.3%	$22,939	21.7%
Victoria County	$54,697	11.1%	$27,509	14.7%

For a textual description of Table 10, see Appendix A – Economics, Section 8.1.3.

2.8.4 Labor Force and Unemployment

Table 11 - Labor Force, Employment, and Unemployment Rates (2016 Annual Averages)[5]

Geographic Area	Civilian Labor Force	Number Employed	Number Unemployed	Unemployment Rate
Texas	13,294,000	12,688,000	606,000	4.6%
Calhoun County	10,815	10,213	602	5.6%
Jackson County	7,246	6,900	346	4.8%
Matagorda County	16,833	15,587	1,246	7.4%
Victoria County	43,919	41,558	2,361	5.4%

For a textual description of Table 11, see Appendix A – Economics, Section 8.1.4.

[4] Source: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates (2016 Estimate)

[5] Source: Bureau of Labor Statistics, Current Population Survey (State estimate, 2016), LAUS (County estimates, 2016)

2.8.5 Race and Ethnicity

Table 12 - Racial Composition by Geographic Area (2016)[6]

Geographic Area	White	Black	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races	Hispanic or Latino
Texas	11,705,684	3,134,962	63,336	1,161,742	18,990	35,509	423,062	10,413,150
Calhoun County	9,518	594	9	1,006	40	0	206	10,432
Jackson County	8,803	1,030	0	29	10	6	160	4,640
Matagorda County	16,681	3,776	99	778	86	0	372	14,927
Victoria County	41,882	5,166	95	1,183	0	113	1,178	41,372
MSC Region Total	76,884	10,566	203	2,996	136	119	1,916	71,371

For a textual description of Table 12, see Appendix A – Economics, Section 8.1.5.

[6] Source: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates (2016 Estimate)

2.8.6 Age

Table 13 - Population by Age Group (2016)[7]

Geographical Area	Age Group												
	<5	5 - 9	10 - 14	15 - 19	20 - 24	25 - 34	35 - 44	45 - 54	55 - 59	60 - 64	65 - 74	75 - 84	85 and over
Texas	7%	7%	7%	7%	7%	15%	14%	13%	6%	5%	7%	3%	1%
Calhoun County	7%	8%	7%	7%	5%	13%	11%	13%	7%	6%	9%	5%	2%
Jackson County	7%	7%	7%	7%	5%	12%	12%	12%	8%	6%	9%	5%	2%
Matagorda County	7%	8%	7%	7%	6%	12%	11%	13%	6%	8%	8%	5%	2%
Victoria County	7%	7%	7%	7%	7%	14%	12%	12%	6%	6%	8%	4%	2%
MSC Region	7%	7%	7%	7%	6%	13%	12%	13%	7%	6%	8%	5%	2%

For a textual description of Table 13, see Appendix A – Economics, Section 8.1.6

2.8.7 Demographic Indicators for Environmental Justice

EJSCREEN is an environmental justice mapping and screening tool that is used by the Environmental Protection Agency (EPA) to obtain and display demographic and environmental information for a given area (Appendix A – Economics, Section 8.1.7). The geographic area of interest for the MSC project was input into the EJSCREEN tool, and the results displayed in terms of six demographic indicators, and a demographic index (Figure 25).

An explanation of the demographic indicators shown on the graph follows. Percent Low-Income is the percentage of an area's population in households where the household income is less than or equal to twice the federal poverty level). Percent Minority is the percentage of individuals in an area who list their racial status as a race other than white alone and/or list their ethnicity as Hispanic or Latino). Less than high school education is the percentage of people age 25 or older in an area whose education is short of a high school diploma. Linguistic isolation is the percentage of people in households in which all members age 14 years and over speak a non-English language and also speak English less than "very well"), individuals under age 5, and individuals over age 64.

[7] Source: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates (2016 Estimate)

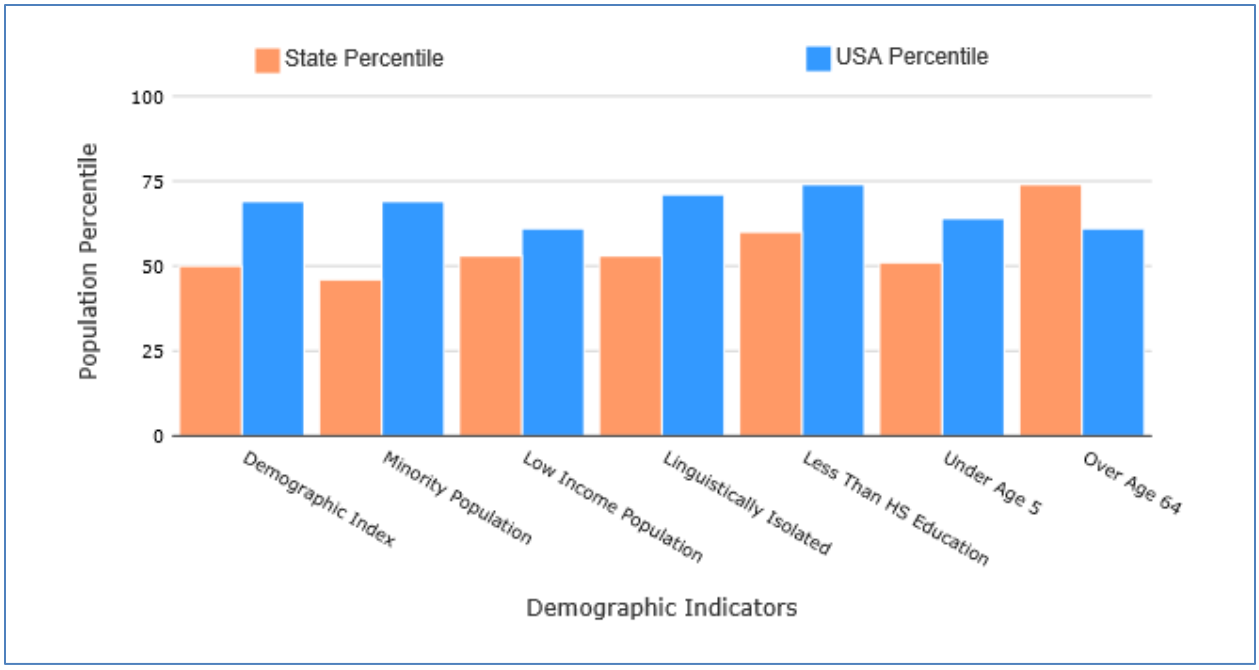


Figure 25 - Environmental Justice Demographic Indicators for the MSC Region

As shown in Figure 25, the MSC region's minority population is at the 46th percentile in the state, meaning that the region's percentage of minority population is equal to 46% of the state. When compared with the US, the region is at the 69th percentile. The MSC region is in the 53rd percentile in the state in terms of low income population (61st in the national percentile); it is also in the 53rd percentile in the state in terms of linguistically isolated population (71st in the national percentile); it is in the 60th percentile in terms of population with less than a high school education (74th in the national percentile); 51st in population under the age of five (64th in the national percentile); and 74th in population over age 64 (61st in the national percentile). The demographic index, which is based on the average of two demographic indicators: percent low-income and percent minority, shows that the MSC region is in the 50th percentile when compared to the state and 69th percentile in the nation.

3 Expected Future Without-Project Conditions – Step 2, Part 2

FWOP conditions are defined as those conditions that would exist within the study area, during the 50-year period of analysis (2024 – 2073), in the absence of a proposed water resources project. The expected FWOP condition is the same as the “No Action” alternative plan, is therefore a projection of how these conditions are expected to change over time if no the USACE plan is implemented.

A quantitative and qualitative description of resources within the study area is characterized, for both existing and future conditions. The second step of plan formulation, and the starting point in any the USACE analysis, is to develop an accurate picture of the existing and FWOP conditions.

Forecasts should extend from the base year (the year when the proposed project is expected to be operational) to the end of the period of analysis.

The FWOP condition forms the basis against which alternative plans are developed, evaluated, and compared. Proper definition and forecasting of the expected FWOP condition are critical to the success of the alternative planning process. The expected FWOP condition constitutes the benchmark against which alternative plans are evaluated.

3.1 Hydrology, Hydraulics and Sedimentation

Changes in wave climate and sea-level rise are much easier to predict than changes in currents or bathymetry. Waves should remain unchanged, but the sea level is unknown. The historic rise is the Low Level Curve.

Currents would be expected to increase as long as Pass Cavallo continues to get smaller.

Bathymetric changes are the most difficult parameter to predict. If current trends continue, the entire navigation channel will slowly return to pre-Harvey dimensions. However, as long as Pass Cavallo continues to shrink, velocities in the entrance channel must increase, resulting in increased scouring between the jetties (Appendix F – Engineering, Section 2.6).

3.1.1 Waves

Wave heights and periods in deep water are little affected by changes in currents or water levels (sea level rise), thus there is no reason to expect significant changes in the wave climate. A ship wake analysis was performed for both existing and new project conditions. Results show that the new project will increase ship wake wave heights by only 0.1ft, which is well within the error bar of the methods. On this basis, it was decided not to perform a shoreline erosion analysis (Appendix F – Engineering, Section 2.6.2).

3.1.2 Currents

Matagorda Bay has only two inlets: the channel through Matagorda Peninsula and Pass Cavallo. Whenever the flow increases through one, then the flow through the second must decrease. Additional information can be found in the *2006 Matagorda Ship Channel, Texas:*

Jetty Stability Study[8]. The FWOP condition assumption is that the Jetty Deficiency project will be implemented. This project is not dependent upon the Jetty Deficiency project.

Analysis of cross-sectional areas of the three inlets is underway. Q = V A will then be used to estimate change in currents V in the entrance channel. (Appendix F – Engineering, Section 2.6.2)

3.1.3 Relative Sea Level Rise (RSLR)

Because of the much larger expected changes in currents and bathymetry, RSLR effectively has no effect on hydraulic design of the new channel. The main effect of RSLR would be to raise water levels, thus decreasing dredging costs but increasing environmental impacts (raising water levels in marshes, eroding beaches, etc.). (Appendix F – Engineering, Attachment 1)

3.1.4 Climate Change

This section discusses other future climate changes (mainly precipitation) based on current scientific evidence and studies. Climate change is expected to pose several challenges along the Texas coast. It is expected to vary greatly along the extensive Texas coast from the Mexican border to the Louisiana border. These challenges will unfold against a backdrop that includes a growing urban population, incentives for energy production, and advances in technology.

For the current study area, the primary climatic forces with potential to affect the project are changes in temperature, sea and inland water levels, precipitation, storminess, ocean acidity, and ocean circulation. Air temperatures in the Houston-Galveston mean statistical area, on average, increased about 1 degree Centigrade over the past 20 years, a pattern that is expected to continue. Sea surface temperatures have risen and are expected to rise at a faster rate over the next few decades. Global average sea level is rising and has been doing so for more than 100 years. Greater rates of sea-level rise are expected in the future (Parris 2012). Higher sea levels cause more coastal erosion, changes in sediment transport and tidal flows, more frequent flooding from higher storm surges, and saltwater intrusion into aquifers and estuaries.

Patterns of precipitation change are affecting coastal areas in complex ways. The Texas coast saw a 10 to 15 percent increase in annual precipitation between 1991 and 2012 compared to the 1901-1960 average. Texas coastal areas are predicted to experience heavier runoff from inland areas, with the already observed trend toward more intense rainfall events continuing to increase the risk of extreme runoff and flooding.

Texas' Gulf Coast historically averages three tropical storms or hurricanes every four years (annual probability of 75%), generating coastal storm surges and sometimes bringing heavy rainfall and damaging winds hundreds of miles inland. The estimated rise in sea level will result in an effective increase in storm surge along the Texas Gulf coast and miles inland. Tropical storms have increased in intensity in the last few decades. Future projections suggest increases

---

8 https://www.researchgate.net/publication/235091543_Matagorda_Ship_Channel_Texas_Jetty_Stability_Study

in hurricane rainfall and intensity (with a greater number of the strongest - Category 4 and 5 - hurricanes). (Appendix F – Engineering, Attachment 2)

3.1.5 Bathymetry and Inlet's Cross-sectional Areas

A basic concept in coastal engineering is that inlets must maintain the same tidal prism volume (surface area times tide range). Unfortunately, West Matagorda Bay is complicated by having two or three inlets (Appendix F – Engineering, Section 2.6.3).

MSC inlet and channel construction occurred in 1963-66. The resulting tidal flows from the new channel's inlet reduced flows through Pass Cavallo and induced collapse of its large ebb-tidal shoal. After that collapse, Pass Cavallo's tidal prism stabilized at ~175 million m3 for spring tide and 110 million m3 for mean tide.

Since the total tidal prism must remain constant, these inlets are linked. If one shrinks, then the other must either enlarge its cross-sectional area A or increase its velocity V: Q = V A, in order to maintain the same discharge Q.

Kraus and Batten (2008, p. ii) state: "Since the mid-1990s, the width of Pass Cavallo has remained stable, suggesting the sediment load to the inlet from collapse of its ebb shoal has declined." Unfortunately, the situation has changed again since that study. Pass Cavallo has now split into two inlets (Figure 26). (Appendix F – Engineering, Section 2.6.3)

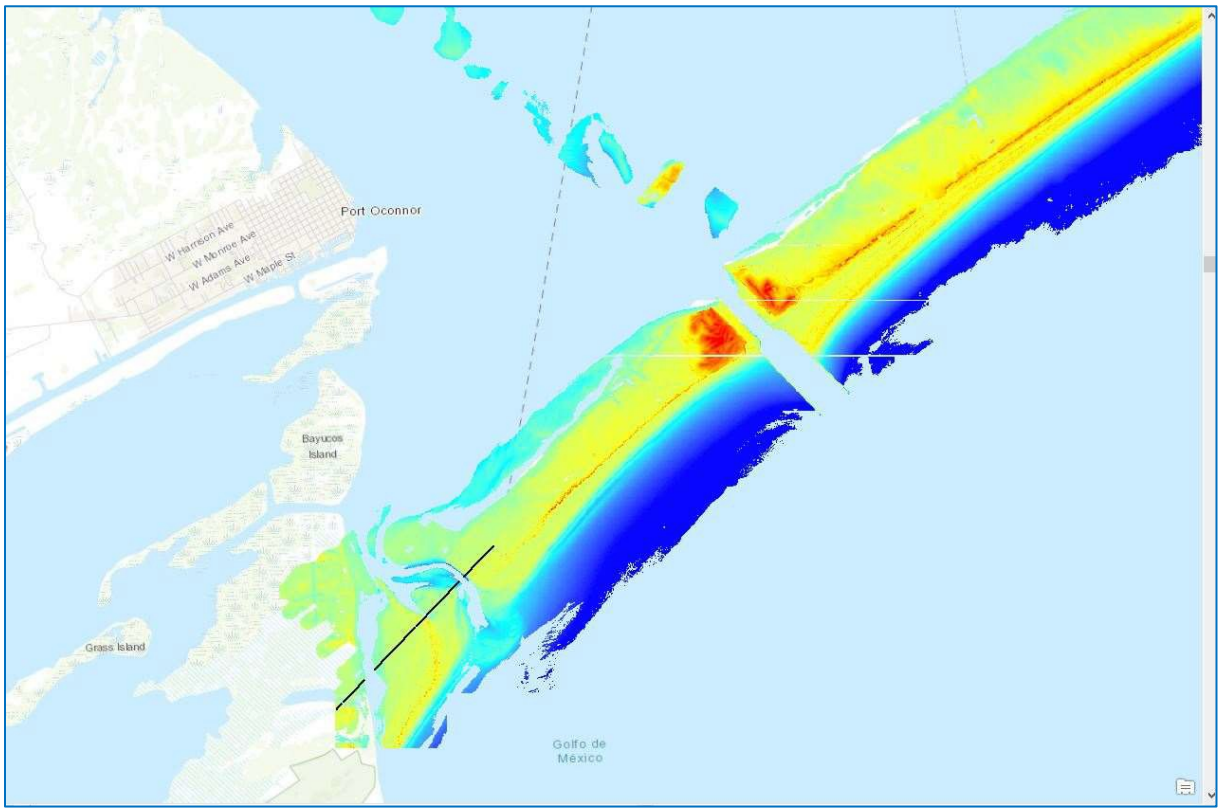


Figure 26 - Pass Cavallo (color-coded elevations from 8-16 Sep 2016 LiDAR survey)

3.2 Economics

3.2.1 Port Expansions

At the onset of this study, in addition to the crude oil users whose facilities were under construction and whose throughput tonnage is considered part of existing conditions for the purposes of this analysis, both the Port and its tenants were in the process of expanding their facilities and infrastructure (Appendix A – Economics, Section 3.1).

3.2.1.1 Terminal Expansions

The Port is currently in the permitting stages of a South Peninsula Development Project (Figure 27). The project includes the addition of four bulk liquid product barge berths and three bulk liquid product docks to be used for the shipment and receipt of petrochemical products, crude oil, and condensate, with the possibility of being used for other liquid products in the future. The docks are designed for an Aframax class vessel with dimensions of 840' length overall (LOA) and 140' beam. The design depth for the liquid bulk docks will be -47' in the future with- or without-project condition.

The development project is projected to be fully complete by 2020. The first liquid dock and the barge berths are scheduled to be operational in 2019, the second liquid dock in 2020, and the third liquid dock is to be operational based on market demand. Though not included in the HarborSym model, these new developments at the Port support the growth in the throughput tonnage that was forecasted for this analysis (Appendix A – Economics, Section 3.1.1).

Figure 27 - CPA South Peninsula Development Project

3.2.1.2 Formosa Plastics Corporation

Formosa supplies plastic resins and petrochemicals and has been a user of the MSC since 1982. Formosa's Point Comfort facility expanded in 1994 at a cost of $1.5 billion. It expanded a second time in 1998 for $900 million. The company's sales in 2015 totaled ~$5.7 billion (Appendix A – Economics, Section 3.1.2).

Since 2015, Formosa has been undergoing a third expansion, scheduled to be completed in 2019. This expansion, pictured in Figure 28 will add 800 acres to the plant, bringing the facility's footprint in Point Comfort from 1,500 acres to 2,300 acres. The company, which employees ~2,000 full-time employees and 922 contract staff, is projected to add 340 permanent jobs to the region. The growth being experienced by this channel user supports the growth forecasted in the chemicals commodity category.

Figure 28 – Formosa's Plant Facilities Undergoing Construction

3.2.2 Commodities Forecast

Commodity throughput was forecasted for benefitting commodities, i.e., chemicals and petroleum products, over a 50-year period (2024-2073) (Appendix A – Economics, Section 3.2). To estimate future tonnage levels, annual growth rates were applied to the baseline tonnage levels for chemicals and petroleum products. The methodology used to obtain and apply the commodity forecasts for the two major commodity groups are detailed in this section. Several sources of data were used to establish the commodity forecasts including historical data, the U.S. Energy Information Administration's Annual Energy Outlook, and a 2015 IHS Global Insight forecast prepared for the Gulf Coast.

3.2.2.1 Global Insight

IHS Global Insight (Global Insight) provides comprehensive economic, financial, and political coverage of countries, regions, and industries and utilizes models, data, and software within a common analytical framework to support planning and decision-making. For trade forecasting,

Global Insight's model is based on the IHS World Trade Service (WTS) model. Conceptually, the WTS real value trade model uses a three-level process (Figure 29). This multi-stage forecasting uses a combination of bottom-up and top-down approaches (Appendix A – Economics, Section 3.2.1).

A 2015 Global Insight forecast for the Port of Houston was consulted when developing projected growth rates for MSC. The forecast was divided in to major commodity categories including petroleum products, chemicals, primary manufactured good, food and farm, manufactured equipment, and crude materials, as well as sub-categories within the major commodity categories.

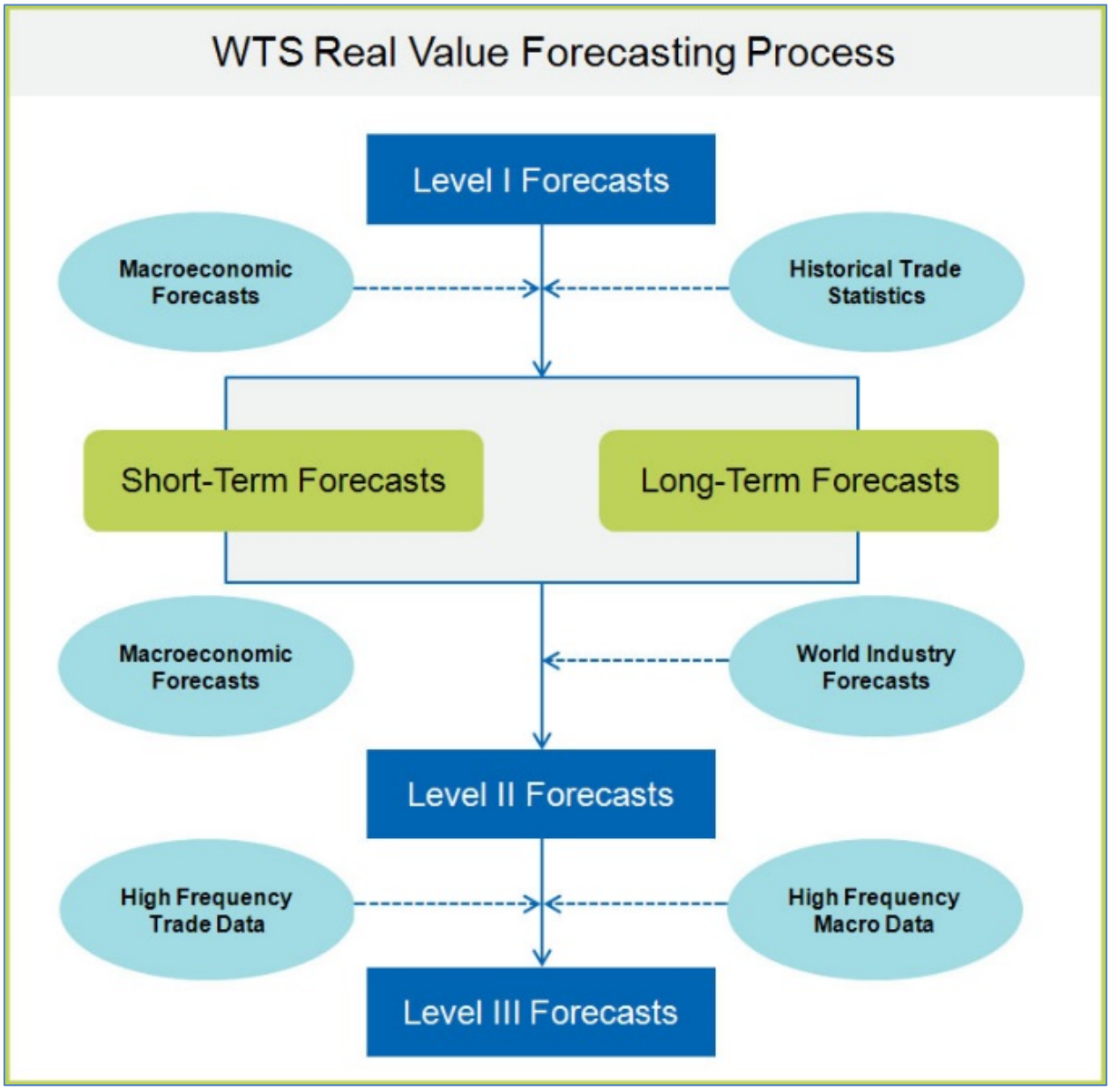


Figure 29 - World Trade Service Real Value Forecasting Process

3.2.2.2 American Energy Outlook

The American Energy Outlook (AEO) is a report on trends and projections for energy use and supply that is published annually by the U.S. Department of Energy's Energy Information Administration (EIA). The AEO is developed using the National Energy Modeling System (NEMS), an integrated model that aims to capture various interactions of economic changes and energy supply, demand, and prices, and it provides modeled projections of domestic energy markets through the year 2050. This forecast used the "reference" case, which assumes trend improvement in known technologies, along with a view of economic and demographic trends reflecting the current central view of leading economic forecasters and demographers. As of 2017, given the strong domestic production and relatively flat demand, the AEO projects that the U.S. becomes a net energy exporter (in most cases) between 2017 and 2050 (Appendix A – Economics, Section 3.2.2).

3.2.2.3 Chemical Imports and Exports

Data collected by the WCSC between the years of 1996 and 2014 was obtained. Foreign traffic was isolated, because domestic, barge traffic will not benefit from the channel deepening and widening (Appendix A – Economics, Section 3.2.3).

First, the compound annual growth rate (CAGR) for both imports and exports were calculated to identify trends in historical chemical tonnage. The calculations of CAGR for "2001" through "2015" resulted in growth rates of 1.18% for exports and 6.17% for imports. Since a large majority of Port imports are used as raw materials for the Port's exports, the Global Insight forecast prepared for Port of Houston was consulted to assist in projecting the growth of chemical import (Figure 30).

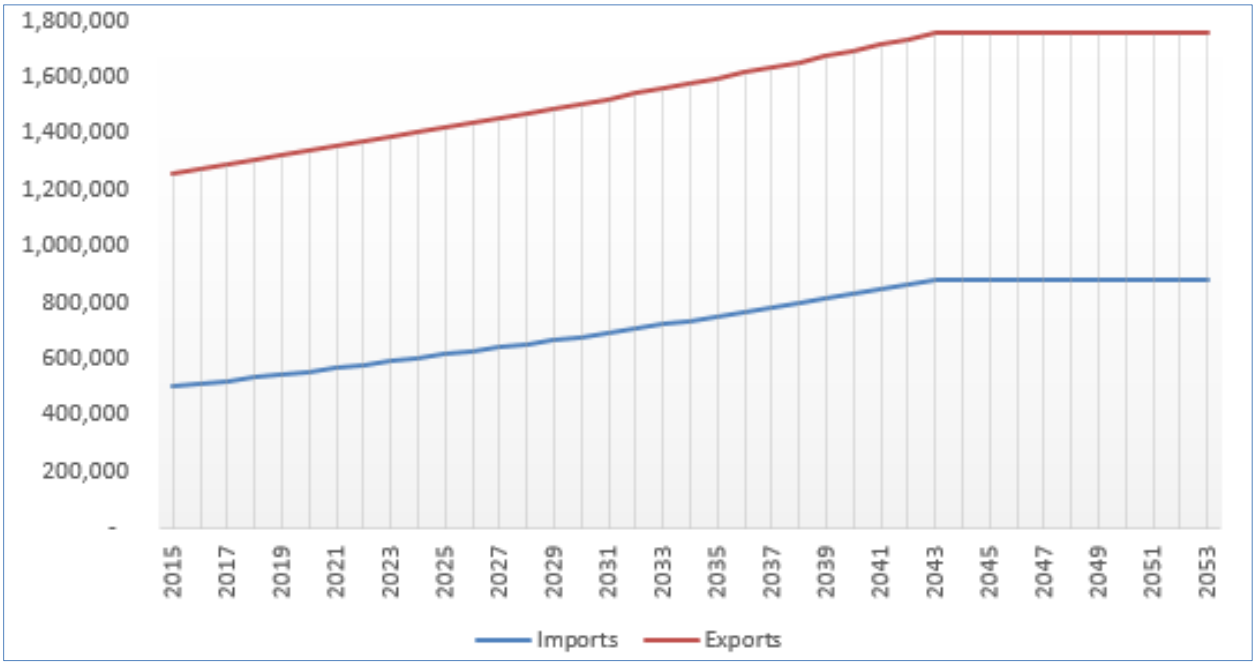


Figure 30 - MSC Chemical Tonnage Forecast (2015 - 2053)

3.2.2.4 Crude Oil and Condensate Exports

The export of petroleum products from the Port is a new type of commerce (Appendix A – Economics, Section 3.2.4). The 2017 AEO growth rates for petroleum product exports were applied to the baseline tonnage number, 2.6 million metric tons, to develop the forecast for crude oil and condensate exports (Figure 31).

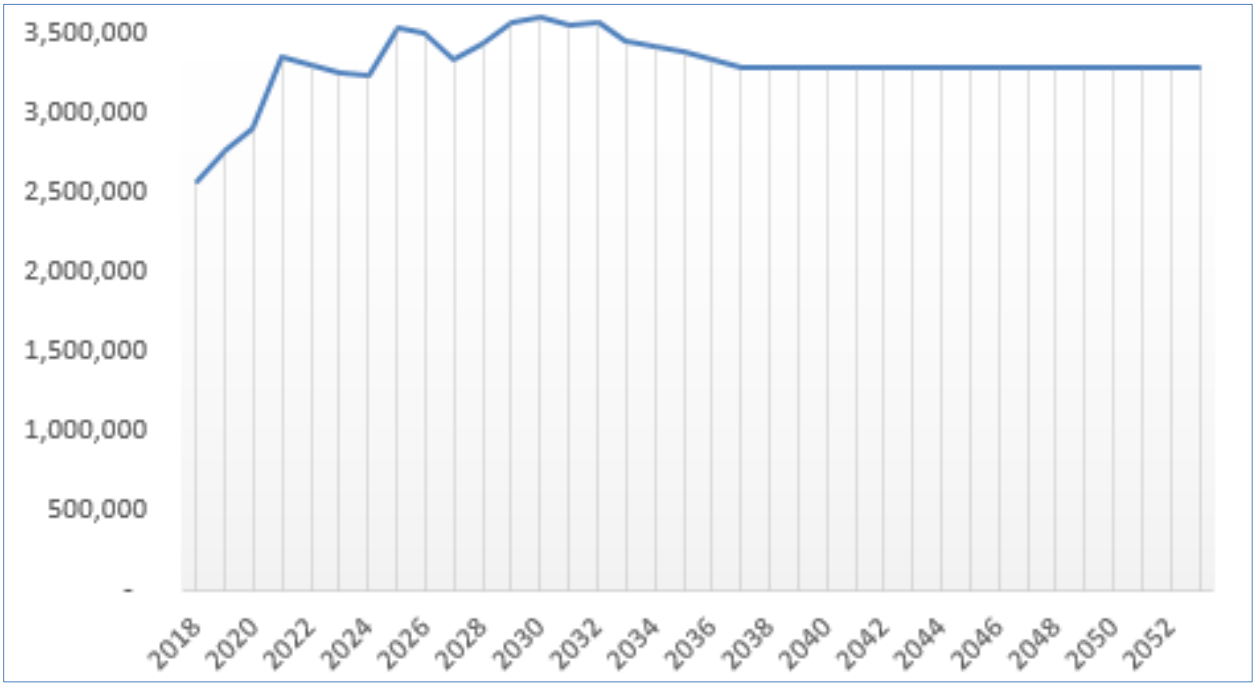


Figure 31 - MSC Crude Oil Tonnage Forecast (2015 – 2053)

For the period of analysis (2024 – 2073), the AEO's petroleum-product export-growth rates forecast ranges between -2% and 6% annually. In addition to negative growth forecasted by AEO beginning in in 2028, the baseline tonnage is adjusted downward to account for changes in output due to the Petro Nova project, which is projected to reach its highest level of output in the next ten years (2018-2028). The forecast is held constant after year 2039, the projected end of the Petra Nova project. It is assumed that after the end of the project, the pipeline would be repurposed, but due to the uncertainty, the forecast was capped.

3.2.2.5 Benefitting Tonnage Levels

Growth is capped in year 2043 and tonnage levels are held constant for chemical imports, chemical exports, and crude oil exports (Appendix A – Economics, Section 3.2.5). Growth rates were applied to the established baseline tonnage levels to obtain benefitting tonnage levels in three different decades, 2024, 2034, and 2044 (Figure 32). This commodity forecast is held constant in the FWOP and each of the FWP scenarios.

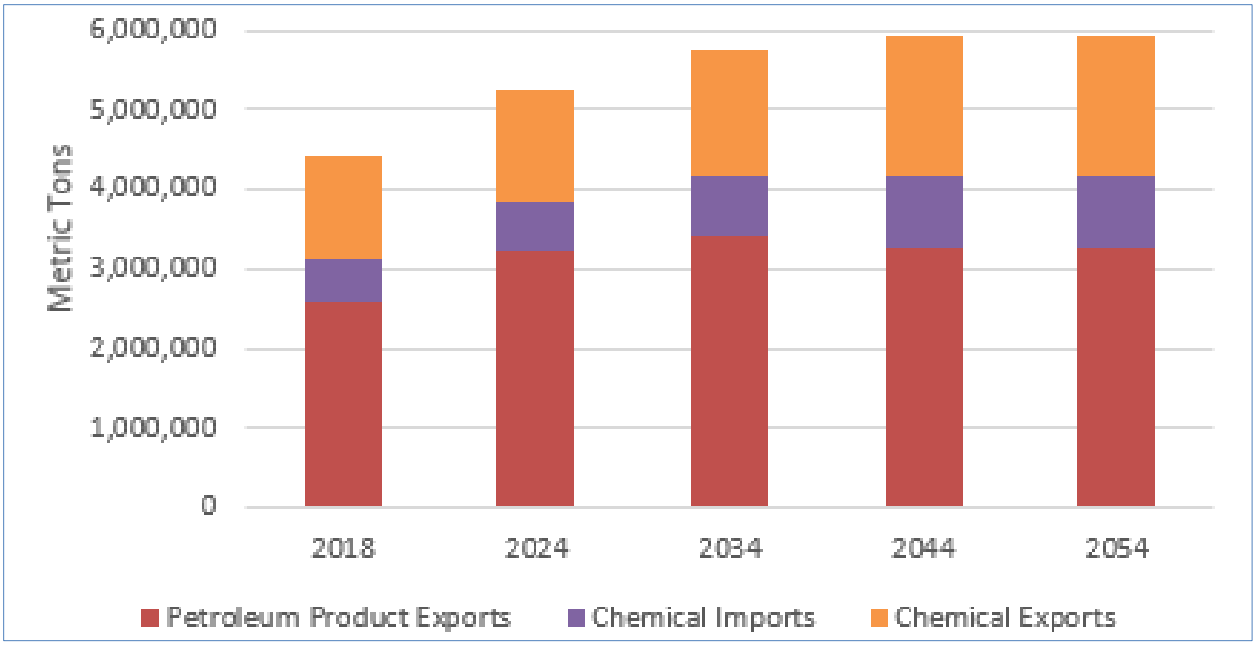


Figure 32 - MSC Benefitting Commodities Forecast by Decade

3.2.3 Design Vessel

The design vessel, the mid-sized Aframax tanker of 110,000 DWTs, is the largest vessel that is expected to call regularly in the FWP conditions (Appendix A – Economics, Section 3.4). Given the narrow dimensions of the existing channel and, as stated previously, the fact that the widest vessel that can physically fit into the channel is currently being used, the design vessel in this study is expected to be wider (and longer) than vessels currently calling at the Port. The largest vessel in the chemical fleet would remain the same as in the FWOP conditions. The largest vessel in the petroleum tanker fleet in the FWOP condition would remain a PT-PX2 (60,000-80,000 DWT). Though petroleum product exports do not have a long history at the Port, this type of vessel has called at the Port in the past. In the FWOP condition, the largest petroleum tanker calling at the Port is expected to transition from a 70,000 DWT petroleum tanker (PT-PX2) to a mid-size Aframax tanker (Figure 33).

Aframax tankers refer to tankers between 80,000 and 120,000 DWTs. These vessels are used extensively in non-OPEC (Organization of Petroleum Exporting Countries) companies that generally do not have the infrastructure to accommodate Very Large Crude Carriers (VLCCs) or Ultra-Large Crude Carriers (ULCCs). Also according to the EIA, this vessel size is popular with oil companies for logistical purposes, and therefore, many vessels have been built with these specifications. To validate the efficiencies of the Aframax tankers compared to the Panamax tanker, cost per ton calculations were completed using the Institute for Water Resources (IWR) Vessel Operating Costs. As

Table 14 shows, the Aframax (110,000 DWT) cost per ton is cheaper in each alternative depth when compared to the Panamax (70,000 DWT).

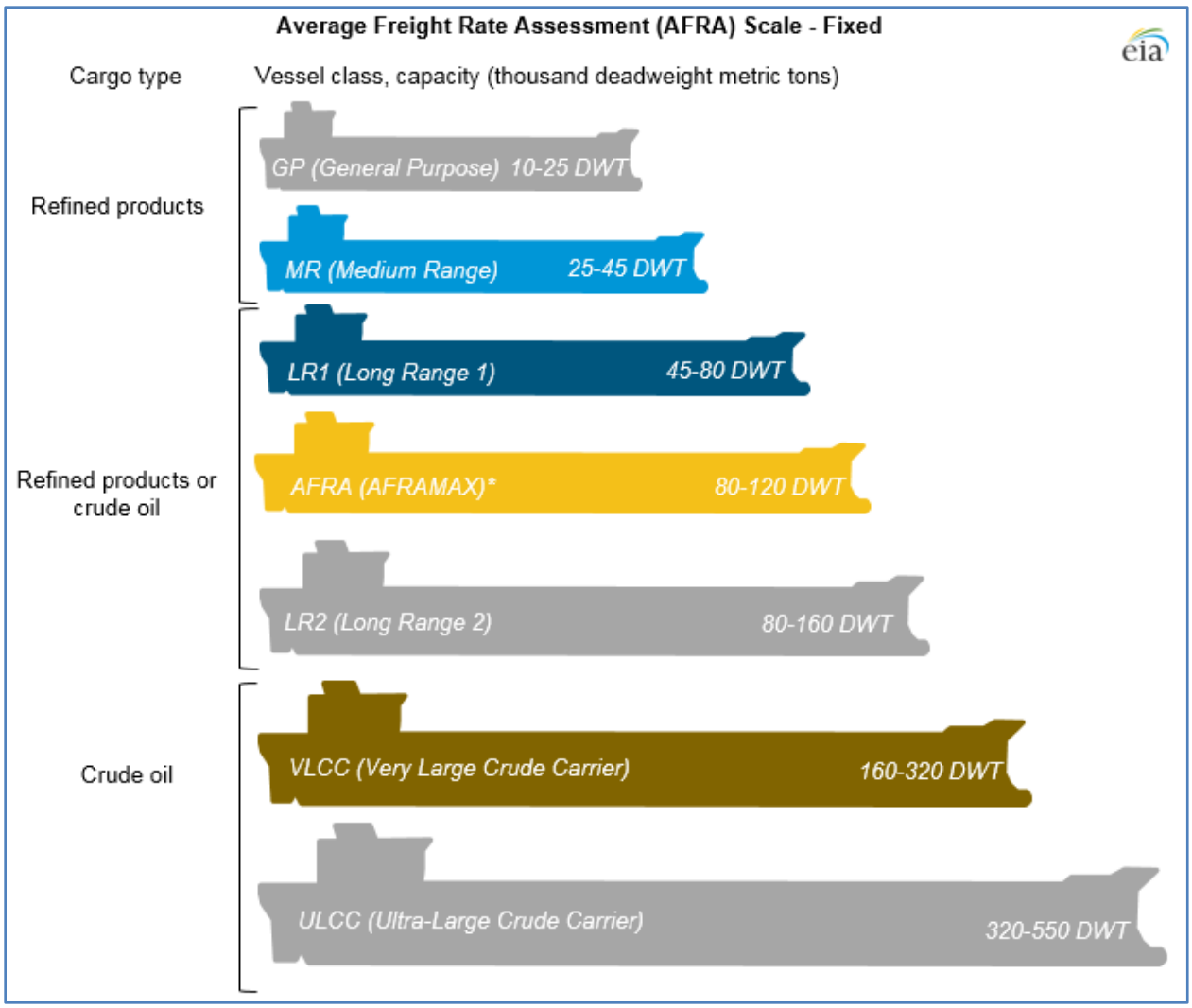


Figure 33 – Petroleum Tanker Average Freight Rate Assessment (AFRA) Scale

NOTE: Aframax is not an official vessel classification on the AFRA scale, but shown only for comparison.

Table 14 - Costs per Ton Aframax vs. Panamax

Channel Depth	-38’	-41’	-43’	-45’	-47’
Tonnage Carried Panamax	51,984	58,165	62,286	66,407	70,527
Cost per Ton Panamax	$11.41	$10.20	$9.52	$8.93	$8.41
Tonnage Carried Aframax	68,730	77,215	82,872	88,529	94,186
Cost per Ton Aframax	$10.64	$9.47	$8.83	$8.26	$7.77
Savings per Ton Aframax	$0.77	$0.73	$0.70	$0.67	$0.64

Aframax tanker new builds are increasing faster than Panamax tankers. As of 2017, 7% of the in-service tanker fleet is Panamax tankers. The percentage of new builds that were Panamax tankers increased by only 1%, but 20% of new builds were Aframax tankers (Table 15). The only vessel classes that showed an increase in new builds as compared to in-service vessels were the Aframax and the Suezmax (125,000 – 199,999 DWT) tankers.

Table 15 - Tankers in the 2017 World Fleet

Vessel Class	In Service	%	New Build	%	% Growth
Handy	1385	23	122	17	▼ -5
MR1	607	10	33	5	▼ -5
MR2	1602	26	161	23	▼ -3
PT Panamax	424	7	57	8	► 1
Aframax	939	15	140	20	▲ 4
Suezmax	472	8	101	14	▲ 7
VLCC	689	11	92	13	► 2
ULCC	2	.0003	0	0	► 0

In addition to the Aframax tanker class becoming a larger percentage of the world fleet and therefore more readily available, since the US is still a net importer of petroleum products, specifically crude oil, Aframax tankers delivering the crude oil to the Texas Gulf would be able to be chartered for backhaul. Therefore, the design vessel used for this analysis is a, 110,000 DWT petroleum tanker with average dimensions of 800’ LOA, 138’ beam, and a -49’ design draft.

(NOTE: This page intentionally left blank.)

3.3 Environmental Resources – Affected Environment

3.3.1 Wetlands

Estuarine tidal flats may decline due to relative sea level rise (RSLR) under the FWOP. However, new tidal flats may be created by wash-over from tropical storms/hurricanes.

Estuarine (saline and brackish) marshes may decline due to RSLR under the FWOP. However, new marshes may be created by wash-over from tropical storms/hurricanes. New marshes may also be created in Pass Cavallo due to long shore drift.

Estuarine scrub-shrub wetland would not be impacted under the FWOP. Black mangrove populations in Pass Cavallo and Port O'Connor would likely adjust to new elevations caused by long shore drift.

Fresh-intermediate wetlands and SAVs would not be impacted under the FWOP. (Appendix B – Environmental Resources, Section 3.10)

3.3.2 Submerged Aquatic Vegetation

The SAV community in the project area will not be affected under the FWOP, except for the beds in Keller Bay, which may be impacted if the southern shoreline is breached by erosion or tropical storm/hurricane wash-over. If the shoreline is breached ~250 acres of SAV could be permanently lost. (Appendix B – Environmental Resources, Section 3.10)

3.3.3 Aquatic Resources

The FWOP will not impact open-bay bottom habitats. Ongoing maintenance dredging and open-water placement may indirectly impact benthic and demersal species due to increased turbidity and burying of the benthos. No decrease in abundance is expected and any impacts would be temporary. (Appendix B – Environmental Resources, Section 3.12.)

3.3.3.1 Oysters

The FWOP will not impact oyster reefs. However, the ongoing maintenance dredging and open-water placement may indirectly impact oyster reef beds due to increased turbidity. (Appendix B – Environmental Resources, Section 3.12.3)

3.3.4 Wildlife

No direct impacts to wildlife would occur as a result of the No-Action Alternative. Continued commercial and residential development may result in loss of habitat for wildlife. Ongoing maintenance dredging and placement operations may result in increased turbidity in the bay and a resulting impact to aquatic species used as prey by coastal birds and other terrestrial wildlife species. (Appendix B – Environmental Resources, Section 3.11)

3.3.5 Threatened and Endangered Species

Ongoing maintenance dredging may impact some species of sea turtles. Hopper dredging may result in the mortality of Kemp's ridley sea turtles; however no Kemp's ridleys have been reported taken during dredging maintenance operations of the MSC since before October 2008

(USACE, 2018). Sea turtle avoidance measures would include an avoidance plan for hopper dredge impacts to sea turtles. This avoidance plan includes reasonable and prudent measures that have largely been incorporated in USACE regulatory and civil works projects throughout the Gulf for more than a decade. These measures include use of temporary dredging windows, when possible; intake and overflow screening; use of sea turtle deflector dragheads; observer reporting requirements; and sea turtle relocation/abundance trawling. (Appendix B – Environmental Resources, Section 3.13)

3.3.6 Essential Fish Habitat

The FWOP will not impact EFH. However, the ongoing maintenance dredging and open-water placement may indirectly affect EFH due to increased turbidity. Any indirect effects are expected to be temporary. (Appendix B – Environmental Resources, Section 3.12.4)

3.3.7 Air Quality

The FWOP does not include an increase in construction or dredging operations, and thus there is no expected increase in air-contaminant emission-sources. Air contaminants are likely to increase due to an increase in shipping traffic resulting from growth in existing businesses and new businesses.

Ongoing existing maintenance dredging activities will continue to contribute to air emission contaminants through the fuel combustion/exhaust of marine vessels, as will construction equipment on-shore, and local commuter vehicles. Maintenance dredging schedules are not expected to change from current timelines and no increase in emissions is expected from this activity. (Appendix B – Environmental Resources, Section 3.1)

3.3.8 Noise

The FWOP does not include widening or deepening of the existing ship channel. However, the existing maintenance dredging and operations of the channel will continue. A hopper dredge is typically used for a portion of the maintenance dredging operations. This type of dredge houses its equipment below deck and is likely to operate at noise levels similar to that of a large tugboat.

Permanent noise impacts are not expected under the FWOP. Dredging operations occur in the channel, which is a significant distance from the shoreline and sensitive receivers. The nearest receiver, at Magnolia Beach, is ~3,000’ from the channel. This distance will reduce the amount of noise output from the channel that is received at the shoreline. The existing noise levels in the project area range from 52.4 to 65.1 dBA (L_{dn}). The FWOP is not likely to result in short-term or permanent noise impacts. (Appendix B – Environmental Resources, Section 3.2)

Table 16 - Typical noise levels associated with dredging operations

Equipment	Noise Level (dBA)
Cutterhead Dredge (at 160 ft.)	79[1]
Hopper Dredge (at 50 ft.)	87[2]
Large Tug Boat (at 50 ft.)	87[3]
Small Tug Boat	72[3]
Bulldozer (at 50 ft.)	82[4]
Bucket Crane (at 50 ft.)	82[4]

[1] Geier and Geier Consulting, 1997
[2]Assumed to be the same as a large tug boat.
[3] Epsilon Associates, 2006
[4]Federal Highway Administration, 2006

3.3.9 Soils and Prime and Other Important Unique Farmland

Placement of dredged material in the upland PAs is the main driver of impacts to soils in the project area. The placement of maintenance material will continue under the FWOP, but is not expected to occur at an elevated rate, nor increase the impacts to soils. Commercial and residential development is another driver of impacts to local soils and is not expected to increase under the FWOP.

The FWOP would have no impact to Prime or Other Important Unique Farmland, (Appendix B – Environmental Resources, Section 3.6)

3.3.10 Energy and Mineral Resources

The FWOP condition would not cause any changes to the energy or mineral resources of the project area. As maintenance dredging continues under normal scheduled operations more sand and sediment would become available that could be used beneficially to counter natural shoreline erosion. (Appendix B – Environmental Resources, Section 3.5)

3.4 Cultural Resources

There are an estimated 113 cultural resources located within and along the MSC and the formation processes that currently affect these sites will continue into a future without the project. Undiscovered submerged cultural resources could be at risk from future maintenance dredging activities and shifting bars if these resources were to migrate into the channel. This could potentially occur if these resources are located outside of surveyed areas along channel margins, and migrate into the channel due to erosion or sloughing of channels at the side slope margins, or movement from other events such as storms. Upland historic and prehistoric sites will continue to be at risk from shoreline erosion and commercial, industrial, and residential development. These formation processes may result in partial or total loss of historic properties.

3.5 Environmental Engineering

3.5.1 Water and Sediment Quality

The effects on dissolved oxygen (DO) concentrations from the FWOP are not entirely clear. There are conflicting study results on whether or not the placement of maintenance material affects DO (Brown and Clark, 1968; Hopkins, 1972; May, 1973; Pearce, 1972; Wakeman, 1974; Windom, 1972). Temporary decreases in DO were found by May (1973) at the interface of the water and sediment at areas of mudflow, possibly due to the anaerobic nature of maintenance material.

The amount of turbidity resulting from dredging activities will be unchanged under the FWOP.

No changes to the quality of sediments are expected under the FWOP. Natural recovery through sedimentation will continue to areas with high levels of mercury concentrations in the area of the ALCOA (Point Comfort)/Lavaca Bay Superfund Site, as stated in the ROD for the ALCOA Superfund Site. (Appendix B – Environmental Resources, Section 3.9.3)

3.5.1.1 Currents and Circulation

No changes to the vessel channel depth or width would occur under the FWOP condition, and water movements would continue to follow historical trends. (Appendix B – Environmental Resources, Section 3.9.1)

3.5.1.2 Salinity

No changes to the vessel channel depth or width would occur under the FWOP condition, and changes in salinity would continue to follow historical trends. (Appendix B – Environmental Resources, Section 3.9.2)

3.5.2 HTRW Concerns

The FWOP condition does not include any expected impacts to hazardous materials in the project area. Maintenance dredging and placement would continue. Increased vessel traffic, resulting from growth in existing and/or new businesses, may slightly increase the possibility of spills resulting from accidents, but is not expected to differ from recent rates. (Appendix B – Environmental Resources, Section 3.8)

3.6 Geology and the Structural Setting

The FWOP condition is not likely to change in any significant way in either the geology or structural setting of the study area. (Appendix B – Environmental Resources, Section 3.4)

3.7 Socioeconomics

Detailed socioeconomic and demographic information characterizing industry, income, unemployment, age, and race in the study area can be located in Appendix A – Economics, Section 8. The deepening and widening of the channel is not anticipated to affect the distribution of these socioeconomic and demographic metrics within the study area.

3.7.1 Population Projections

Table 17 displays population estimates and projections for the counties in the area of the study as well as for the state overall. The state and each of the counties surrounding the study area are projected to experience positive growth between 2016 (the US Census Bureau's latest estimate) and 2050. Between these years, the annual growth rate is forecasted to be 1.2% for the state of Texas, 1.1% in Calhoun County, 0.2% in Jackson County, and 0.6% in both Matagorda and Victoria Counties. The deepening and widening of the MSC is not anticipated to affect the population growth in these areas. (Appendix A – Economics, Section 8)

Table 17 - Population Projections through 2050[9]

Geographic Area	2010 Population Estimate	2016 Population Estimate	2020 Population Projection	2030 Population Projection	2040 Population Projection	2050 Population Projection
State of Texas	**25.1 million**	**27.0 million**	**28.8 million**	**32.7 million**	**36.6 million**	**40.5 million**
Calhoun Co.	**21,381**	**21,805**	**23,935**	**26,659**	**29,203**	**31,666**
Jackson Co.	**14,075**	**14,678**	**14,663**	**15,200**	**15,441**	**15,649**
Matagorda Co.	**36,702**	**36,719**	**39,448**	**41,823**	**43,482**	**44,774**
Victoria Co.	**86,793**	**90,989**	**93,902**	**100,465**	**105,735**	**110,868**
MSC Region Total	**158,951**	**164,191**	**171,948**	**184,147**	**193,861**	**202,957**

[9] Source: US Census Bureau, Population Division (2000, 2010 Estimates); US Census Bureau, 2012-2016 American Community Survey 5-Year Estimates (2016 Estimate); Texas State Data Center, the University of Texas at San Antonio (2020, 2030, 2040, 2050 Projections)

(NOTE: This page intentionally left blank.)

4 Plan Formulation – Step 3

Plan formulation is the process of building alternative plans that meet planning objectives, and avoid planning constraints. Combinations of management measures make up alternative plans, and are defined is sufficient detail, that realistic evaluation and comparison of each plan's contributions to the objectives, and other effects, can be identified, measured, and considered.

To recap from Chapter 1, opportunities exist to:

- Modify the existing designed channel such that it can accept vessels whose drafts are greater than -38'.
- Modify the existing designed channel such that deeper draft vessels can come into the Port fully loaded.
- Modify the existing designed channel such that deeper draft vessels do not have split their cargoes before coming to the Port.
- Modify the existing designed channel such that it can accept vessels moving in both directions simultaneously.
- Modify the existing designed channel such that the Pilots feel it is safe for themselves, vessel's crews, and the environment to move these, and larger vessels, during nighttime hours.
- Modify the existing turning basin such that it can accept larger vessels with larger transport capacities.

Specific Study Planning Objectives

- Improve the navigational efficiency of the deep-draft navigation system over the period of analysis (2024 – 2073)
- Improve the operational safety of the deep-draft navigation system over the period of analysis (2024 – 2073)

Specific Planning and Institutional Constraints

Planning Constraints

- Avoid the Alcoa Corporation (Alcoa) Superfund Site

Institutional Constraints

- Plans must be consistent with existing Federal, State, and local laws
- Plans must include a Least Cost DMMP that includes environmentally suitable PAs
- Plans should include a Least Cost DMMP that includes the use the beneficial use (BU) of dredged material, if possible

4.1 Description of Preliminary Management Measures

After the problems, opportunities, objectives, and constraints were agreed upon by the PDT (USACE and the NFS), the PDT brainstormed management measures (measures). They came up with four non-structural and five structural measures (Table 18).

A measure is defined as a means to an end; an act, step, or procedure designed for the accomplishment of an objective. In other words, a measure is a feature (structure), or an activity, that can be implemented at a specific geographic site to address one or more planning objectives. Measures are the building blocks of alternative plans and are categorized as structural and non-structural. Equal consideration was given to these two categories of measures during the alternative planning process.

Table 18 - Preliminary Management Measures

Measure Name	Non-Structural or Structural
Modification to Pilot's Rules	**Non-Structural**
Modification to Tug Assist	**Non-Structural**
Split Deliveries	**Non-Structural**
Light Loading	**Non-Structural**
Deepening of Existing Channel	**Structural**
Widening of Existing Channel	**Structural**
Vessel Passing-lane	**Structural**
Turning Basin Modifications	**Structural**
New Turning Basin	**Structural**

4.1.1 Non-structural Measure

The P&G [2.1.4 Definitions] describes non-structural management measures as "A modification in public policy, an alteration in management practice, a regulatory change, or a modification in pricing policy that provides a complete or partial alternative plan for addressing water resources problems and opportunities."

1. **Modification to Pilot's Rules** – This non-structural measure would consist of modifying the current pilot's rules, as practicable, to allow for more efficient loading and maneuvering of vessels within the bay. Daylight and calm weather (winds less than 15 knots) transit only.
2. **Modification to Tug Assist** – This non-structural measure consists of increasing the numbers of tugs (from two to four tugs) currently used to safely escort (pull / push) the design vessel (Section 3.2.3 Design Vessel).
3. **Split Deliveries** – This non-structural measure consists of shipping and / or receiving large loads on two or more vessels.
4. **Light Loading** – This non-structural measure consists of loading the design vessel below its maximum storage capacity. This practice allows some vessels (not all) to transit the channel; however, it limits the vessel's full draft capability leading to more overall vessel calls.

4.1.2 Structural Measures

The *IWR Report 10-R-4, Deep-Draft Navigation*, dated April 2010, defines structural measures as “Certain physical measures…designed by engineers.” Like non-structural measures, structural measures may be used in combination with other measures, or independently.

1. **Deepening of Existing Channel** – This structural measure consists of dredging the existing MSC deeper, by two-foot increments, from -41’ in the Main Channel, and from the existing -43’ in the Entrance Channel.

   NOTE: The Entrance Channel would include an additional three feet in advanced maintenance, and an additional two feet in allowable over-depth. The Main Channel would include an additional two feet in both advanced maintenance and allowable over-depth. This means that whichever depth is determined to be part of the NED plan, the actual Entrance Channel would be dredged approximately five feet deeper, and the Main Channel would be dredged approximately four feet deeper (Figure 34 and Figure 35).

2. **Widening of Existing Channel** – This structural measure consists of widening the existing MSC Entrance Channel from its current width of 300’ to 600’, and from its current width of 200’ to 350’ in the Main Channel. These widths were determined as follows:

   In 2009, the NFS completed the *Final Environmental Impact Statement for the Proposed Matagorda Ship Channel Improvement Project, Calhoun and Matagorda Counties, Texas*. This EIS used a Liquid Natural Gas Carrier (LNGC) as the design vessel. This LNGC has a LOA of 983.0’ and a beam of 151.0’. It was determined that the optimum Main Channel width for this LNGC to be 350’. Since the design vessel for this study is a mid-sized Aframax tanker with a maximum LOA of 810.0’, and a maximum beam of 138.0’, the USACE judged that using the same beam for the Aframax tanker would be an acceptable cost and schedule risk.

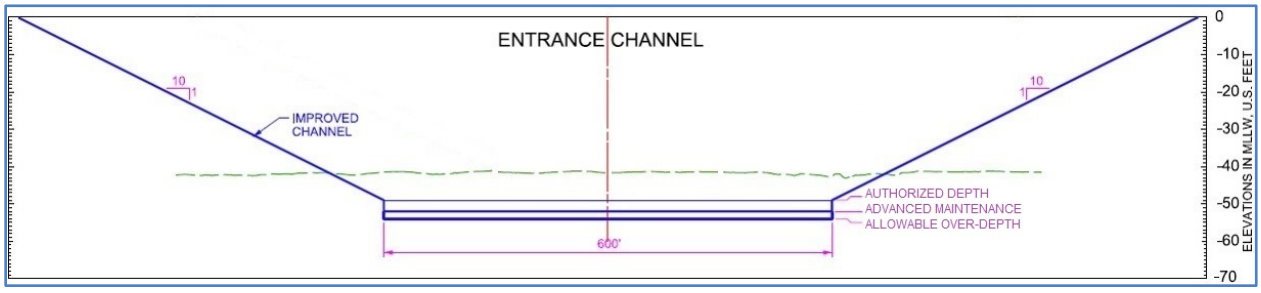


Figure 34 - Drawing of Entrance Channel Cross Section

USACE discussed with the Pilots the proposed bottom width of the Entrance Channel. Currently the Entrance Channel is 1.5 times the width of the Main Channel, so an Entrance Channel 1.5 times the bottom width of the proposed Main Channel (350’) would be 525’.

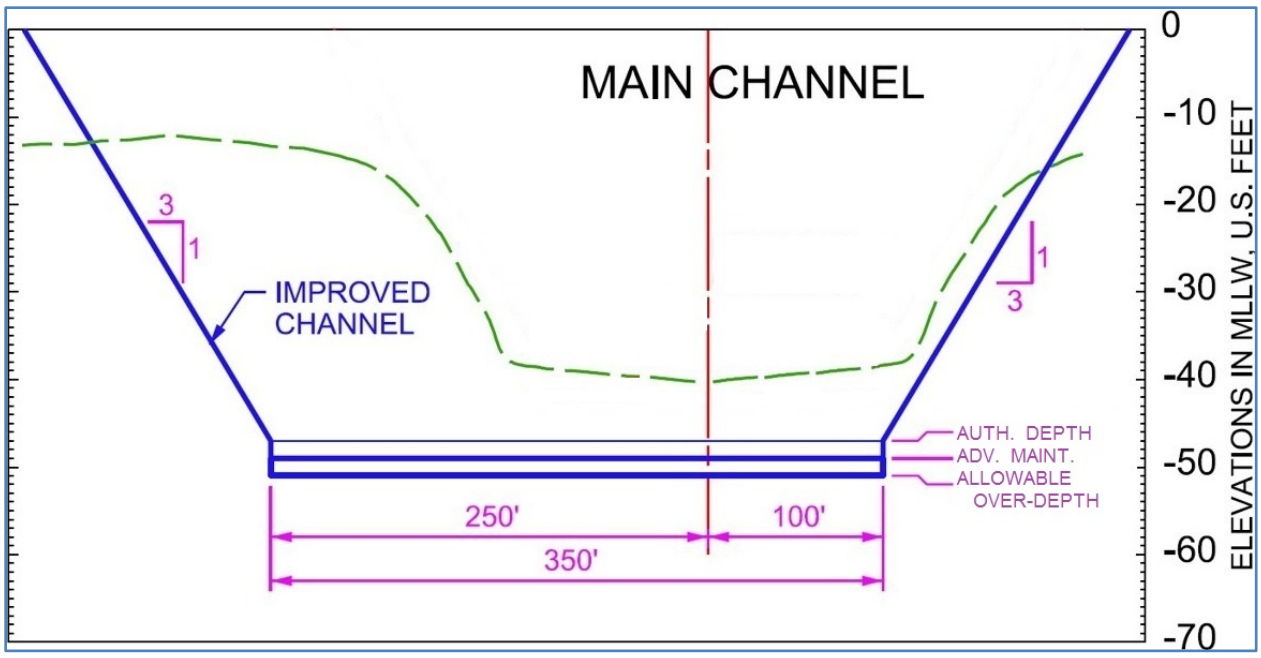


Figure 35 - Drawing of Main Channel Cross Section

However, because the MSC Entrance Channel is considered the most dangerous Entrance Channel in the US, for safety reasons, the USACE and Pilots decided to increase the evaluated Entrance Channel bottom width to 600'.

NOTE: Per current engineering standards, the Entrance Channel would include slopes of 1V:10H, with the slopes of the Main Channel being 1V:3H (Figure 34 & Figure 35).

3. **Vessel Passing-lane** – This structural measure consists of widening a portion of the single lane channel towards the mid-point of the Main Channel such that vessels heading towards the public port facilities could pull over and stop to the side, in order to allow a vessel returning to the Gulf to pass. The vessel stopped in the vessel passing-lane would then continue on to the public port facilities (Figure 36).

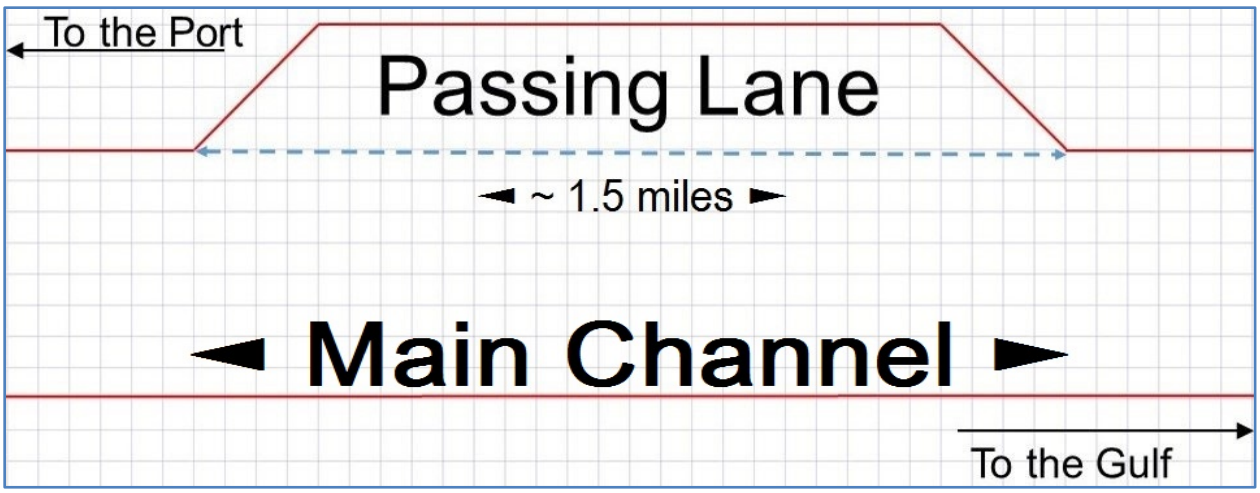


Figure 36 - Drawing of Vessel Passing-lane

4. **Modification of Existing Turning Basin** – This structural measure consists of physically expanding the existing 1,000’ by 1,000’ by -47’ deep turning basin at Point Comfort, to 1,200’ by 1,200’, and by the new economically justified depth for the design vessel. Modifying the existing turning basin would be in lieu of creating a new turning basin.
5. **New Turning Basin** – This structural measure consists of dredging a new 1,200’ diameter turning-basin to the northwest side of the ship channel at STA 114+004.58 where the channel curves into the existing turning basin / port.

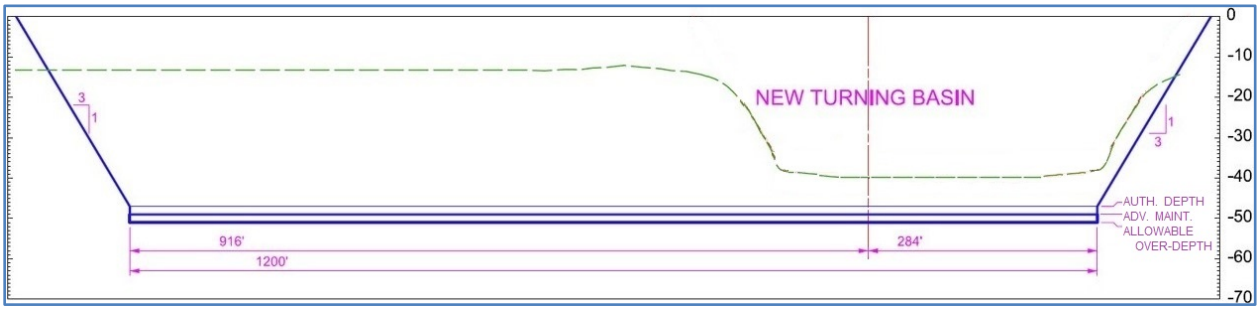


Figure 37 - Drawing of New Turning Basin Dimensions

The depth of the new turning basin would be the new economically justified depth for the design vessel (Figure 37). The new turning basin would be in lieu of modifying the existing turning basin.

NOTE: The new turning basin would include an additional two feet in both advanced maintenance and allowable over-depth. This means that whichever depth is determined to be part of the NED plan, the actual turning basin would be dredged approximately four feet deeper.

4.2 Preliminary Evaluation and Screening of Management Measures

The USACE and the NFS, with the assistance of the Pilots, conducted a preliminary screening of management measures to evaluate the applicability of each measure, and the potential for each measure to contribute to the study's specific planning objectives consistent with planning constraints.

First, each measure was identified as either meeting a specific study objective (**Yes**) or failing to meet a specific planning objective (**No**) (Table 19). Those measures that did not meet study objectives were removed from further consideration.

Table 19 – Screening of Preliminary Management Measures with the Planning Objectives

Measure Name	Planning Objectives	
	Improve Navigational Efficiency	Improve Safety
Modification to Pilot's Rules	No	No
Modification to Tug Assist	No	No
Split Deliveries	No	No
Light Loading	No	No
Deepening of Existing Channel	Yes	Yes
Widening of Existing Channel	Yes	Yes
Vessel Passing-lane	Yes	Yes
Turning Basin Modifications	Yes	Yes
New Turning Basin	Yes	Yes

The Pilots indicated that the current Pilot's Rules have evolved over the years as commodities have changed, and vessels have been built increasingly larger. Those rules have been tried and tested over time, and under different weather and sea conditions.

The pilot's best judgment is that this modification of the pilot's rules would allow vessels the size of an Aframax to call at the MSC only ~60 days out of every year. The pilot's best judgment is that even with doubling the number of tugs necessary to stop, turn, and reverse an Aframax tanker into the Port; it would not be safe for the crew, the Pilots, the Port facilities, or the bay. It would be too dangerous. The USACE concurred with this assessment.

Split deliveries and light loading are already happening with Panamax tankers, which are smaller than the mid-sized Aframax tanker. Economics dictate that if split loading or light loading of Aframax tankers were economically justified, companies would have tried this.

Second, each measure was discussed with the Pilots and the results are explained below.

Deepening of the Existing Channel – Deepening the existing channel to at least -41' would allow Aframax tankers to utilize Point Comfort to some extent. Deeper depths would allow Aframax tankers to increase their loads without the danger of grounding. The PDT, using best professional judgment, determined that deepening the channel alone would not be safe for crew or pilots. Therefore, deepening the channel alone would not be a complete alternative plan in, and of, itself.

Per IWR Report 10-R-4, Deep-Draft Navigation, "the depth of a channel section should first be analyzed using two to three foot increments and then narrowing it down to one foot increments." The USACE decided to start with a minimum depth of -41' and a maximum depth of -51' for economic evaluation.

Widening of the Existing Channel – The USACE determined that widening the channel, without also increasing the channel's depth, would not allow Aframax tankers to utilize the MSC, since depth is the limiting factor for the design vessel. Therefore, widening the channel alone would not be a complete alternative plan in, and of, itself.

The Pilots were asked whether they felt that a 600' Entrance Channel was sufficient for two vessels to meet and pass. They expressed the opinion that due to the strong currents between the jetties, it would not be safe for vessels to pass regardless of their size (beam). In the outer part of the Entrance Channel, that section out in the Gulf, the National Association of Navigational Congress Rule states that two vessels may pass as long as their combined beam is less than 54% of the channel bottom width (54% Rule). For the Gulf section of the Entrance Channel, as long as the combined beam of two vessels is less than 324' (600' x .54), the Pilots are comfortable allowing two vessels to meet and pass each other.

For the Main Channel, the Pilots would also use the 54% Rule to determine whether to allow to vessels to meet and pass each other. For the Main Channel, the combined beam of two vessels would need to be less than 189' (350' x .54).

Vessel Passing-Lane – The Pilots were asked their opinion on where along the MSC a vessel passing-lane would be most effective. They indicated that centering it between the GIWW and the turn near STA 97+000 would be the best place, as this was in the straightaway. When asked what size of passing lane would be required to move the typical sized vessels out of the way of oncoming traffic in order to wait for the channel to clear, the Pilots said that the lane would need to be ~1.5 miles in length and at least 100' wide. That length would be required to move vessels over, slow down or slow to a complete stop, and then to get back up to speed in order to reenter the Main Channel. The Pilots requested additional time to confer among themselves as to the utility of dredging a vessel passing-lane.

The USACE concurred, and this measure was kept for inclusion in alternative formulation. It was acknowledged, at the preliminary measures evaluation and screening meeting, that dredging a vessel passing-lane without also increasing the channel's depth, would not allow Aframax tankers to utilize the MSC, since depth is the limiting factor for the design vessel. Therefore, dredging a vessel passing-lane alone would not be a complete alternative plan in, and of, itself.

Modification of the Existing Turning Basin –Enlarging the existing turning basin by ~200' in width on two sides would cost more than dredging a new 1,200' in diameter by -41'+ deep turning basin (Section 4.1.2 Structural Measure #5). The six public barge berths, the multi-purpose dock, the barge staging area, and both liquid cargo piers would have to be torn down and reconstructed. The control center for the liquid cargo piers would most likely have to be re-centered to the south. Overall costs make this structural measure inefficient.

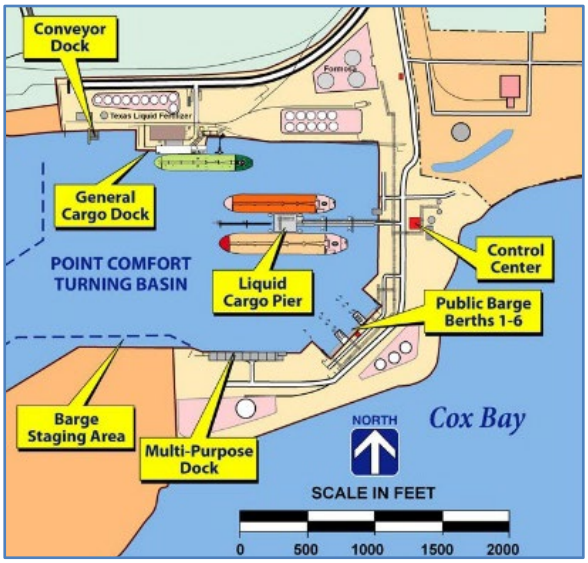


Figure 38 - Existing Turning Basin (Drawing)

Figure 39 - Existing Turning Basin (Aerial)

In addition to the high costs of modifying the existing turning basin, PA-19 is located to the southwest of the barge staging area and multi-purpose dock. PA-19 is a confined upland site and if the turning basin were enlarged, this PA would have to be relocated, incurring additional costs to the modification.

New Turning Basin – The USACE and the Pilots used the USACE navigation safety guidelines to determine that the smallest turning basin, necessary for an Aframax tanker to safely turnaround, is 1,200' in diameter (Figure 37 & Figure 40). This turning basin would be located at the turn from the Main Channel into the Port, at STA 114+004.58. This would allow Aframax tankers to turn around and back into the Port, with the same kind of tug assist that smaller vessels now use.

USACE determined that dredging a new turning basin, without also increasing the channel's depth and width, would still not allow Aframax tankers to utilize the MSC, since depth is the limiting factor for the design vessel. Therefore, a new turning basin alone would not be a complete alternative plan in, and of, itself.

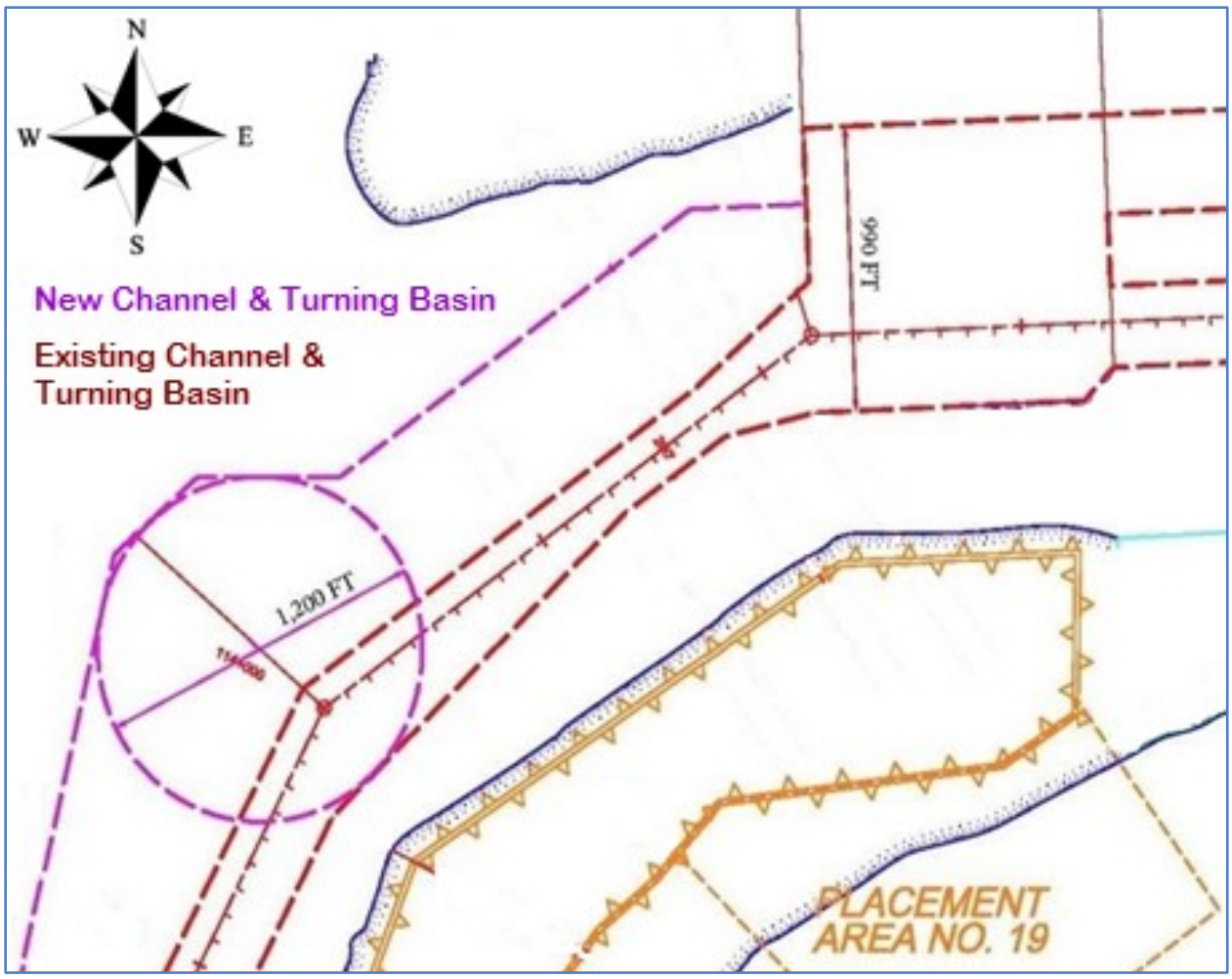


Figure 40 - New Turning Basin Site

4.3 Preliminary Management Measures Eliminated From Further Study

To recap, non-structural measures to channel improvements, such as split deliveries, light loading, and changes to either pilot regulations or tug assistance, were not considered viable for further channel improvement evaluation because these practices have already been implemented to the extent practicable, in response to the current limitations in channel depth, width, and water velocities.

- No non-structural measure, singly or in combination with any other management measure(s), meets the purpose, and needs, of the proposed project.
- No non-structural measure, singly or in combination with any other management measure(s), addresses the constraint of channel depth.
- No non-structural measure, singly or in combination with any other management measure(s), addresses the unique characteristics of the commodities imported / exported through the channel.

Modification of the existing turning basin would cost more, for no additional benefits, than would dredging a new turning basin of the appropriate size and depth. Therefore, this structural measure was removed from further consideration.

4.4 Preliminary Management Measures Carried Forward for Further Study

All structural measures, except modification of the existing turning basin, were carried forward for further study.

Table 20 - Preliminary Management Measures Carried Forward for Further Study

Measure Name	Improve Navigational Efficiency	Improve Safety
Deepening of Existing Channel	**Yes**	**Yes**
Widening of Existing Channel	**Yes**	**Yes**
Vessel Passing-lane	**Yes**	**Yes**
New Turning Basin	**Yes**	**Yes**

4.5 Description of Preliminary Alternative Plans

This section addresses the Alternatives Section in a NEPA document, per 40 Code of Federal Regulations (CFR) 1502.10 "Recommended format."

The USACE and NFS combined the remaining structural management measures into two alternative plans, Alternative Plan A and Alternative Plan B. Both alternative plans include the same channel widths of 350' and 600' (Main Channel & Entrance Channel) and the new 1,200' diameter-turning basin. Alternative Plan A does not include the passing-lane, but Alternative Plan B does. The depths for both Alternative Plan A and Alternative Plan B were scaled to start at a depth of -41' (Main Channel) and increased to a depth of -51', in two-foot increments (Table 21). Note that the depth of the Entrance Channel for all scales includes an additional two feet of dredging for depth. So 'Alternative Plan A at -41' ' is a -41' deep Main Channel with a -43' deep Entrance Channel. This is clearly shown in Figure 7, but is shortened for the remainder of the report for simplicity.

Table 21 – Preliminary Array of Alternative Plans

Alternative	Depth Main / Entrance (MLLW)	Width Main / Entrance	Turning Basin	Passing Lane
No Action Plan	-38' / -40'	200' / 300'	~1,000'	NO
A	-41' / -43'	350' / 600'	1,200'	NO
	-43' / -45'	350' / 600'	1,200'	NO
	-45' / -47'	350' / 600'	1,200'	NO
	-47' / -49'	350' / 600'	1,200'	NO
	-49' / -51'	350' / 600'	1,200'	NO
	-51' / -53'	350' / 600'	1,200'	NO
B	-41' / -43'	350' / 600'	1,200'	YES
	-43' / -45'	350' / 600'	1,200'	YES
	-45' / -47'	350' / 600'	1,200'	YES
	-47' / -49'	350' / 600'	1,200'	YES
	-49' / -51'	350' / 600'	1,200'	YES
	-51' / -53'	350' / 600'	1,200'	YES

4.5.1 No Action Plan

The Council on Environmental Quality (CEQ) regulations (40 CFR 1500–1508) for implementing NEPA do not define the "No Action Alternative," stating only that NEPA analyses shall "include the alternative of No Action" (40 CFR 1502.14).

The USACE regulations [33 CFR 325 9.b (5) (b)] define the No Action Plan as "one which results in no construction requiring a USACE permit,"

For purposes of this integrated feasibility report and EIS, under the No Action Plan, the USACE would implement no changes to the existing federally authorized deep-draft navigation channel (Main Report, Section 1.6.2 Description of the Currently Authorized Project). FWOP conditions are expected. The current Pilot's Rules would be neither alleviated nor reduced.

4.5.2 Alternative Plan A

Table 22 - Alternative Plan A

Alternative	Depth (MLLW)	Width Main / Entrance	Turning Basin	Passing Lane
A	-41’	350’ / 600’	1,200’	NO
	-43’	350’ / 600’	1,200’	NO
	-45’	350’ / 600’	1,200’	NO
	-47’	350’ / 600’	1,200’	NO
	-49’	350’ / 600’	1,200’	NO
	-51’	350’ / 600’	1,200’	NO

4.5.3 Alternative Plan B

Table 23 - Alternative Plan B

Alternative	Depth (MLLW)	Width Main / Entrance	Turning Basin	Passing Lane
B	-41’	350’ / 600’	1,200’	YES
	-43’	350’ / 600’	1,200’	YES
	-45’	350’ / 600’	1,200’	YES
	-47’	350’ / 600’	1,200’	YES
	-49’	350’ / 600’	1,200’	YES
	-51’	350’ / 600’	1,200’	YES

4.6 Screening of Preliminary Alternative Plans

The USACE and the NFS, with the assistance of Pilots, conducted a preliminary screening of the No Action Plan, Alternative Plan A, and Alternative Plan B on September 28, 2017.

The group also did a short brainstorming session for additional management measures to address the problems and meet study objectives. The group agreed that there were no more measures to be considered.

4.6.1 No Action Plan

The MSC would remain a -38’ deep navigation channel with its current maintenance-dredging program. The restrictive depth and width of the MSC would continue to prevent some vessels from entering with full loads, and prevent the use of the channel by some large vessels altogether.

It is assumed that the current commodities (petroleum and petroleum products, fertilizers, other chemicals and their related products) would also remain the same.

Because the No Action Plan does not address the problems, nor does it meet study objectives, the No Action Plan was removed from further evaluation and comparison, leaving the various scales of Alternatives A to be evaluated and compared.

4.6.2 Alternative Plan A

Alternative Plan A at the six different scales (41’, -43’, -45’, -47’, -49’, and -51’) was carried forward for plan evaluation and comparison.

4.6.3 Alternative Plan B

At the initial meeting, where the management measures were screened, the Pilots requested additional time to confer about the utility of dredging a vessel passing-lane where one on-coming vessel could move aside to allow another vessel to pass.

At this subsequent meeting, the Pilots expressed their opinion that dredging a vessel passing-lane would not increase efficiencies in vessel movements into, or out of the Port. While vessels of various sizes occasionally anchor in the Gulf waiting for another vessel to exit the MSC, it is a very rare event for two large vessels to be at the Port at the same time. The Pilots do not expect this to change. The USACE and NFS concurred.

Therefore, Alternative Plan B at all six different scales was removed from further evaluation and comparison, leaving the various scales of Alternative Plan A to be evaluated and compared.

4.7 Evaluation and Comparison of Alternative Plans – Step 4

Normally at this stage of a Civil Works study, there are multiple alternative plans to evaluate. The MSC, Texas, study is unique in that at this stage of the study the only alternative plan remaining is Alternative Plan A.

Cost estimates were generated for Alternative Plan A at the -41’, -47’, and -51’ depths.

The cost estimates were prepared using MII ver. 4.3, Unit Price Book, labor rates, and equipment rates for Region 6, and fiscal year (FY) 2015 (Table 24). The estimate was prepared in accordance with ER 1110-2-1302 Civil Works Cost Engineering, dated September 15, 2008. The Abbreviated Risk Analysis was developed with the participation of the USACE in October 2017. Because the total project cost is over $40 million dollars, a formal risk analysis (Crystal Ball) is required.

Table 24 – Total Project Cost Estimate for Alternative Plan A at three depths

Construction Item	Cost at -41'	Cost at -47'	Cost at -51'
01 - Lands and Damages	$162,500	$162,500	$162,500
02 - Relocations	$57,694,675	$57,694,675	$57,694,675
06 - Fish and Wildlife	$26,055,650	$26,055,650	$26,055,650
12 - Navigation	$227,651,900	$323,605,475	$417,135,875
Subtotal	$311,564,725	$407,518,300	$501,048,700
Construction Management (E&D, S&A)	$43,596,300	$57,029,800	$70,124,075
TOTAL PROJECT COST	**$355,161,000**	**$464,548,100**	**$571,172,775**
E&D – Engineering and Design, S&A - Supervision and Administration			
Direct Construction Costs are based on Oct 2017 Price Level, and Total Fully Funded Project Cost is based on an average escalation of 6.8%, based on the CWCCIS Rates			

The cost for Alternative Plan A at the -43' depth was extrapolated from the -41' and -47' costs.

It was understood that the existing public port facilities are designed for a water depth of -47', plus two feet allowance for advanced maintenance and two feet for allowable over-dredge depth. Any deepening beyond -47'+ -2'+ -2' would require a modification to the Port's foundation and supporting structures. The initial cost for the -49' depth was extrapolated from the -47' and -51' costs, and then the cost for the Port modifications was added. The final cost for the -51' depth also included the costs for the Port modifications.

4.8 Comparison of the Scales / Sizes of Alternative Plan A – Step 5

Normally at this stage of a Civil Works study, there are multiple alternative plans to compare to each other. The MSC, Texas, study is unique in that at this stage of the study the only alternative plan remaining is Alternative Plan A.

This section describes the economic analysis completed to calculate the NED benefits of each of the deepening (and associated widening) measures that were carried forward for this study. The study measures increase shipping efficiency, leading to a reduction in the total cost of commodity transit, which translates to NED benefits. NED benefits were estimated by calculating the reduction in transportation costs for each project depth using the HarborSym Modeling Suite of Tools (HMST) developed by the IWR. The HMST reflects USACE guidance on transportation cost savings analysis. Within The HMST is described in detail, including the inputs required and their application in the study in Appendix A - Economics, Section 4.

4.8.1 Methodology

Channel improvements result in reduced transportation cost by allowing a more efficient future fleet mix and less wait time when traversing the channel, resulting in at-sea and in-port cost savings. The HMST was designed to allow users to model these benefits (Appendix A – Economics, Section 4.1).

Channel restrictions limit a vessels capacity by limiting its draft. Deepening the channel reduces this constraint and the vessel's maximum practicable capacity increases towards its design capacity. This increase in vessel capacity results in fewer vessel trips being required to transport the forecasted cargo. HarborSym allows for detailed modeling of vessel movements and transit rules on the waterway.

To begin, HarborSym was setup with the basic required variables. To estimate OD cost saving benefits (or the reduction in transit costs associated with a drop in the total number of port calls caused by deeper loading or the use of a more efficient fleet mix), the BLT, a module within the HMST, was used to generate a vessel call list based on the commodity forecast at the MSC for a given year and available channel depth under the various alternatives. The resulting vessel traffic was simulated using HarborSym, producing average annual vessel OD transportation costs. The TSP was identified by considering the highest net benefit based on the OD transportation cost saving benefits (Appendix A - Economics, Section 4.1).

4.8.1.1 HarborSym Model

IWR developed HarborSym as a planning level, general-purpose model to analyze the transportation costs of various waterway modifications within a harbor (Appendix A – Economics, Section 4.1.1). HarborSym is a Monte Carlo simulation model of vessel movements at a port for use in economic analyses. While many harbor simulation models focus on landside operations, such as detailed terminal management, HarborSym instead concentrates on specific vessel movements and transit rules on the waterway, fleet and loading changes, as well as incorporating calculations for both within harbor costs and costs associated with the ocean voyage.

HarborSym represents a port as a tree-structured network of reaches, docks, anchorages, and turning areas. Vessel movements are simulated along the reaches, moving from the bar to one or more docks, and then exiting the port. Features of the model include intra-harbor vessel movements, tidal influence, the ability to model complex shipments, incorporation of turning areas and anchorages, and within-simulation visualization. The driving parameter for the HarborSym model is a vessel call at the port. A HarborSym analysis revolves around the factors that characterize or affect a vessel movement within the harbor.

HarborSym is an event driven model. Vessel calls are processed individually and the interactions with other vessels are taken into account. Vessels move from reach to reach, eventually arriving at the dock that is the terminus of the leg.

The model calculates import and export tons, import and export value, and import and export allocated cost. This information allows for the calculation of total tons and total cost, allowing for the derivation of the desired metrics at the class and total level. The model can thus deliver a high level of detail on individual vessel, class, and commodity level totals and costs.

4.8.1.2 Bulk Loading Tool

The non-containerized vessel call list for future years was developed using the BLT, a tool within the HarborSym Modeling Suite of Tools. Users must provide data to specify the framework for generating the synthetic vessel call list. The BLT relies on much of the information and data from HarborSym, but has data additional specific requirements (Appendix A – Economics, Section 4.1.4).

Much of the required forecast information was based on an examination of an existing vessel call list created from historical data (obtained from WCSC). Statistical measures, commodity transfer amounts, and logical constraints can all be derived from an examination of a set of historical calls that have been stored in a HarborSym database.

4.8.1.3 BLT Vessel Call Lists

Historical vessel call data for the MSC that was obtained from WCSC and used to develop the future without and future-with project vessel calls (Appendix A – Economics, Section 4.1.5). Using the BLT and the commodity forecast new vessel call lists were created for the without-project condition and for each alternative depth for the years 2024, 2034, and 2044. New vessel call lists were not created for years after 2044, because the commodity forecast is held constant after this year.

The vessel counts by vessel class for each alternative depth and out year are displayed below (Table 25). As expected, the total number of vessels required to move the same amount of tonnage decreases as the channel is deepened, because each vessel can carry more tonnage in a deepened channel, with the exception of the SPX1 and PT-SPX1 tankers, as mentioned previously.

Within the BLT, an allocation priority can be assigned to each vessel class. The allocation priority determines the order in which vessel classes are called upon to satisfy commodity forecasts. For this study, in both the chemical and the petroleum tanker categories, the largest vessels were loaded first (i.e., given an allocation priority of “1”). In both vessel type categories, the mid-sized vessel classes (i.e., PT-PX1 for petroleum tankers and SPX2 for chemical tankers) were given the last allocation priority. Therefore, the number of calls within these classes are reduced as the channel is deepened. This is consistent with the distribution of calls by these respective vessel sizes that is observed in other Gulf Coast ports.

In each out year (2024, 2034, and 2044), the number of Aframax vessels calling at the Port of Point Comfort was increased by 50%. This manual increase in the BLT is to simulate what is expected to take place at the Port as more Aframax vessels are added to the world fleet.

Table 25 - Vessel Fleet Forecast (Number of calls by vessel class and alternative depth)

	Vessel Class	FWOP	FWP (-41)	FWP (-43)	FWP (-45)	FWP (-47)	FWP (-49)
2024	SPX1	110	110	110	110	110	110
	SPX2	58	51	42	29	21	21
	PX1	82	73	73	73	73	73
	PT-SPX1	6	6	6	6	6	6
	PT-SPX2	12	12	12	12	12	12
	PT-PX1	110	96	87	81	78	77
	PT-PX2	30	13	13	13	13	13
	PT-Afra1	0	11	11	11	11	11
	Total	**408**	**372**	**354**	**335**	**324**	**323**
2034	SPX1	127	127	127	127	127	127
	SPX2	69	63	45	33	26	26
	PX1	95	84	84	84	84	84
	PT-SPX1	6	6	6	6	6	6
	PT-SPX2	13	12	12	12	12	12
	PT-PX1	118	94	86	80	76	74
	PT-PX2	32	14	14	14	14	14
	PT-Afra1	0	17	16	17	17	17
	Total	**459**	**416**	**390**	**373**	**362**	**360**
2044	SPX1	146	146	146	146	146	146
	SPX2	71	70	54	35	24	24
	PX1	110	97	97	97	97	97
	PT-SPX1	6	6	6	6	6	6
	PT-SPX2	13	12	12	12	12	12
	PT-PX1	109	76	67	62	53	52
	PT-PX2	31	13	13	13	13	13
	PT-Afra1	0	25	25	25	25	25
	Total	**485**	**445**	**420**	**396**	**376**	**375**

4.8.2 Transportation Cost Savings by Depth

Transportation cost benefits were estimated using the HarborSym Economic Reporter, a tool developed by IWR that summarizes and annualizes HarborSym results from multiple simulations. This tool collects the transportation costs from various model run output files and generates the transportation cost reduction for all project years, then produces an Average Annual Equivalent (AAEQ). Results were verified using IWR Planning Suite and spreadsheet models as well (Appendix A – Economics, Section 4.2).

Transportation costs were estimated for a 50-year period beginning in 2024 and ending in 2073. Transportation costs were estimated using HarborSym for the years 2023, 2033, 2043. Transportation costs were held constant beyond 2043. The present value was estimated by interpolating between the modeled years and discounting at the current FY 2017 Federal Discount rate of 2.75%. Estimates were determined for each alternative project depth.

Table 26 provides the annual transportation costs in total and for the at-sea and in-port portions for years 2024, 2034, and 2043 and beyond by channel depth. The transportation costs were held constant beyond 2043.

Table 26 - Origin - Destination Annual Transportation Costs for Alternative Plan A by Scale

Total At-Sea and In-Port Transportation Cost Allocated to Port for Alternative A						
Year	FWOP	-41’	-43’	-45’	-47’	-49’
2024	$135,130	$123,555	$117,464	$112,844	$109,982	$109,595
2034	$148,689	$133,626	$126,935	$122,598	$119,147	$118,372
2043 - 2073	$151,522	$136,837	$130,002	$125,116	$118,185	$118,063
At-Sea Transportation Cost Allocated to Port						
Year	FWOP	-41’	-43’	-45’	-47’	-49’
2024	$130,198	$119,043	$113,060	$108,554	$105,759	$105,362
2034	$143,244	$128,600	$122,066	$117,841	$114,459	$113,676
2043 - 2073	$145,914	$131,533	$124,853	$120,103	$113,288	$113,170
In-Port Transportation Costs						
Year	FWOP	-41’	-43’	-45’	-47’	-49’
2024	$4,933	$4,512	$4,404	$4,290	$4,223	$4,232
2034	$5,445	$5,026	$4,869	$4,757	$4,687	$4,696
2043 - 2073	$5,608	$5,303	$5,149	$5,013	$4,897	$4,893
Price levels are October 2017 and the discount rate is 2.75%. ($ in thousands)						

Table 27 - Annual Transportation Cost Savings for Alternative Plan A by Scale

At-Sea and In-Port Transportation Cost Saving Benefits					
Year	Alt A -41'	Alt A -43'	Alt A -45'	Alt A -47'	Alt A -49'
2024	$11,575	$17,666	$22,286	$25,148	$25,535
2034	$15,063	$21,754	$26,091	$29,542	$30,316
2043 - 2073	$14,686	$21,521	$26,406	$33,337	$33,459
At-Sea Transportation Cost Saving Benefits					
Year	Alt A -41'	Alt A -43'	Alt A -45'	Alt A -47'	Alt A -49'
2024	$11,154	$17,137	$21,643	$24,439	$24,835
2034	$14,645	$21,178	$25,403	$28,785	$29,568
2043 - 2073	$14,381	$21,062	$25,812	$32,626	$32,744
In-Port Transportation Cost Saving Benefits					
Year	Alt A -41'	Alt A -43'	Alt A -45'	Alt A -47'	Alt A -49'
2024	$421	$529	$643	$709	$700
2034	$418	$576	$688	$757	$748
2043 - 2073	$304	$459	$595	$711	$714
Price levels are October 2017 and the discount rate is 2.75% ($ in thousands)					

Table 28 - AAEQ Transportation Cost Reduction Benefit by Alternative

Alt A	AAEQ Transportation Cost	AAEQ Transportation Cost Reduction Benefit
FWOPC	$147,380	-
-41'	$133,220	$14,160
-43'	$126,577	$20,802
-45'	$121,902	$25,478
-47'	$116,789	$30,590
-49'	$116,428	$30,952
Price levels are October 2017 and the discount rate is 2.75% ($ in thousands)		

4.8.3 Transportation Cost Savings Benefit Analysis

A summary of project first cost by alternative is provided in Table 29. Only the costs for the -41', -47', and -51' were calculated by cost engineering. Costs (and durations) between the three depths displayed in the table were interpolated assuming a linear relationship. Navigation costs include the associated costs, which are necessary to realize project benefits; these costs are non-Federal costs paid by the NFS. Between the depths of -41' and -47', berth deepening is required and is considered an associated cost. After -47', dock modifications would be required in order to deepen berths. The costs to modify docks and deepen berths are included in the navigation costs for the -51' alternative (Appendix A – Economics, Section 4.3).

NOTE: The single-owner rule does not apply in this case; while crude exports are a significant portion of the overall benefits, there are other facilities that will benefit from deepening.

Table 29 – Total Project Cost Estimate for Alternative Plan A at three depths

Construction Item	Cost at -41'	Cost at -47'	Cost at -51'
01 - Lands and Damages	$162,500	$162,500	$162,500
02 - Relocations	$57,694,675	$57,694,675	$57,694,675
06 - Fish and Wildlife	$26,055,650	$26,055,650	$26,055,650
12 - Navigation	$227,651,900	$323,605,475	$417,135,875
Subtotal	$311,564,725	$407,518,300	$501,048,700
Construction Management (E&D, S&A)	$43,596,300	$57,029,800	$70,124,075
TOTAL PROJECT COST	**$355,161,000**	**$464,548,100**	**$571,172,775**
E&D – Engineering and Design, S&A - Supervision and Administration			
Direct Construction Costs are based on Oct 2017 Price Level, and Total Fully Funded Project Cost is based on an average escalation of 6.8%, based on the CWCCIS Rates			

4.8.4 Summary of Costs and NED Benefits

The economic cost summary, including project first cost, Interest During Construction (IDC), total investment costs, Operations, Maintenance, Repair and Replacement (OMRR&R) costs, and annualized total costs are presented below (Table 30). The OMRR&R costs presented are an estimate of the difference in existing OMRR&R costs and the with-project OMRR&R costs and are held constant for all alternative depths. Note that the -51' alternative depth was not modeled because incremental net benefits became negative at the -49' depth (Appendix A – Economics, Section 4.3).

Table 30 – AAEQ Cost Summary of Costs for Alternative Plan A at Scaled Depths

Alt A	Project Costs	IDC	Total Investment	AAEQ Total Investment	AAEQ OMRR&R	Total AAEQ	Incremental AAEQ Costs
-41’	$355,161	$14,853	$370,014	$13,706	$6,000	$19,706	-
-43’	$391,623	$17,492	$409,115	$15,154	$6,000	$21,154	$1,448
-45’	$428,086	$20,131	$448,216	$16,602	$6,000	$22,602	$1,448
-47’	$464,548	$22,770	$487,318	$18,051	$6,000	$24,051	$1,449
-49’	$517,860	$29,549	$547,409	$20,277	$6,000	$26,277	$2,226
Price levels are October 2017 and the discount rate is 2.75% ($ in thousands)							

The results of transportation cost savings benefit analysis are annualized and displayed in Table 31. These annualized benefits are compared with the annualized costs to calculate net benefits and select the NED plan. As displayed in the table, net benefits are negative in the -41’ and -43’ alternative. Net benefits become positive at -45’ and maximize at -47’ before again becoming negative at -49’, resulting in an NED plan of deepening the channel to -47’ MLLW.

Table 31 - Summary of AAEQ Costs & Benefits for Alternative Plan A at Scaled Depths

Alt A	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	Benefit / Cost Ratio
-41’	$19,706	$14,160	($5,546)	-	0.7
-43’	$21,154	$20,802	($352)	$5,194	1.0
-45’	$22,602	$25,478	$2,876	$3,228	1.1
-47’	$24,051	$30,590	$6,539	$3,664	1.3
-49’	$26,277	$30,952	$4,675	($1,864)	1.2
Price levels are October 2017 and the discount rate is 2.75% ($ in thousands)					

4.9 Selection of the Tentatively Selected Plan – Step 6

Economic analyses indicate that Alternative Plan A at -47’ is the NED Plan. It is the plan that reasonably maximizes net economic benefits consistent with protecting the Nation’s environment. The NFS, CPA, is in agreement with this selection, and is not requesting a Locally Preferred Plan. Alternative Plan A at -47’ is therefore the TSP.

Table 32 - Tentatively Selected Plan Alternative Plan A - -47'

Alternative	Depth Main / Entrance (MLLW)	Width Main / Gulf	Turning Basin
A	**-47' / -49'**	**350' / 600'**	**1,200'**

4.9.1 Principles and Guidelines Four Criteria Evaluation

As part of Federal guidelines for water resources projects, there are general feasibility criteria that must be met. According to the USACE ER 1105-2-100 for planning, any the USACE project must be analyzed with regard to the following four criteria:

1. **Completeness** – Does the alternative plan include all necessary parts and actions to produce the desired results?
2. **Effectiveness** – Does the alternative plan substantially meet the objectives? How does it measure up against constraints?
3. **Efficiency** – Does the alternative plan maximize net NED benefits?
4. **Acceptability** – Is the alternative plan acceptable and compatible with laws and policies?

Table 33 - Principles and Guidelines Four Criteria Evaluation

	Complete?	Effective?	Efficient?	Acceptable?
Alternative A at -47'	**YES**	**YES**	**YES**	**YES**

1. **Completeness** – Alternative Plan A at -47' provides and accounts for all necessary investments, addresses the problems, and ensures the realization of the planning objectives. This plan improves the safety of all vessels of the sizes currently visiting Point Comfort. This plan provides increased efficiency in the transportation of commodities into and out of the Port by allowing larger vessels to call, up to mid-sized Aframax tankers. This plan includes a least cost DMMP with suitable PAs, and the BU of dredged material where appropriate (Appendix E).
2. **Effectiveness** – Alternative Plan A at -47' contributes to the achievement of the planning objectives and avoids all constraints.
3. **Efficiency** – Alternative Plan A at -47' is the NED plan and the most cost effective means of achieving the objectives of all of this study's alternatives, plans, and scales of alternative plans.
4. **Acceptability** – Alternative Plan A at -47' is acceptable in terms of all known applicable laws, regulations, and public policies. Appropriate mitigation of adverse effects is an integral part of Alternative Plan A at -47'.

4.10 Description of the TENTATIVELY SELECTED PLAN at DRAFT REPORT

Economic analyses indicated that Alternative Plan A at -47' was the NED Plan, or TSP. It was the plan that reasonably maximized net economic benefits consistent with protecting the Nation's environment.

Alternative Plan A at -47' would accommodate vessel drafts up to -44' (-47' + 3' under-keel clearance) (with no waves) or -44' + 3' = -41'. Light loading of the design vessel was part of the economic analyses. No modifications to port facilities were required for the TSP.

4.10.1 General Description

The proposed MSC is shown in Appendix F – Engineering Appendix on the Location Plan, Drawing G-2. Table 6.4, MSC TSP. Dimensions show the new A -47' depth proposed dimensions for the separate reaches of the channel. The channel depth column includes the advance maintenance for each reach. Typical cross sections on Drawings C-12 and C-13 show the proposed channel depths for each reach of the channel. Drawing C-11 shows the proposed 33,000' extension to the entrance channel.

The proposed MSC channel reaches for the TSP are described in the paragraphs below.

4.10.2 Entrance Channel Extension - STA -33+000 to STA -20+000

The extension of the entrance channel is needed to account for the proposed deeper channel depth. The authorized depth for the new Matagorda entrance extension channel would be -49'. The advanced maintenance would be three feet with two feet of allowable over-depth. The bottom width of the channel will be 600', 300' from each side of the centerline of the existing channel. This additional width is needed to give vessels room to maneuver away from strong winds and currents.

4.10.3 Entrance Channel - STA -20+000 to STA -6+000

The authorized depth for the entrance channel increases from -40' to -49'. The advanced maintenance is three feet with two feet of allowable over-depth. The depth in this channel reach has historically been an additional two feet deeper than the main channel to allow for the effects of vessel pitch, roll and heave occurring there as a result of strong currents, waves and wind. The width of the channel increases from 300' to 600', 300' from the centerline of each side of the existing channel. This additional width in the entrance channel is needed to give vessels room to maneuver away from strong winds and currents.

4.10.4 Jetty Channel - STA -6+000 to STA 0+000

The authorized depth for the jetty channel increases from -40' to -49'. The advanced maintenance is three feet with two feet of allowable over-depth. The width of the channel increases from 300' to 600', 300' from centerline of each side of the existing channel. The east side of the channel from STA 4+700 to STA 6+000 has an increase of 150' making the total width in this area, 500'. This additional width is needed to give vessels room to maneuver away from strong winds and currents.

4.10.5 Channel through Matagorda Bay - STA 0+000 to STA 75+000

The authorized depth for the Lavaca Bay Channel increases from -38’ to -47’. The advanced maintenance is two feet with two feet of allowable over-depth. The width of the channel increases from 200’ to 350’ for the majority of the channel. This includes an increase of 150’ on the west side of the existing channel. The east side of the channel from STA 4+700 to STA 8+500 has an increase of 150' making the total width in this area, 500'. This additional width is needed to give vessels room to maneuver away from strong winds and currents.

4.10.6 Channel through Lavaca Bay - STA 75+000 to STA 116+223

The authorized depth for the Lavaca Bay Channel increases from -38’ to -47’. The advanced maintenance is two feet, with two feet of allowable over-depth. The width of the channel increases from 200’ to 350’. This includes an increase of 150’ on the west side of the existing channel.

4.10.7 Proposed Addition of Turning Basin

The proposed addition of a new turning basin transitions in the Lavaca Bay Channel from STA 111+450.24 to STA 114+592. The actual 1,200-ft diameter is between STA 113+352 and STA 114+592. The 1,200-ft and was chosen because it would enable larger vessels to transit the improved MSC and maneuver into the adjacent berths at the port. Based on the length of the proposed design vessel, a 1,200’ diameter turning-basin will be sufficient for maneuverability. The size of the turning basin should provide a minimum turning diameter of at least 1.2 times the length of the design vessel where prevailing currents are 0.5 knots or less. Recent simulator studies have shown that turning basins should provide minimum turning diameters of 1.5 times the length of the design setup where tidal currents are less than 1.5 knots. The design vessel is an Aframax with an 800' LOA (length overall) x 138' beam and a design draft of -49’. The 1.5 knots x 800’ LOA = 1,200’ diameter.

4.10.8 Point Comfort Turning Basin - STA 116+223 to STA 117+223

The authorized depth for the Point Comfort Turning Basin increases from -38’ to -47’. The advanced maintenance is two feet with two feet of allowable over-depth. The width remains the same, 1000’. The existing 1000’ by 1000’ basin does not provide sufficient room for the larger vessels that might enter the MSC. If the existing basin is deepened to match the proposed improved channel depth, the basin could serve as both a transit route for larger vessels, and a turning basin for vessels of the size that currently use the channel.

4.10.9 Point Comfort North and South Basins - STA 117+223 to STA 118+502

The authorized depth increases from -38’ to -47’. The advanced maintenance is two feet with two feet of allowable over-depth. The varying widths remain the same. The width for the North Basin varies between 344.77’ and 159.43’. The slope is 1:3. The width for the South Basin varies between 283.78’ and 185.41’.

4.10.10 New Work Dredging

Hydrographic condition channel surveys were used to estimate the new work dredging quantities. The total amount of new work material to be dredged for the TSP is 30.22 mcy. The new work material volumes are shown by reaches in Appendix E – DMMP, Table 6.5. New work material volumes do not contain maintenance material. The new work volumes include Advance Maintenance as well as the recommended Allowable Over-depth.

4.10.11 Allowable Over-depth

An additional depth outside the required template is permitted to allow for inaccuracies in the dredging process. District commanders may dredge a maximum of two' of Allowable Over-depth in coastal regions, and in inland navigation channels. (ER 1130-2-520 Navigation and Dredging Operations and Maintenance Policies) This additional dredging allowance is referred to as Allowable Over-depth (AO). The existing channel has two feet of allowable over-depth. It is anticipated that large pipeline dredges will be utilized to construct the proposed waterway. District policy recommends two feet allowable over-depth in reaches where large dredges operate. The existing and proposed channel contains the same allowable over-depth for the entire length of the channel.

4.10.12 Advanced Maintenance

The existing Matagorda Entrance and Jetty Channel have a constant three feet Advance Maintenance depth. The existing Matagorda Main Channel has a constant two feet Advance Maintenance depth. There depths were assumed to remain constant for the proposed channel.

4.10.13 Mitigation

There are unavoidable impacts to oysters and marshes, after minimization and avoidance efforts were completed. In compliance with the 1990 DOD/EPA MOA regarding impacts under Section 404(b)(1) of the clean water act, compensatory mitigation shall be addressed as part of the project proposal.

4.10.14 Aids to Navigation

We are assuming there are existing aids to navigation that will be affected by the proposed widening plan of the MSC that may require relocating or removal. There may also be a need for the installation of new aids to navigation. The US Coast Guard (USCG) is responsible for installing, relocating, and removing the aids to navigation. The MSC will be widened on both sides of the Entrance and Jetty Channel and on the west side of the channel through the Lavaca Bay and Matagorda Bay.

4.10.15 Projected Shoaling Rates

The Corps Shoaling Analysis Tool (CSAT) was applied to estimate annual shoaling rate along MSC in support of DMMP development. The CSAT computes shoaling rate using channel boundary information from National Channel Framework (NCF), hydrographic survey datasets from e-Hydro (enterprise Hydrosurvey Processing), and historical dredging records. CSAT uses historical dredging records to identify dredging events, and shoaling rate and is computed based

on elevation differences for the survey pairs between dredging events (Appendix F – Engineering, Section 2.10).

Average annual shoaling rate for the entire MSC reaches was 1,961,333 cy/yr for the 2012-2015 time period. CSAT identified significant spatial variability in shoaling rates along MSC reaches.

4.10.16 Real Estate

All PAs are owned, or will be acquired, by the CPA (Appendix D – Real Estate, Section 4.2). In the event contaminated materials are found within the dredge template, the Sponsor will be 100% responsible for investigation, removal and disposal of any HTRW involved with construction and O&M of the project in accordance with ER 1165-2-132 and PGL No. 34.

The DMMP was updated by removing PA ER3/D. NOTE: In 2002, the NFS and Alcoa Inc. entered into a Settlement Agreement WHEREAS, if mercury is present in, or on, or under all or part of the CCND owned lands, including submerged lands, described in the Lease Agreement dated June 16, 1982, those contaminated materials will be deposited in PA ER3/D. It includes a CONTRACT FOR DREDGE DISPOLSAL CAPACITY and TERM EASEMENT AND RIGHT OF WAY FOR ACCESS TO AND USE OF DREDGE ISLAND. See Volume 356, Page 681, of the Official Public Records of Calhoun County, Texas.

Navigational servitude may be exercised if necessary and approved at higher headquarters. The Real Estate Appendix contains more information on NFS-owned property and existing USACE interests in Section 4.

4.10.17 Placement Areas

The proposed MSC Project will utilize the existing Sundown (Chester) Island PA for the storage of the new work dredging material. New upland PA P1 (Terrestrial Upland) will be constructed and utilized for placement of new dredging material if capacity is required in PED for new work dredge material. New Unconfined open water PAs will also be constructed west of the existing Matagorda and Lavaca Bay channel and an Ocean Dredge Material Disposal Site (ODMDS) to contain the new work material. Details concerning all of the proposed PAs can be found in Appendix E - DMMP.

4.10.18 Relocations

During the initial planning phase, 22 pipelines were estimated to be impacted by the project (Appendix D – Real Estate, Section 12). The number of pipelines was based on the July 2014 Real Estate Appendix prepared for the Calhoun Port Authority for the MSCIP by URS Corporation.

4.10.19 Hazardous and Toxic Materials

In 1994, the EPA added Alcoa Point Comfort Operations (PCO) contaminated sites to the National Priorities List (NPL) and signed an Administrative Order on Consent to conduct a RI/FS under CERCLA. The Preliminary Close-out Report for the site was signed in July 2007. Long-term monitoring of the sediments, red drum, and blue crab are ongoing. Over the past 15 years sampling of the sediments and elutriates have not returned any adverse analytical findings which would indicate the dredge material was unsuitable for open water placement.

Coordination with EPA with regards to the Alcoa site will continue prior to and during construction of the MSC. Dredge material will be tested for contaminants and, if any are found, the Non-Federal Sponsor will be responsible for all costs of cleanup and response, including the costs of any studies and investigations necessary to determine an appropriate response to the contamination. Such costs shall be paid solely by the Non-Federal Sponsor without reimbursement or credit by the Government.

4.10.20 Environmental Objectives and Requirements

Significant ecological, aesthetic, and cultural values must be preserved and protected. Natural resources should also be conserved. The human and natural environments should be maintained and restored as needed. Plans implemented to improve navigation should avoid damaging the environment and contain methods to minimize or mitigate damages to the environment.

4.10.21 Operation and Maintenance

The plan proposed for maintenance dredging is discussed in Appendix E – DMMP, Section 4.2 Maintenance Dredging.

4.10.22 Cost Estimate for the TSP

Table 34 - Summary of Costs for Alternative Plan A at Scaled Depths

Alt A	Project Costs	IDC	Total Investment	AAEQ Total Investment	AAEQ OMRR&R	Total AAEQ	Incremental AAEQ Costs
-47’	$464,548	$22,770	$487,318	$18,051	$6,000	$24,051	$1,449
Oct 2017 prices, 2.75% Interest Rate ($ in thousands)							

4.11 Description of the RECOMMENDED PLAN @ FINAL REPORT

After the TSP milestone, additional hydraulic, geotechnical, and economic analyses indicated that Alternative Plan A at -47' remains the NED Plan. It is the plan that reasonably maximizes net economic benefits consistent with protecting the Nation's environment.

A hydraulic shoaling analysis was performed on the MSC. This analysis indicated the need for a sand engine, south of the jetty, on the Gulf side of the Matagorda Peninsula (Section 4.11.12). This change was captured in the updated design, quantities, costs, benefits, and DMMP.

A ship simulation was performed to identify the most economically beneficial dimension for the MSC. Channel widths were reduced by 50' for both the Entrance Channel and Main Channel. The dimension of the turning basin remained 1,200'. The width of the channel between the new turning basin and the port's facilities were slightly adjusted for safety reasons (Appendix F – Plates).

After additional research into pipeline easements and locations, only 16 pipelines could be identified as being within the project template.

The DMMP was updated by removing PA ER3/D. NOTE: In 2002, the NFS and Alcoa Inc. entered into a Settlement Agreement WHEREAS, if mercury is present in, or on, or under all or part of the CCND owned lands, including submerged lands, described in the Lease Agreement dated June 16, 1982, those contaminated materials will be deposited in PA ER3/D. It includes a CONTRACT FOR DREDGE DISPOLSAL CAPACITY and TERM EASEMENT AND RIGHT OF WAY FOR ACCESS TO AND USE OF DREDGE ISLAND. See Volume 356, Page 681, of the Official Public Records of Calhoun County, Texas.

A slope stability analysis was performed which determined that the side slopes for the TSP remain the same for the Recommended Plan (Appendix E – DMMP).

4.11.1 Economic Analysis Updates

This section of the report describes changes and updates the economic analysis for the recommended plan based on changes in both costs and benefits since the Draft Feasibility Report was released in 2018 (Appendix A – Economics, Section 5). The NED plan of deepening the channel to -47' depth remains unchanged by these updates. This section also updates costs and interest rates to FY 2019 (October 2018) prices levels.

4.11.1.1 Refinement of Channel Widths

Following the TSP milestone meeting, a ship simulation was performed to determine the channel width required to accommodate the design vessel. It was determined from the simulation that the design width of the ~21-mile inner-harbor channel could be decreased from 350' bottom width to 300' bottom width. This change in channel width combined with other refinements in feasibility level costs caused the project first cost estimate to decrease from $464,548,000 to $247,255,000. This revised project first cost will be used in this section to update the economic analysis results for the recommended plan (Appendix A – Economics, Section 5.1).

4.11.1.2 Refinement of Fleet Forecast

During the review of the Draft Feasibility Report, assumptions regarding the fleet forecast, specifically as it relates to the new crude oil traffic, were revisited. The initial forecast of the number of design vessels calling at the Port annually, which was created using data on petroleum product exports from Port Corpus Christi, was inconsistent with updated projections being made by channel users. A review of the data from Port Corpus Christi supported using a vessel fleet distribution with a greater number of Aframax vessels when considering exports of crude oil and condensate alone rather than all petroleum products. As such, the vessel fleet forecast was refined using the vessel fleet distribution of vessels exporting crude oil and condensate from Corpus Christi as a basis. The updated vessel fleet forecast that resulted from the refinement is displayed in Table 35 below. HarborSym runs were completed for each out-year (2024, 2034, and 2044) for the recommended plan using the new fleet forecast. Again, the vessel fleet was held constant after 2044 (Appendix A - Economics, Section 5.2).

Table 35 - Refined Vessel Fleet Forecast for Recommended Plan

Vessel Class	2024		2034		2044	
	FWOP	FWPC -47’	FWOP	FWPC -47	FWOP	FWPC -47’
SPX1	110	110	127	127	146	145
SPX2	58	21	69	26	71	24
PX1	81	73	95	84	110	96
PT-SPX1	4	4	5	4	4	4
PT-SPX2	1	1	2	1	2	1
PT-PX1	5	4	6	4	5	4
PT-PX2	128	55	133	59	130	54
PT-Afra1	0	28	0	30	0	30
Total	388	296	438	334	468	359

4.11.1.3 Recommended Plan Costs

Feasibility-level costs for the recommended plan, including project first cost, IDC, total investment costs, annual total investment costs, annual OMRR&R costs, and annualized total costs are summarized and presented in Table 36 below. These costs were developed at the October 2018 price level, and reflect the decrease in the design channel width (from 350’ to 300’ in the Bay and 600’ to 550’ in the Entrance Channel) that was established during the ship simulation (Appendix A – Economics, Section 5.3).

Table 36 - Recommended Plan Cost Summary

Alt A	Project Cost	IDC	Total Investment	AAEQ Total Investment	AAEQ OMRR&R	Total AAEQ
-47'	$220,192	$11,019	$231,211	$8,774	$7,112	$15,886
Oct 2018 Prices, 2.875% Discount Rate ($ in thousands)						

4.11.1.4 NED Plan Net Benefits and Benefit-Cost Ratio

The annualized transportation cost savings (benefits); annualized costs, net benefits, and benefit/cost ratio for the recommended plan are summarized and displayed below (Table 37) (Appendix A – Economics, Section 5.4).

Table 37 - Recommended Plan Economic Analysis

Alt A	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Benefit/Cost Ratio
-47'	$15,886	$35,858	$19,972	2.26
Oct 2018 Prices, 2.875% Discount Rate ($ in thousands)				

4.11.1.5 Sensitivity Analysis

The Principles & Guidelines and subsequent ER1105-2-100 recognize the inherent variability to water resources planning. Navigation projects are subject to various uncertainties about future conditions. Therefore, a sensitivity analysis in which key quantitative assumptions and computations are changed is required to assess their effect on the final outcome. Therefore, a sensitivity analysis was conducted in which commodity tonnage levels were both lower than forecasted and higher than forecasted; however, this did not result in a change to the recommended plan (Appendix A – Economics, Section 6).

4.11.1.6 Multi-port Analysis

Multiport impacts, or the potential effects the deepening of the MSCI could have on other ports, were assessed qualitatively for this study. Multiport analysis is necessary to consider, because with-project alternatives could induce regional transfer of cargo among competing ports. Therefore, it must be determined to what extent competition exists and how it affects the with- and without-project conditions (Appendix A – Economics, Section 7).

In multiport analysis, port hinterlands must be defined as either captive or competitive. Competitive cargo hinterlands are those in which there is a choice between ports for the origin or destination of cargo. Captive cargo hinterlands will use the study port exclusively for either origin or destination. The historical users of the MSCI, such as Formosa, Invista, and INEOS, have a long history at the port and have facilities and infrastructure in close proximity to the Port. Though there are several ports along the Texas Gulf Coast that handle similar types of cargo to the Port of Point Comfort, the Port has historically had a captive cargo hinterland, with

its onsite/nearby channel users exclusively utilizing the MSC to receive and ship chemical products to and from their facilities.

The new users of the channel who are beginning to export crude oil via the MSC create more of a competitive cargo hinterland at the Port, because there are multiple ports along the Texas Gulf Coast that are equipped to export crude oil. However, these new channel users have recently made considerable investments in their facilities at Point Comfort. The Recommended Plan is intended to allow these users to more efficiently move cargo, either by loading vessels deeper, or by using larger vessels. There are many factors may influence the growth of a particular harbor: landside development and infrastructure, location of distribution centers for imports, source locations for exports, population and income growth and location, port logistics and fees, business climate and taxes, carrier preferences, labor stability and volatility, and business relationships. Though the deepening and widening may make the Port of Point Comfort a more desirable location for shippers in the future, it is not expected that the recommended plan will cause a shift in traffic from nearby ports.

4.11.2 General Description

For detailed drawings with station numbers see the Appendix F – Engineering Appendix, Drawings No. G-2, and Drawing Nos. C-01 thru C-11. The Recommended Plan includes the addition of a new 1,200’ turning basin in the Lavaca Bay reach to accommodate the larger vessels needing to navigate the Port. This plan also includes extending the entrance channel 13,000’ further into the Gulf to allow for deepening to -49’, as well as dredging a 1,600-ft long sediment trap in the area of the offshore bar. This improvement would allow larger and deeper draft ships to navigate the channel. The MSC Recommended Plan improved reaches are described below.

Table 38 - Recommended Plan Dimensions

Reach	STA	Bottom Width	Project Depth	Channel Depth	AO	Side Slope
Entrance Channel Extension	**-33+000 to -20+000**	**550’**	**-49’**	**-52’**	**2’**	**1V:10H**
Entrance Channel	**-20+000 to 6+000**	**550’**	**-49’**	**-52’**	**2’**	**1V:10H**
Jetty Channel	**-6+000 to 0+000**	**550’**	**-49’**	**-52’**	**2’**	**1V:10H**
Matagorda Bay	**0+000 to 75+000**	**550’ - 300’**	**-47’**	**-49’**	**2’**	**1V:3H**
Lavaca Bay and Turning Basin	**75+000 to 116+223**	**300’ to 1,200’ to 1,000’**	**-47’**	**-49’**	**2’**	**1V:3H**
Point Comfort Turning Basin	**116+223 to 117+223**		**-47’**	**-49’**	**2’**	**1V:3H**

Point Comfort North & South Basins	**117+223 to 118+502**		**-47'**	**-49'**	**2'**	**1V:3H**

4.11.3 New Work Dredging

Hydrographic condition channel surveys were used to estimate the new work dredging quantities (Appendix E – DMMP, Section 4.1). The total amount of new work material to be dredged for the Recommended Plan is 21 mcy. New work material volumes do not contain maintenance material. The new work volumes include Advanced Maintenance as well as the recommended Allowable Over-depth. Table 29 provides the dimensions for the Recommended Plan and new work dredging, including advance maintenance and allowable over-depth. (Appendix F – Engineering, Section 6.3)

Table 39 - DMMP New Work Volumes

Start Station	End Station	Distance Interval (ft)	Volume w/Advanced Maintenance (CY)	Allowable Over-depth (CY)	Total Volume (CY)	PAs	Method
-33+000	**-16+000**	**17,000**	**2,606,681**	**634,436**	**3,241,117**	**O5**	**Hopper**
-16+000	**-6+000**	**10,000**	**1,115,407**	**292,354**	**1,407,760**	**SE**	**Pipeline**
-6+000	**20+000**	**26,000**	**1,886,389**	**419,862**	**2,306,250**	**Sundown Island**	**Pipeline**
20+000	**25+000**	**5,000**	**577,757**	**29,262**	**607,019**	**NP1**	**Pipeline**
25+000	**55+000**	**30,000**	**3,557,723**	**222,288**	**3,780,011**	**NP2**	**Pipeline**
55+000	**80+000**	**25,000**	**2,918,279**	**228,873**	**3,147,152**	**NP3**	**Pipeline**
80+000	**85+000**	**5,000**	**525,600**	**71,559**	**597,159**	**NP4**	**Pipeline**
85+000	**98+400**	**13,400**	**1,534,157**	**66,864**	**1,601,021**	**NP5**	**Pipeline**
98+400	**113+300**	**14,900**	**2,415,745**	**151,401**	**2,567,146**	**NP6**	**Pipeline**
113+300	**118+502**	**5,202**	**1,519,876**	**188,887**	**1,708,763**	**NP7**	**Pipeline**
				TOTAL:	**20,963,397**		

4.11.4 Allowable Over-depth

The allowable over-depth (AO) for the Recommended Plan shown previously in Table 38 is the additional dredging depth outside the required template that is permitted to allow for inaccuracies in the dredging process. The existing and proposed channels contain the same allowable over-depth (two feet) for the entire length of the channel. (Appendix F – Engineering, Section 6.4)

4.11.5 Advanced Maintenance

The existing Matagorda Entrance and Jetty Channel have a constant depth of three feet of Advanced Maintenance. The existing Matagorda Main Channel has a constant depth of two feet of Advanced Maintenance. These depths were assumed to remain constant for the Recommended Plan. (Appendix F – Engineering, Section 6.5)

4.11.6 Mitigation Measures

Selection of potential mitigation sites and modeling of benefits will be conducted in coordination with resource agencies. While the exact locations have not been selected at this point for oyster reef mitigation construction, discussions with TPWD and USFWS have indicated that placing the reefs near the mouth of Powderhorn Lake or Keller Lake would provide a buffer from erosive forces currently effecting these areas. Further discussions with these agencies and their local biologists will continue during the planning and construction phases to confirm the best location for reef construction. The location of the marsh mitigation sites will be, to the extent practicable, within the areas surrounding Matagorda Bay.

Costs of the mitigation measures were estimated based on recent work in nearby bays and given to the economists for inclusion in the benefit to cost ratio calculation. These costs were updated for the final report. Impacts of the recommended will be fully compensated in accordance with specific impacts and benefits quantified by the Habitat Suitability Index (HSI) modeling. Marsh creation/mitigation will be conducted in compliance with ER 1165-2-27 (Establishment of Wetland Areas in Connection with Dredging). (Appendix B – Environmental Resources, Section 5)

4.11.6.1 Oyster Reefs

After discussions with the resource agencies percent cultch cover was estimated to be 90 percent over the 129.2 acres impacted along the channel. This coverage was assumed to remain consistent over the entire period of analysis for the period of analysis.

The preferred option for oyster reef restoration is through artificial cultch placement. This method entails placing a hard substrate on the bay bottom which allows oyster spat to attach and mature into adults and develop into reefs. This is the most common method employed along the Texas Gulf coast.

There are multiple methods of providing artificial cultch for the reef development. One method is the use of reef balls, large concrete domes with space for the oyster spat to attach. The more common method is the use of crushed limestone of river pebble placement. Placement of this material in layers of thickness from 6-9” thick has been shown to be the most successful method of oyster reef creation. The mass placement of rock allows for effective coverage of the bay bottom to accomplish our goal of 90 percent cultch coverage.

There are two methods of seeding artificial cultch for the generation of oyster reef. The first method relies on the natural recruitment of oyster larvae. A second method, which could be used if natural seeding is unsuccessful, is direct seeding. This method involves the purchase of spat from farmed oysters and placing them directly on the artificial cultch.

The method of mass placement of crushed limestone and natural recruitment is the most common and most successful method of reef creation on the Gulf coast and is the recommend method of oyster mitigation. At this time comparable reef creation projects of this type in Texas have a cost of approximately $157,000/acre. (Appendix B – Environmental Resources, Section 5.1)

4.11.6.2 Marsh

The location of the 2.0 acres of marsh restoration has not been isolated. The PDT has been working with the resource agencies and local agency biologists to try to find a suitable location. This mitigation will only be required in the unlikely case that PA P1 will need to be used. Without a specific location chosen for the mitigation within the Matagorda Bay system a conceptual mitigation plan will be discussed below.

A berm will initially need to be built around the two acre site around the mitigation site to control the hydrologic conditions within the site. Channelization within the site will need to be constructed to make sure the proper amount of water flow will be able to reach the entire region of the mitigation site. Based upon the condition of the interior of the mitigation site there may need to be some grading of the land to control for hydrologic sheet flow through the site. Planting of the appropriate vegetation (to be determined) will need to be done after grading. The estimated costs for this work were taken from recent marsh creation in the Matagorda Bay region and totaled $80,000/acre. (Appendix B – Environmental Resources, Section 5.2)

4.11.7 Aids to Navigation

The PDT assumed that there are existing aids to navigation that will be affected by the proposed widening plan of the MSC that may require relocating or removal. There may also be a need for the installation of new aids to navigation. The US Coast Guard (USCG) is responsible for installing, relocating, and removing the aids to navigation. The MSC will be widened on both sides of the Entrance and Jetty Channel and on the west side of the channel through the Lavaca Bay and Matagorda Bay.

A current meter is planned for installation between the jetties. The NOAA maintains another current meter near Sundown Island. This project plans to broadcast one or both current meter readings to ships in order to improve Aids to Navigation. (Appendix F – Engineering, Section 6.7)

4.11.8 Projected Shoaling Rates

The Corps Shoaling Analysis Tool (CSAT) was applied to estimate annual shoaling rate along MSC in support of DMMP development. The CSAT computes shoaling rate using channel boundary information from National Channel Framework (NCF), hydrographic survey datasets from e-Hydro (enterprise Hydrosurvey Processing), and historical dredging records. CSAT uses historical dredging records to identify dredging events, and shoaling rate and is computed based on elevation differences for the survey pairs between dredging events (Appendix F – Engineering, Section 2.10).

Average annual shoaling rate for the entire MSC reaches was 1,961,333 cy/yr for the 2012-2015 time period. CSAT identified significant spatial variability in shoaling rates along MSC reaches.

4.11.9 Real Estate

All PAs are owned, or will be acquired, by the CPA (Appendix D – Real Estate, Section 4.2). In the event contaminated materials are found within the dredge template, the Sponsor will be 100% responsible for investigation, removal and disposal of any HTRW involved with construction and O&M of the project in accordance with ER 1165-2-132 and PGL No. 34.

Navigational servitude may be exercised if necessary and approved at higher headquarters. The Real Estate Appendix contains more information on NFS-owned property and existing USACE interests in Section 4.

4.11.10 Placement Areas

The new least cost placement plan requires the creation of numerous in-bay PAs, and potentially an upland PA. Plate D-01 shows the locations of the PAs for the new least cost placement plan (Appendix E – DMMP, Section 7). PA capacities will be revised in PED once additional surveys and borings are completed. (Appendix F – Engineering, Section 6.10)

PA footprints have been assessed for reefs and anomalies. The least cost plan has been finalized regarding the inclusion of these potential unconfined PAs through cooperation with Galveston District Operations Division. The unconfined PAs in were proposed to accept new work and maintenance material corresponding to the deepening and widening of the channel.

O5 – New ODMDS as Open-Water Unconfined PA - PA O5 is a 1,600-acre rectangular open-water PA located approximately three miles offshore and 1,200’ south of the channel centerline. The ODMDS will be used for the placement of ~3.2 mcy of new work dredged material from Entrance Channel.

PA 1 – Existing ODMDS as Open-Water Unconfined PA - PA 1 is a 453-acre rectangular open-water PA located approximately two miles offshore and 1,000’ south of the channel centerline. PA 1 will be used for the placement of ~17.9 mcy of maintenance material from the Entrance Channel over a 50-year period.

Sand Engine - Sand Engine (SE) is an approximate 119-acre, rectangular shaped site located at the entrance channel southwest of the jetties. The SE was not in previous DMMPs, but deemed as a necessity to reduce erosion at the southwest jetty. The SE will accept both new work and maintenance materials with the 50-year DMMP. The material in the SE will also nourish the beach as dredge material is carried west by virtue of longshore drift. The SE will be used to contain ~1.4 mcy of new work material and 9.0 mcy of future maintenance material over a 50-year period.

Sundown Island as Open-Water Unconfined PA (BU Site as Bird Island) - Sundown Island periodically receives material from maintenance dredging of the GIWW and MSC, but was not previously used to develop the 50-year DMMP. Sundown Island is ~442-acres and located southeast of GIWW. This island will expand to accept both new work and maintenance materials in the 50-year DMMP.

New Unconfined Open-Water PAs (NP 1, NP 2, NP 3, NP 4, NP 5, NP 6, and NP7) - These new PAs are located southwest of the ship channel in Matagorda Bay. The areas of NP1, NP6 and NP7 is estimated at 230 acres. The areas of NP 2 and NP 3 are estimated at 1433 acres and 661 acres. The areas of NP4, NP5, are estimated at 172 acres. These seven areas will be used for the placement of ~14.0 mcy of new work material.

O&M Unconfined Open-Water PAs (OP 1, OP 2, OP 3, OP 4, OP 5, OP 6, OP7, OP8, OP9, and OP10) - The areas of OP1, OP2, OP3, OP4, OP5 OP6, OP7, OP9, and OP10 are estimated 230 acres. The area of OP8 is estimated 172 acres. These ten PAs will be used for the placement of ~114.2 mcy of maintenance material over a 50-year period. It should be noted that OP1 to OP10 are located further away from the channel than New Work PAs to avoid maintenance material from shoaling back into channel.

P1 – Terrestrial Upland - Placement Area P1 will only be constructed and placed into if additional placement capacity is determined necessary in PED to accommodate new work dredge material. Placement Area P1 will be created south of Alamo Beach on existing agricultural land. The placement area will be designed and scaled to contain quantity of material needed. The containment dike will be constructed utilizing existing material within the placement area. The maximum footprint of this placement area would be 248-acres and could impact a maximum of 1.5 acres of farmed wetland. If impacted, marsh cells will be constructed as environmental mitigation.

Applicant's Preferred Alternative

Feature Identity	Feature Description	New Work (mcy)	Maintenance (mcy)
O5	Offshore Dispersive Site	3.2	0.0
Sand Engine	New Unconfined Area for Work and Maintenance Material	1.4	9.0
Sundown Island	Existing Unconfined Area along GIWW	2.3	12.9
NP1 to NP7	New Unconfined Area only for New Work Material	14.0	0.0
OP 1 to OP 10	New Unconfined Area only for Maintenance Material	0.0	114.2
PA 1	Existing Offshore Dispersive Site	0.0	17.9
TOTAL	New Work and Maintenance Material	21.0	154.0

Figure 41 - Revised Placement Features for New Least Cost Placement Plan

4.11.11 Relocations

After the TSP milestone meeting, additional data was reviewed including 2018 Railroad Commission of Texas data, CPA pipeline easement records, and maps of pipelines prepared by Atkins in November 2017. As a result of the updated data, it was determined that the 22 pipelines identified in 2014 is no longer accurate (Appendix D – Real Estate, Section 12). Sixteen pipelines were identified in the project area: 8 in-service pipelines and 1 abandoned pipeline in Lavaca Bay, 5 in-service and 1 abandoned pipeline in Matagorda Bay, and 1 in-service pipeline crossing the Entrance Channel. This information is preliminary only and will need to be further verified in PED.

Therefore, ~16 pipelines cross the MSC and will need to be removed or relocated. With the exception of the ammonia and acrylonitrile pipelines operated by Ineous USA Pipelines, the pipelines carry natural gas (Table 40).

CPA owns the submerged lands where the pipelines cross the channel. CPA lease agreements with the pipeline companies require the pipeline owners to remove and/or relocate the lines at the owner's expense, if required for improvements to the MSC.

However, since this is a deep-draft navigation project, the NFS must bear at least 50 percent of the cost of relocation as required by WRDA Section 101(a)(4) and explained in Policy Guidance Letter (PGL) 44. The law apportions the remaining payment responsibility to the pipeline owner. Costs borne by the NFS for utility relocations are credited toward the NFS's additional payment of 10% of the cost of the general navigation features. To the extent that the total amount eligible for credit under Section 101(a)(2) exceeds 10 percent of the total cost of the general navigation features, the NFS shall not be entitled to reimbursement.

Table 40 - Pipelines that May Require Removal / Relocation

	Approx. Channel Station	#	T4 Permit No. or P5 No.	Operator	Size	Depth	Permit No.	Miles	Status[1]
Lavaca Bay	+105+594	1	07368/605990	Neumin Production Company	4.5”	-	-	2.88	In Service*
	+91+330	1	04143/845690	Texas Eastern Trans, LP	30”	-50’	3560	3.99	In Service
	+91+330	1	05554/424191	Ineos USA LLC	8.63”	-	-	24.48	In Service
	+91+330	1	05569/424191	Ineos USA LLC	8.63”	-	-	24.47	In Service
	+82+960	4	00441/624246	Onyx Pipeline Company	8.63”	-	-	4.34	Abandoned
	+76+314	1	90134/881288	Valero Interstate Trans Co.	6.63”	-	82679	2.29	In Service
Matagorda Bay	+72+949	4	00276/489680	Lavaca Pipeline Company	8.63”	-	4566	16.51	In Service**
	+43+000	1	07025/385533	High Island Gas LLC	16”	-	6729	7.8	In Service**
	+22+472	1	06146/876520	Union Oil Co of CA	8.63”	-	-	8.14	Abandoned
Offshore	-18+472	1	02878/253368	Enterprise Products Operating LLC	24”	-65’	14794	26.21	In Service

[1]Information on Status of pipeline provided by the Railroad Commission of Texas (RRC)

**This line has been cut, flushed, filled with bay water, and capped according to the CPA.*

*** These lines are listed as in-service by the Railroad Commission of Texas, but as abandoned in July 2016 according to the CPA.*

4.11.12 Hazardous and Toxic Materials

The potential for encountering impacted material during the construction of the project is limited. Impacts associated with regulated facilities are most likely to be encountered near the source of

the contaminants. These sources include, but are not limited to, industry located in the Point Comfort area. According to a review of database records and research of the environmental history of the region, the industrial activity adjacent to Lavaca Bay has caused measurable impacts to the terrestrials and marine environments adjacent to this and adjacent waterways.

The industrial activity adjacent to Lavaca Bay is extensive and primarily related to two large industrial complexes located immediately adjacent to the project. Industrial activity at Alcoa Point Comfort Operation and Formosa has resulted in quantifiable impacts to groundwater, surface water, soil, and sediment. Corrective action performed at both facilities has minimized the potential to encounter media during project construction. In spite of remedial activities, the potential for the project to encounter impacted media remains. The documented areas impacted by previous industrial activity are isolated to the Lavaca Bay adjacent to Point Comfort. According to the regulatory agency database report, the northern extent of the project enters into an area defined as a NPL or Superfund site. This area has been defined as having been impacted by contaminant releases from the Alcoa facility. Data provided by NOAA delineates elevated levels of mercury within sediment near Dredge Island. The concentrations of mercury within the impacted area range from below detection limits to 2.00 mg/kg. Over the past fifteen years no sediment samples have shown mercury levels that exceed TCEQ water quality standards.

Due to the prolonged use of portions of the area as military training, the potential of unexploded ordnance within the project area does exist. However, the potential to encounter unexploded ordnance during dredging activity is considered to be quite low. The existing channel has been maintained through maintenance dredging for the last 50 years and there have been no reported incidences of unexploded ordnance encountered in the Matagorda Bay area.

Dredge material will be tested for contaminants and if any are found, the Sponsor will be 100% responsible for investigation, removal and disposal of any HTRW involved with construction and O&M of the project in accordance with ER 1165-2-132 and PGL No. 34. (Appendix F – Engineering, Section 7.0)

The DMMP was updated by removing PA ER3/D. NOTE: In 2002, the NFS and Alcoa Inc. entered into a Settlement Agreement WHEREAS, if mercury is present in, or on, or under all or part of the CCND owned lands, including submerged lands, described in the Lease Agreement dated June 16, 1982, those contaminated materials will be deposited in PA ER3/D. It includes a CONTRACT FOR DREDGE DISPOLSAL CAPACITY and TERM EASEMENT AND RIGHT OF WAY FOR ACCESS TO AND USE OF DREDGE ISLAND. See Volume 356, Page 681, of the Official Public Records of Calhoun County, Texas.

4.11.13 Environmental Objectives and Requirements

Significant ecological, aesthetic, and cultural values must be preserved and protected. Natural resources should also be conserved. The human and natural environments should be maintained and restored as needed. Plans implemented to improve navigation should avoid damaging the environment and contain methods to minimize or mitigate damages to the environment.

The different depths considered under Alternative A would each have similar environmental impacts. The relative differences would be proportional to the depths in that the shallowest proposed channel would have the least amount of impacts, while the deepest proposed channel would have the largest amount of impacts (Table 41). The impacts are associated to each depth scale, and are expected to be proportional to each depth scale of Alternative A in intensity. Each foot of additional depth of dredging increases the impact to bay bottom by 19 acres.

Table 41 - Alternative A -47' Showing Depth, Width, and Dredge Quantities

Channel Depth (MLLW)	Bottom Width (ft)	Top of Channel Width (ft)	Dredge Quantities (mcy)
-47	300'	632'	21

4.11.14 Operations and Maintenance

The estimated annual maintenance dredging volume is based on a CSAT modeling software that calculates the volume using: historic dredging records, total suspended sediment concentrations, hydrodynamics of the proposed channel, and the amount and location of material placed in unconfined PAs. Projected maintenance volumes per cycle for each reach of the channel are provided in Table 42. All open water PAs for maintenance material theoretically have an unlimited capacity since they are unconfined and dispersive. (Appendix F – Engineering, Section 9.0)

Table 42 - Projected Maintenance Dredging Volumes per Cycle

Start Station	End Station	Dredge Quantities per Cycle (CY)	50 Year O&M Quantities (CY)	Placement Area	Method	Frequency (years)
-33+000	-15+000	1,433,731	17,921,632	1	Hopper	4
-15+000	-6+000	716,865	8,960,816	SE	Hopper	4
-6+000	25+000	517,783	12,944,583	Sundown Island	Pipeline	2
25+000	35+000	114,520	2,863,000	OP1	Pipeline	2
35+000	45+000	114,520	2,863,000	OP2	Pipeline	2
45+000	55+000	114,520	2,863,000	OP3	Pipeline	2
55+000	65+000	114,520	2,863,000	OP4	Pipeline	2
65+000	75+000	512,052	12,801,308	OP5	Pipeline	2
75+000	85+000	518,106	12,952,653	OP6	Pipeline	2
85+000	97+446	641,766	16,044,156	OP7	Pipeline	2
97+446	110+000	642,238	16,055,948	OP8	Pipeline	2
110+000	114+000	807,781	20,194,537	OP9	Pipeline	2
114+000	118+502	988,107	24,702,678	OP10	Pipeline	2

4.11.15 Cost Estimate for the Recommended Plan

A detailed cost estimate for the Recommended Plan has been developed utilizing Micro Computer Aided Cost Estimating System (MCACES) software tools (Appendix F – Engineering, Section 12).

Costs have been updated to reflect the revisions made to the Recommended Plan post ship simulations.

An Abbreviated Risk Analysis (ARA) developed with the participation of the PDT in October 2017, was revised in November of 2018 to take into account deleted and added Features of Work. For screening of alternatives for the TSP, an average risk contingency of 37% from the ARA was applied to the direct first construction costs, as well as for PED and Construction Management (CM). Since the total project cost of the TSP exceeds $40 million, a formal Cost and Schedule Risk Analysis (CSRA) was required. The CSRA was prepared by the Cost Center of Expertise in Walla Walla District, with participation from the PDT. Refined risk contingencies were developed using the risk modeling software, Crystal Ball. The resulting contingency markups of 29% were then applied to all Code of Accounts for features of work, as well as PED, and CM. However, the 25% risk contingency developed by Real Estate Section would continue to be utilized for the Lands and Damages Code of Account. A summary breakdown of the Federal, Non-Federal, and Associated Costs for the Recommended Plan is below (Table 43).

Costs for required port improvements, considered “Associated Costs” were generated by CPA and reviewed appropriately by Cost Engineer. Relocations total $31,061,000, while Berthing Improvements & Docks total $4,759,000. (Appendix F – Engineering, Section 12.0) Aids to Navigation, which is 100% federally funded and paid to the US Coast Guard, total $1,883,000.

Table 43 - Recommended Plan – First Costs Allocation

Cost Account	Project Features	Federal (75%)	Non-Federal (25%)	Total
		October 2018 price levels		
	Construction General – General Navigation Features (GNF)			
12	Dredging	$91,121,000	$30,373,000	$121,494,000
06	Fish & Wildlife Facilities	$19,693,000	$6,564,000	$26,257,000
01	Lands and Damages (Non-Federal 100%)	$0	$1,554,000	$1,554,000
30	Planning, Engineering, and Design	$14,711,000	$4,904,000	$19,615,000
31	Construction Management	$9,388,000	$3,129,000	$12,517,000
02	Relocations	$0	$31,061,000	$31,061,000
	Total Cost	**$134,913,000**	**$77,585,000**	**$212,498,000**

Benefits were calculated using the USACE approved HarborSym model. Benefits and costs were calculated with a base year of 2024 and a 50-year period of analysis (2024-2073) using the FY19 discount rate of 2.875 percent. Construction of the Recommended Plan would generate total average annual benefits of $35,858,000 with total average annual costs of $15,886,000, producing a benefit-to-cost ratio (BCR) of 2.26 at the 2.875 percent discount rate.

Total First Costs of this project is $212,498,000 with a Federal share of $134,913,000, and a NFS cost share of $77,585,000. Total First Cost for Aids to Navigation are 100% Federal with funds going to the US Coast Guard for $1,883,000.

Table 44 - General Cost Allocation

Feature	Federal Cost %[1]	Non-Federal Cost %[1]
General Navigation Features (GNF)	●90% from 0 feet to 20 feet ●**75% from 20 feet to 50 feet** ●50% for 46 feet and deeper	●10% from 0 feet to 20 feet ●**25% from 20 feet to 50 feet** ●50% for 46 feet and deeper
Mitigation	●**75%**	●**25%**
Navigation Aids	●**100% USCG**	●**0%**
Operation and Maintenance		
GNF	●**100% except cost share 50**% costs for maintenance > 50 feet	●0% except cost share 50% costs for maintenance > 50 feet

[1] *The non-Federal sponsor shall pay an additional 10% of the costs of GNF over a period of 30 years, at an interest rate determined pursuant to Section 106 of WRDA 86. Normally, the value of LERR shall be credited toward the additional 10% payment; however, there are no LERRs for this project.*

4.11.16 Residual Risk and Uncertainty

There is no minimum level of performance, or protection, or size required for USACE projects. The smaller in size, or the lower the level of performance however, the higher the residual risk. Residual risk can never be completed eliminated in any project.

The Recommended Plan as described in Section 4.11 is the NED plan for the Matagorda Ship Channel Section 216 feasibility study. The following risks were identified during the study.

Risk	Operations Risks	Management
The channel through the offshore bar will fill in within 2-6 months (advanced maintenance schedule for this area is every 2.5 to 5 years.)	Very Low	The Pilots are very familiar with the existing channel, and have indicated that they will continue to adjust their current Pilot's Rules which already take this section of the Entrance Channel, and its bathymetry into account. Also, a sediment trap has been added to the design of the MSC to address the shoaling at this bar.

During certain weather and sea events, pilots can ground out on the bottom while navigating the larger draft ships.	Low	Post-TSP Ship Simulations informed the design for the Recommended Plan. The Pilots are very familiar with the existing channel, and have indicated that they will continue to adjust their current Pilot's Rules which already take weather conditions into account.
Jetty Deficiency Project not implemented before the MSC construction	NONE	Post-TSP Ship Simulations shows that the bottleneck, being addressed as part of the Jetty Deficiency fix, does not prevent the MSC design vessel from using the Matagorda Ship Channel.
The constructed channel may be too narrow, too shallow and unsafe. Vessels could ground.	Low	Post-TSP Ship Simulations show that the design vessels may safely pass through the Matagorda Ship Channel in anticipated FWP conditions. However, there is no guarantee that unanticipated conditions, such as weather, could cause vessels to ground.

Risk	Environmental Risk	Management
Sundown Island erodes	NONE	Sundown Island is part of the current DMMP, as well as the DMMP for this study. It will not erode away. Also, the USFWS has already said that any USACE navigation projects in the area should include dredge disposal at Sundown Island.

Risk	Risk	Management
Pass Cavallo filling in	NONE	There is no danger of the Pass completely closing. Residual flows from the bay south of the Pass will keep some flow through the Pass, since it remains the most efficient inlet for San Antonio Bay (the next bay along the coast to the southwest).

(NOTE: This page intentionally left blank.)

5 Expected Future With-Project Condition for the Recommended Plan

This chapter describes what can be reasonably expected to happen in the study area. This forecast extends from the base year (the year when the proposed project is expected to be operational) to the end of the period of analysis (2024 – 2073).

The same important resources described in the existing and FWOP conditions (Chapters 2 and 3) are also described for the FWP condition in order to identify differences between the two futures.

5.1 Hydrology, Hydraulics and Sedimentation

5.1.1 Waves

Wave height at the entrance (Appendix F – Engineering Appendix, Section 2.8.2) is Hmo = 1.2m = 3.94’ from the hindcast model, but is much higher in winter (10’ – 12’) at ebb tide, according to the pilots. Waves inside the Bay are much less at close to zero (calm winds) or three feet during normal storm conditions. (Appendix F – Engineering, Section 2.6.2)

5.1.2 Currents

Currents would be expected to increase as long as Pass Cavallo continues to get smaller. (Appendix F – Engineering, Section 2.6.4) There is no danger of the Pass completely closing. Residual flows from the bay south of the Pass will keep some flow through the Pass, since it remains the most efficient inlet for San Antonio Bay (the next bay along the coast to the southwest). The next closest inlet is an intermittent inlet (not a maintained channel) 35 miles to the southwest. If the entrance channel’s smallest cross-section continues to grow, more flow will occur through that channel instead of Pass Cavallo. So it is expected that Cavallo will have less flow in the future, but it cannot close unless some other inlet opens as a breach.

5.1.3 Tides

The tidal range in the Gulf is very small, approximately one foot on a diurnal cycle. The meteorologically driven tide can be greater than the astronomically driven tide, especially during frequent winter cold fronts that may depress the water level up to three feet. (Appendix F – Engineering, Section 2.6.3)

5.1.4 Relative Sea Level Rises (RSLR)

Because of the much larger expected changes in currents and bathymetry, RSLR effectively has no effect on hydraulic design of the new channel. The main effect of RSLR would be to raise water levels, thus decreasing dredging costs but increasing environmental impacts (raising water levels in marshes, eroding beaches, etc.) (Appendix F – Engineering, Section 2.6.3)

5.1.5 Bathymetry

Bathymetric changes are the most difficult parameter to predict. If current trends continue, the entire navigation channel would slowly return to pre-Harvey dimensions. However, as long as Pass Cavallo continues to shrink, velocities in the Entrance Channel must increase, resulting in increased scouring between the jetties. (Appendix F – Engineering, Section 2.5)

5.1.6 Shoreline Changes

This project would have an effect on wave refraction that would be so small as to probably be unmeasurable. This tiny change in refraction is too small to have any measureable impact on the wave climate.

Deepening of the channel can be expected to further disrupt long-shore sediment transport and thus cause erosion on the down drift (southwest) shore. The currently authorized channel is already partially disrupting the long-shore sediment transport. This study has not quantified these effects.

The USACE is considering a large increase in advanced maintenance dredging at a bar offshore of the jetties. Both computer modeling and direct measurement of sediment transport are unreliable and subject to large error bars. The best way to both measure this effect, and mitigate for it, would be to pump this silty sand directly onto the down drift beach, instead of using the offshore PA. (Appendix F – Engineering, Section 2.2.2)

5.2 Economics

5.2.1 Regional Economic Analysis

The RED account measures changes in the distribution of regional economic activity that would result from each alternative plan. Evaluations of regional effects are measured using nationally consistent projection of income, employment, output, and population (Appendix A – Economics, Section 9).

The USACE Online Regional Economic System (RECONS) is a system designed to provide estimates of regional, state, and national contributions of federal spending associated with civil works and American Recovery and Reinvestment Act (ARRA) projects. It provides a means for estimating the forward linked benefits (stemming from effects) associated with non-federal expenditures sustained, enabled, or generated by USACE recreation, navigation, and Formally Utilized Site Remedial Action Program (FUSRAP). Contributions are measured in terms of economic output, jobs, earning, and/or value added.

An RED analysis was conducted using the feasibility-level project first cost as an input to RECONS, which automates calculations and generates estimates of jobs and other economic measures, such as income and sales associated with associated with project spending. The RECONS report is attached to Appendix A – Economics as Attachment A.

5.2.2 Other Social Effects (OSE)

The OSE account displays plan effects on social aspects such as community impacts, health, and safety, displacement, energy conservation and others. The MSC is an existing Federal project. Increased throughput via the MSC is not projected to occur as a result of a deepening.

Absent of channel improvements, a greater number of vessels would be required to transport the forecasted increase in cargo volumes. However, with implementation of the Recommended Plan the total number of vessels could decrease and transportation costs could be reduced compared to FWOP conditions. Similarly, channel improvements would not induce additional growth including additional traffic, noise, or lighting compared to the future without-project condition. As such, the deepening and widening of the channel is not anticipated to have any measurable impact on the OSE account.

5.3 Environmental Resources – Affected Environment and Environmental Consequences

Two alternatives were analyzed, with varying depths included as scales of each alternative. The impacts of each alternative would be similar, except with respect to duration of construction. The PAs outlined in the DMMP (Appendix E – DMMP, Section 7) would not be changed, as they are large enough to accommodate larger quantities than anticipated from the recommended plan. The alternative and scales that were not selected would not change the expected impacts from the implementation of the recommended plan. The impacts discussed below are in reference to the recommended plan, but would be indicative of impacts associated with the alternative and scales that were eliminated from consideration for the MSC Project.

5.3.1 Wetlands

Nonvascular vegetation, such as freshwater algae and free-floating marine seaweed that occur more commonly near outlets to the Gulf should not be impacted. The freshwater algae are remote from the proposed activities, and sargassum that drifts into the bay from the Gulf would be carried by currents and/or drift away from turbulent areas.

There would no loss of tidal flats expected within the recommended plan greater than would be expected under the FWOP. The recommended plan is predicted to have little effect on both tides and waves. It is unlikely tidal flats would be impacted.

There are no estuarine marshes within the footprint of the widened channel under the recommended plan, so no direct impacts associated with construction are anticipated. However, placement of dredged material would result in the loss of 1.5 acres of marsh at PA1 (Figure 4.1). The HSI model for clapper rail (Lewis and Garrison, 1983) was used to estimate impacts and mitigation requirements. The model indicates the loss of 0.8 Average Annualized Habitat Units (AAHUs) from the material placement. The clapper rail model indicated two acres of marsh mitigation would be required to achieve a replacement value of 0.8 AAHUs.

Changes in salinity predicted by the hydrosalinity model may cause some adjustments in the saline to brackish marshes (i.e., some areas may become more saline or species typical of saline marshes may increase in brackish marshes). However, the salinity ranges provided by the model show less than one PSU difference in average annual salinities between the recommended plan and the FWOP, and so are not expected to have greater impact on these marshes. They are well within the salinity tolerance for wetland communities. The predicted differences are minor under the low flow conditions, thus no loss or reduction in marsh function is anticipated.

The predicted increases in tidal amplitude with the recommended plan are minor. It is unlikely there would be any measurable impacts to the vegetation. However, it is possible that vegetation might exhibit minor shifts in distribution in response to elevated water levels, and if

there were any response, it would likely be that small parts of high salt/brackish marshes would become low marsh. Since low marshes are generally considered better habitat for fish and wildlife, this would not necessarily be considered a negative impact.

No negative impacts to existing shrub-scrub wetlands are anticipated.

No impacts to fresh-intermediate wetlands are anticipated (including aquatic vegetation) are anticipated either by dredging or placement of material, except 1.5 acres of farmed wetlands at PA P1. The USACE Galveston District determined these acres were jurisdictional based on their adjacency to Lavaca Bay. The impacts to wetlands constitute a significant adverse effect.

5.3.2 Submerged Aquatic Vegetation

There are no known occurrences of SAV in the footprint of the proposed dredging or placement of dredged material, so SAV would not be directly impacted by excavation of burial. There may be short-term rises in turbidity and associated reduced water clarity during the channel dredging and placement, but these would not be expected to have any lasting, measurable effect on SAV beds.

The hydrodynamic modeling predicts an increase of less than one practical salinity unit (PSU) in average annual salinity throughout the project area over most of the growing season under low flow conditions. This would not be expected to have a measurable impact on any wetland communities, including SAVs. Although high flow conditions show greater differences in salinities for the recommended plan, the absolute values would be relatively low, and so would not stress the estuaries SAV beds. (Appendix B – Environmental Resources, Section 4.10)

5.3.3 Aquatic Resources

5.3.3.1 Recreational and Commercial Fisheries

Temporary and minor adverse effect to recreational and commercial fisheries may result from altering of removing productive fishing grounds and interfering with fishing activity during construction and maintenance dredging. However, no significant impacts to food sources for nekton are likely; therefore, reductions of nekton standing crop would not be expected. Major species of nekton, including sciaenid fishes and penaeid shrimp, should not suffer any significant losses in standing crop. Thus, recreational and commercial fishing would not be expected to suffer from reductions in the numbers of important species.

A slight increase in salinity is likely to be observed as a result of the proposed channel improvements. However, adverse effects are not expected to occur to community structure or productivity as a result of salinity changes with the recommended plan. Therefore, impacts to recreational and commercial fish populations are not expected to be significant. (Appendix B – Environmental Resources, Section 4.12.1)

5.3.3.2 Open Bay Bottom

The recommended plan directly affects open-bay bottom by loss of benthic habitat. A total of 4,492 acres (excluding the proposed ship channel) of open-bay bottom will be lost; however, the acreage involved is a small fraction of the total available habitat within the entire system.

The recommended plan would alter the benthic habitat through dredging and placement activities. Dredging represents two problems for benthic communities: excavation and placement; however, disposal is more harmful than excavation. Excavation buries and removes

organisms, but organisms can recover rapidly and recolonize, whereas placement smothers or buries existing benthic communities. Placement of dredged material may cause ecological damage to benthic organisms.

Table 45 - Acres of Open-Bay Bottom Impcated

Placement Area	Acres of Bottom Impacted	Creation Type
Proposed Ship Channel	594	None
O5	1600	Offshore placement; topographic relief
In-bay unconfined PAs	2670	Bay bottom

Benthic organisms are, in general, able to tolerate a wide range of salinities with community structure and abundance varying over the salinity gradient within an estuary. The most abundant benthic assemblages in Matagorda Bay and Lavaca Bay are similar; however, the salinity ranges tend to differ, with Matagorda Bay from 18 to 32 and Lavaca Bay from 5 to 20. (Appendix B – Environmental Resources, Section 4.12.2)

5.3.3.3 Oyster Reef

During the construction phase of the recommended plan, 129.2, or ~130 acres of oyster reef habitat will dredged during the construction of the channel (Figure 42). Use of the American Oyster HSI model found a net loss of 79.3 AAHUs. The model calculated that 130 acres of new oyster reef would equal 79.8 AAHUs. The 130 acres of oyster reef would be constructed at locations within the Matagorda Bay. Although it is unknown how long the process may take, an oyster reaches the legal size of three inches in about two years, which a good estimate of the amount of time required for a reef to become productive. The unavoidable impacts to the oyster reefs constitute a significant adverse effect. Indirect effects to oyster reef habitat may result from a higher salinity regime due to the effects of channel improvements.

Indirect effects to oyster reef habitat may result from a higher salinity regime due to the effects of channel improvements. This has the potential to cause an increase in predators such as oyster drills and pathogens such as Dermo.

Water column turbidity would increase during project construction and maintenance dredging that could affect survival or growth of oysters. Heavy concentrations of suspended sediment can clog gills and interfere with filter feeding and respiration. Turbidity from the recommended plan should be temporary and local. The location of oyster populations can gradually shift in response to natural and man-made modifications in the bay system. Therefore, it is likely oyster reefs affected by implementation of the recommended plan could adjust to new conditions over time. As stated previously, ~130 acres of oyster reef would be created by the construction of new reefs within the Matagorda Bay system. (Appendix B – Environmental Resources, Section 4.12.3)

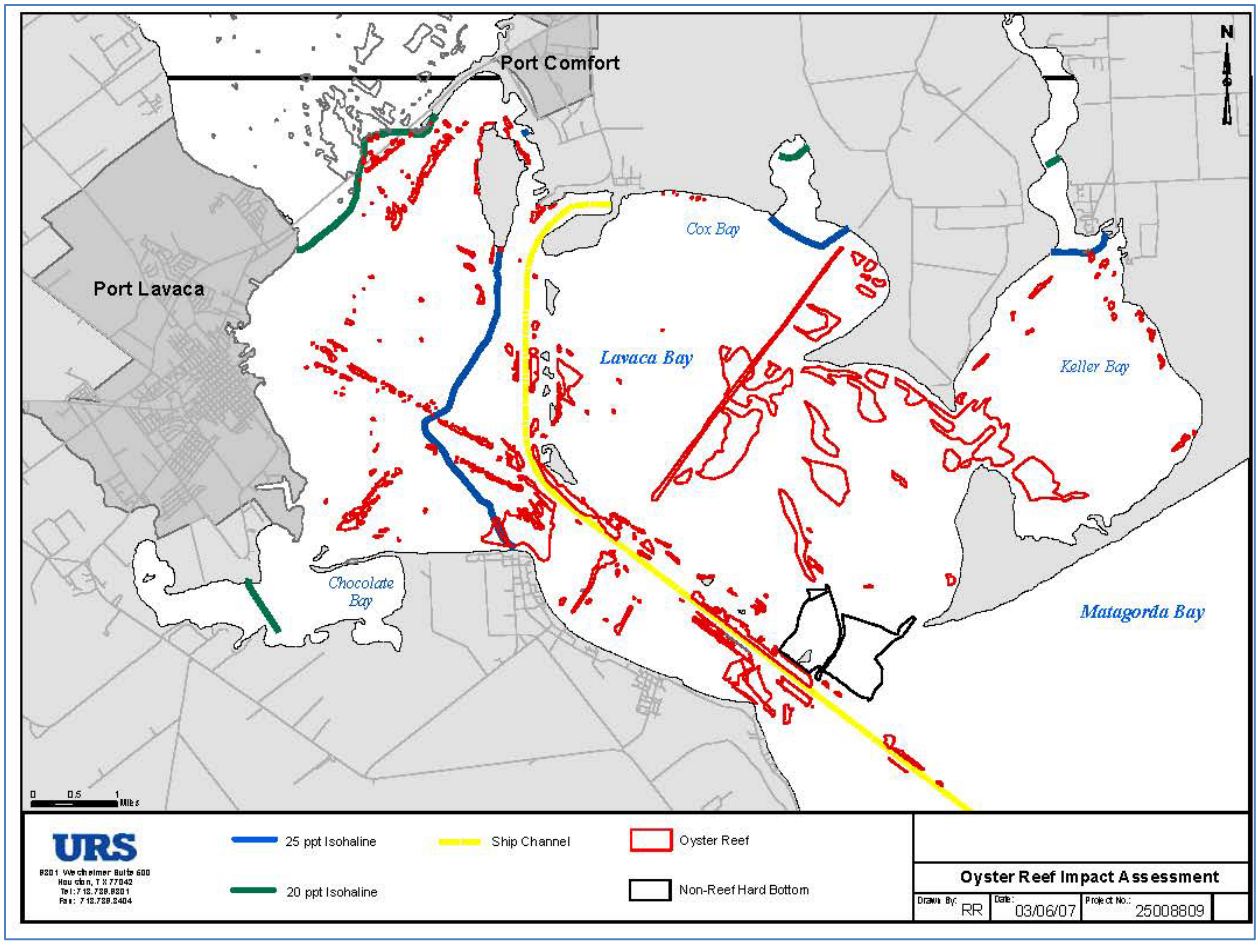


Figure 42 - Oyster Reefs within Lavaca Bay

5.3.4 Wildlife Resources

The dredged material would be deposited in one confined upland PA (PA P1), one confined in-bay PA, one ODMDS, and multiple unconfined in-bay PAs. Construction of these PAs would be unlikely to have a direct impact on wildlife species but may have an indirect impact by affecting the food supply of many terrestrial species.

The primary direct adverse impact of the recommended plan on wildlife would result from the placement of dredged material over the 50-year life of the project. Construction of PA P1 would directly affect ~246.5 acres of agricultural land (i.e., rice fields) and 1.5 acres of jurisdictional wetlands. This tract and adjacent areas provide important habitat for a wide variety of migratory bird species, including shorebirds, waders, waterfowl, raptors, and songbirds. Placement of dredged material within this site would result in the direct loss of habitat currently used by many species of shorebirds, waders, waterfowls, raptors, and songbirds.

Construction activities in the project area might result in the direct destruction of those organisms not mobile enough to avoid construction equipment. These would potentially include individuals of several species of reptiles, mammals, and if construction occurs during the breeding season, the young of some species, including nesting and fledgling birds. Most wildlife species, particularly adult birds and larger wildlife species, would avoid the initial construction

activity and move into available habitat outside the project area. Each species, however, is dependent upon available resources such as food, shelter, water, territory, and nesting sites in any given area of habitat. Displaced wildlife populations would be forced into competition with resident populations in adjoining habitats. Temporary, local impacts to terrestrial communities and habitats may occur due to these activities.

Construction activities in the project area might result in the direct destruction of those organisms not mobile enough to avoid construction equipment. These would potentially include individuals of several species of reptiles, mammals, and if construction occurs during the breeding season, the young of some species, including nesting and fledgling birds. Most wildlife species, particularly adult birds and larger wildlife species, would avoid the initial construction activity and move into available habitat outside the project area. Displaced wildlife populations would be forced into competition with resident populations in adjoining habitats. Temporary, local impacts to terrestrial communities and habitats may occur due to these activities.

Construction of the PA P1, and associated levee, would likely have additional indirect effects on wildlife by affecting aquatic organisms (Appendix B – Environmental Resources, Section 4.12) that serve as a food source for terrestrial species. Temporary impacts to aquatic communities and habitat from increased sedimentation and turbidity would be expected. This in turn may temporarily impact birds in the area by potentially reducing the availability of their local food supply. Noise and increased human activity during construction may temporarily impact wildlife in areas adjacent to the machinery. These impacts are expected to be minor and short term.

While dredging activities are unlikely to have a direct impact on wildlife species, they may have an indirect impact. Such activities may cause temporary impacts to aquatic communities and habitats, which in turn may indirectly impact seabirds in the area by potentially reducing the availability of the food supply. These impacts are local and temporary, and considering the large size of the bay and the mobility of birds, these effects are not likely to be significant. The increased potential for accidental spills of petroleum products, chemicals, or other hazardous materials during dredging activities, however slight, also poses a potential, although very small, threat to the aquatic community, and thus the food source of many coastal birds in the area.

The noise of equipment and increased human activity during dredging activities near shorelines may disturb some local wildlife, particularly, coastal birds, especially during the breeding season. Such impacts, however, would be temporary and without significant long-term implications.

Once the initial dredging activities associated with the project have been completed, only minor additional impacts are anticipated. Maintenance dredging activities would have similar temporary impacts as the initial dredging, but on a lesser scale and for a shorter term. Accidental chemical or petroleum product spills that may occur during dredging operations would pose a potential, albeit minor, threat to the aquatic community, and thus the food source of many coastal birds in the area. Impacts from noise and human activity are unlikely to be a substantial factor, although these impacts may force some mobile species to avoid the immediate vicinity of the project and move into similar adjacent habitats. However, these effects would be short term and no different from impacts associated with current maintenance activities. (Appendix B – Environmental Resources, Section 4.11)

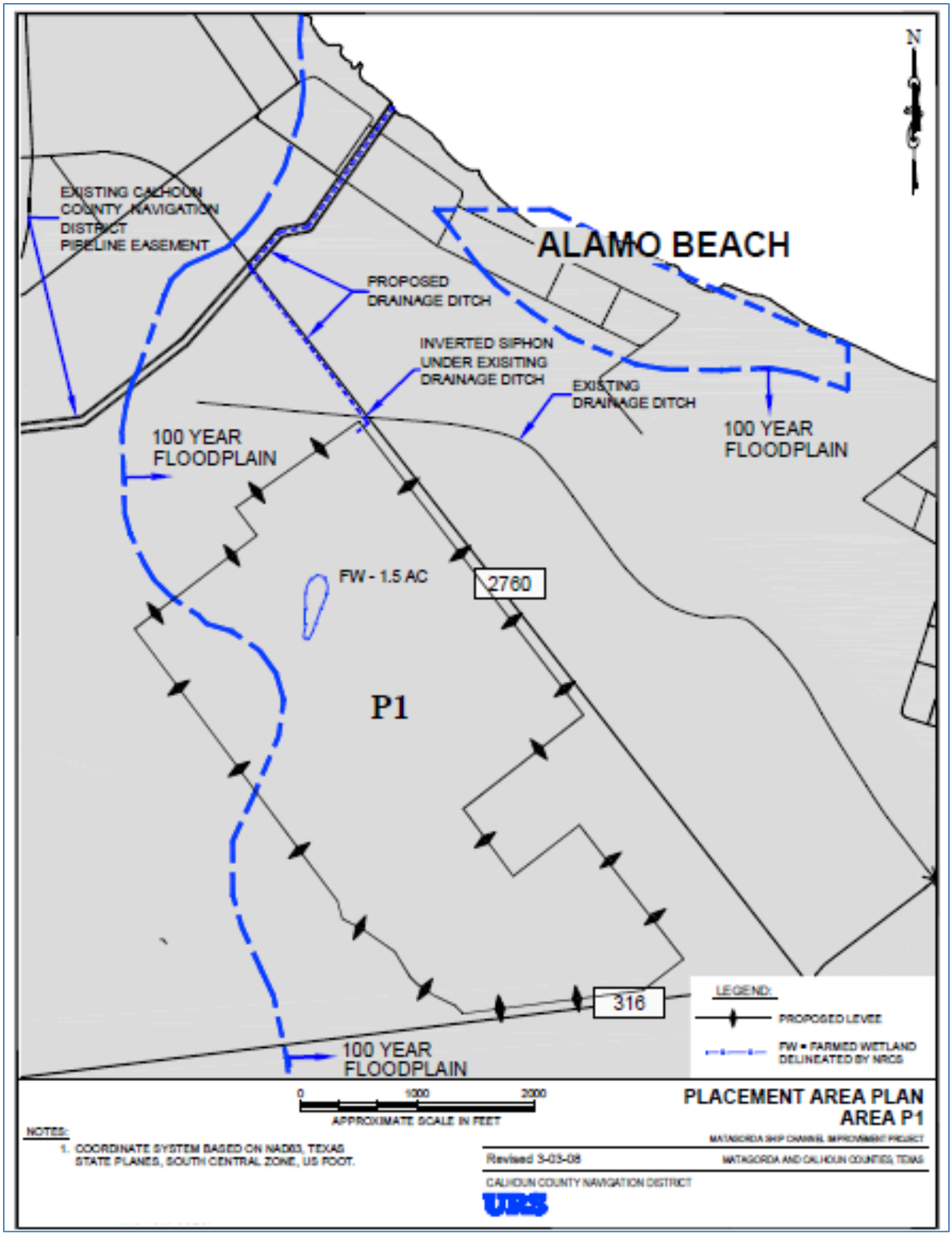


Figure 43 - PA P1 with Designated Wetland within Farmed Lands

5.3.5 Threatened and Endangered Species

Multiple threatened and endangered species were identified from county species lists provided by the USFWS. Inclusion in the list does not imply that a species is known to occur in the project area, but only acknowledges the potential for occurrence. Effect determinations for federally listed species are listed in Appendix B – Environmental Resources, Section 4.13, and Table 4.4.

The West Indian manatee is extremely rare in Texas and to date has not been seen in the project area. Potential impacts to the manatee of the proposed work would be indirect and minor. Should a manatee wander into the project area, the greatest threats would be from boat traffic or dredging operations. However, due to its rare occurrence, the project is not expected to have any significant impact on this species.

Piping plovers and red knots are potential winter residents (November – March), and spring and fall migrants in the project area. Piping plovers are known to occur in the project area. Critical habitats occur near the project area. Minor changes in salinity ant tidal amplitude as a result of the recommended plan are expected to have no impact on the piping plover or red knot. No placement of dredged material will occur within areas of designated critical habitat or in areas that include PCEs for piping plover. The designated critical habitat for the piping plover would not be directly affected by construction of dredging activities.

Other federal-listed species, such as the Northern aplomado falcon, least tern, and whooping crane could occur in the project vicinity. These species are not likely to be adversely affected by project activities. The Gulf jaguarondi is listed as potentially occurring in the project vicinity, though there are no known records of the species in the project vicinity and therefore the recommended plan will not likely adversely affect this species.

It has been well documented that hopper-dredging activities occasionally result in the sea turtle entrainment and death. Sea turtles easily avoid pipeline dredges due to the slow movement of the dredge. Apart from direct mortality, dredging activities could have an impact on sea turtles through an increase in sedimentation, turbidity, and resuspension of toxic sediments.

The sedimentation may affect food sources for the turtles, and the turbidity could affect primary productivity. However, this would be short term. The increased possibility of chemical or oil spills could pose a threat to turtles both directly and indirectly through their food source. While adult sea turtles may be mobile enough to avoid areas of high oil or chemical concentrations, hatchlings, post hatchlings, and juveniles in the area could be more susceptible.

Of the five species of sea turtles occurring in Texas waters, the leatherback sea turtle is the species to likely to be affected by the proposed project because of its rare occurrence and pelagic nature. It is unlikely to occur in the action area and has not been caught in hopper dredges. The proposed hopper dredging activity may affect, but is not likely to affect the leatherback sea turtle.

Sea turtle avoidance measures would include an avoidance plan for hopper dredge impacts to sea turtles. This avoidance plan includes reasonable and prudent measures that have largely been incorporated in USACE regulatory and civil works projects throughout the Gulf for more than a decade. These measures include use of temporary dredging windows when possible, intake and overflow screening, use of sea turtle deflector dragheads, observer reporting requirements, and sea turtle relocation/abundance trawling.

In summary, for nesting sea turtles (Kemp’s ridley, loggerhead, green and hawksbill) the conclusion is “may affect, but is not likely to adversely affect.” For nesting leatherback sea turtles the conclusion is “no effect.” For hopper dredging activities, the conclusion for the

Kemp's ridley, loggerhead, green, and hawksbill sea turtles is "likely to adversely affect", though this can be lessened to "may affect, but not likely to adversely affect" if other forms of dredging are utilized. The conclusion for the leatherback sea turtle is "may affect, but it not likely to adversely affect."

The Biological Opinion previously submitted for the Matagorda Ship Channel Improvement Project in 2014 is still applicable to this project. After personal communications with NMFS biologists in the St. Petersburg office regarding whether reinitiation was appropriate, the determination was made that, since construction had not commenced, the project is not demonstrably different, and the impacts are not larger than those outlined in the BO, reinitiation is not necessary. The take limits on turtles remains the same, as do all terms and conditions within the 2014 BO. (Appendix B – Environmental Resources, Section 4.13)

5.3.6 Essential Fish Habitat

All of the federally managed fisheries in and near the Matagorda Bay system utilize estuarine and gulf habitat during some portion of their life cycle for spawning, food, development, or protection (GMFMC, 2004). The recommended plan will have negative impacts, both directly and indirectly, to EFH in the project area. However, it also has the potential to enhance habitat for EFH throughout the Matagorda Bay system and offshore by the creation of marsh habitat and oyster reef. The recommended plan would temporarily affect EFH by distributing bottom sediments and increasing turbidity in both the marine and estuarine water column near the dredging activity, which can have adverse effects on finfish and shellfish species. Dredging would also directly affect estuarine and Gulf bottom habitats. Although considering the nature of the sediments that would be dredged and the temporary nature of the dredging, these impacts should not be significant.

Unavoidable impacts to EFH would be compensated for through the protection and creation of marshes, increasing the amount of nursery areas, protective habitat, and food sources within the Matagorda Bay estuary. While bay bottom habitat would be lost, the creation of marshes would help offset the effects of this bottom bay habitat loss since marshes provide essential habitat for federally managed species. The loss of oyster reef will indirectly benefit certain federally managed species and their prey given that the mercury-impacted area will no longer be available as habitat. The creation of potential oyster reef habitat could benefit federally managed species and their prey since the new habitat will be located in an unimpacted area.

NMFS was involved with the project from the early Interagency Meeting held in April 2017 through the review of the Draft FR-EIS. The agency representatives did not express the need for mitigation for bay bottom impacts in our discussions, nor did they provide written comments requiring such mitigation. (Appendix B – Environmental Resources, Section 4.12.4)

5.3.7 Air Quality

Temporary increases in air pollution would result from the equipment associated with construction of the Recommended Plan. Construction activities would be considered one-time activities, i.e., the construction activities would not continue past the date of completion. For purposes of estimating emissions, the construction activities would be projected to occur from the year 2020 to the year 2022. These air contaminant emissions would result from the use of marine vessels and land-based mobile sources during the construction activities.

Diesel fired-engines would be used during dredging operations, to transport materials to their designated locations, and for support of associated dredging equipment. This equipment would

include primarily dredges, booster pumps, barges, tugboats, transport and supply boats, survey boats, and crew boats. Emission sources related to the dredging operations can be found in Appendix B - Table 4.1-1. Equipment such as excavators, backhoes, and front-end loaders also would be required.

Emission rates for dredging and support equipment is directly related to the horsepower rating of the engines, load factors, duration of use, and amount of material to be dredged. Diesel fuel combustion in the internal combustion engines of the vehicles during dredging operations would result in emissions of CO, NO_x, particulate matter, SO_2, and volatile organic compounds.

The Matagorda region is in the Corpus Christi – Victoria Air Quality Control Region (AQCR) consisting of Aransas, Bee, Brooks, Calhoun, De Witt, Duval, Goliad, Gonzales, Jackson, Jim Wells, Kenedy, Kleberg, Lavaca, Live Oak, McMullen, Nueces, Refugio, San Patricio, and Victoria Counties. This AQCR meets all of the EPA NAAQS and is in compliance with the Clean Air Act. (Appendix B – Environmental Resources, Section 4.1)

Table 46 - Recommended Plan Construction Emission Sources

Construction Emission Sources	Quantity	Horsepower Rating
Dredging Equipment*		
30-inch Hydraulic Dredge	2	13,200
Hopper Dredge	1	18,000
Clamshell Dredge	1	2,340
Dredging Support Equipment*		
Booster Pump Barge	2	5,400
Dredge Tender Barge	4	150
Tug for Supply Barge	2	1,000
Tug Boat	2	850
Tug Boat for Dump Scow	1	3,500
Work Boat	2	350
Survey Boat	2	350
Crew Boat	2	350
Generator	2	7
Welding Machine	2	10
Air Compressor	2	55
Placement Area Construction Equipment*		
Cat D6 LPG Dozers	3	225
Hydraulic Excavator	3	250
200-ton Crane – Dragline	2	550
Spill Barge/Crane	2	416
Cat 325 Marsh Buggy	2	250
Generator	2	7
Mules	2	50
Air Compressor	2	55
Dump Truck – 20 yard	4	430
Light Plant	4	300
Commuter Vehicles		
Van	5	n/a
Cars	8	n/a
Trucks	17	n/a

*All equipment information is based on experience from past projects.

5.3.8 Noise

Dredging operations would generate noise from multiple sources of equipment, though dredges would be the primary contributor to the noise environment. Smaller vessels would not be expected to contribute appreciably to the noise associated with dredging operations. Table 47 provides a summary of dredging-related noise levels by equipment type.

Table 47 - Typical noise levels

Equipment	Noise Level (dBA)
Cutterhead Dredge (at 160 ft.)	79[1]
Hopper Dredge (at 50 ft.)	87[2]
Large Tug Boat (at 50 ft.)	87[3]
Small Tug Boat	72[3]
Bulldozer (at 50 ft.)	82[4]
Bucket Crane (at 50 ft.)	82[4]

[1]Geier & Geier Consulting, 1997
[2]Assumed same as large tug
[3]Epsilon Associates, 2006
[4]Federal Highway Administration, 2006

No permanent noise sources will be installed as part of the project. However, short-term noise levels could be elevated at the sensitive receptors in Magnolia Beach and Alamo Beach. The proposed project's dredging noise levels at sensitive receivers would be less than the existing ambient conditions beyond 4,100' from the channel. In other words, short-term noise levels from the project would be similar to those from ongoing maintenance dredging operations within the channel.

Under the proposed DMMP material would be placed in PA P1, a 248-acre site located south of FM 2760. Construction equipment would be utilized on as as-needed basis. Material would be delivered via pipeline and moved by earth-moving equipment. The typical noise level of a bulldozer operating at 50'. is ~82 dBA. Noise emissions would be reduced to 76 dBA at 100'., 70 dBA at 200'., and diminish further with increasing distance from the noise source. The noise levels are not expected to increase substantially as a result of the proposed project. (Appendix B – Environmental Resources, Section 4.2)

5.3.9 Soils and Prime and Other Important Unique Farmland

Under the recommended plan the proposed terrestrial upland area PA P1 located south of Alamo Beach on existing agricultural land would be impacted by placement of dredged material. This would cover soils currently used for agricultural purposes. The soil types impacted by this placement are Da (Polacios loam, 0 to 1%slopes, rarely flooded), Fr (Francitas clay loam, 0 to 1%slopes, rarely flooded), Lo (Livia silt loam, 0 to 1%slopes, rarely flooded), and Lv (Livia clay loam, 0 to 1%slopes). None of these soils is considered prime or unique farmland. Therefore, the project is in compliance with the FPPA.

Possible impacts to surface soils exist from the potential release of petroleum products during construction and hazardous material spills from hazardous cargo during shipping operations. However, the use of best management practices (BMPs) in the project area would minimize the potential for this type of impact. (Appendix B – Environmental Resources, Section 4.6)

5.3.10 Energy and Mineral Resources

No mineral activity will be interrupted by the project. Predominantly, the type of mineral activity at the project is oil and gas exploration and production. Based on the lack of local history of mineral activities and potential difficulties with title issues, mineral rights will not be acquired. No mineral exploration or production activity would be impacted due to the project (Appendix B – Environmental Resources, Section 4.5, and Appendix D – Real Estate, Section 9).

5.3.11 Water Quality

Under the recommended plan, factors that could affect DO include the increase in both water circulation and salinity. The increased tidal activity is primarily associated with the bottleneck removal, which is not part of this project. In general, increased water velocity would contribute to improved mixing and oxygen transport. The increase in salinity along the axis of the MSC will slightly reduce the DO saturation concentration and thus the absolute value by a similar amount.

Although there will be more maintenance material placed in Matagorda Bay under the recommended plan, the source of the material will not change, and the method of placement will not change. Open-bay placement of maintenance material would not occur in Lavaca Bay, and turbidity should decrease somewhat in that bay since the turbidity caused by placement of dredged material would not be added to the natural, wind-and-wave-generated turbidity. Also, the fine material that would have resulted from open-bay placement would not be available for resuspension in the water column. There is the possibility of contamination of the maintenance material by a spill or other event, as there is now, but deepening and widening the channel should increase safety and decrease the probability of a spill.

Open-bay placement of maintenance material will continue in Matagorda Bay, so turbidity impacts there should be roughly equivalent to the No-Action Alternative. Offshore placement of construction material will cause a one-time increase in turbidity at the construction material ODMDS, and offshore placement of future maintenance material will periodically create turbidity, as it does now.

Indicator bacteria are a water quality issue in the bay system. The project will not produce any significant alterations in runoff hydrology, so there should not be any change in runoff-related bacteria levels. However, because indicator bacteria are found in sediments (Fries et al., 2006) and the project will disturb sediments as part of the dredging process, some localized and short-term increases in indicator bacteria concentrations during dredging can be expected. (Appendix B – Environmental Resources, Section 4.9.3)

5.3.12 Sediment Quality

The recommended plan could result in the disturbance of bay sediments and subsequently impact the sediment quality in the project area. The primary concern with regard to sediment quality in the project area is mercury. Activities performed as part of the recommended plan that may potentially disturb bay sediments include dredging, placement of dredged material to build dikes or levees, placement of dredged material within placement areas, and building access channels for moving equipment. There is potential for a change in bay-bottom velocities due to a wider and deeper channel and the actions taken as part of the DMMP.

The area north of Dredge Island (PA ER3/D) was identified as an area of concern following the remedial investigation of the Superfund Site. Alcoa sampling data from 2005 confirmed elevated mercury concentrations in the area. The area is currently undergoing natural recovery by

sedimentation. However, the sedimentation rates in the area is lower than rates in the rest of the bay (Alcoa, 1997). No change in surficial sediment quality is expected under the recommended plan.

The quality of the maintenance material is not expected to change from the No-Action Alternative. While more maintenance material is estimated with the recommended plan, the source of the maintenance material will not change and the method of placement will not change in Matagorda Bay. However, the material from the Channel in Lavaca Bay will all be confined. Project actions should increase safety and decrease the probability of a spill. The USACE routinely tests the maintenance material according to the ITM and RIA protocols before dredging to ensure that there are no causes for concern. Past testing of maintenance material with chemical analysis, whole mud bioassays, and bioaccumulation studies has indicated no cause for concern.

Sediment testing will be undertaken during Pre-Construction, Engineering and Design (PED) phase to determine the concentrations of any contaminants present under the requirements of Section 103 of the MPRSA. This testing includes analysis of the sediment and elutriates to determine whether the sediment poses any potential toxicity to the benthic and open water biota in and around the open water placement areas. Bioassays of the sediment and elutriates are required under the testing regimen to allow for placement in an ODMDS. The sampling regimen will be detailed in the Sampling Analysis Plan to be written during PED. While the exact suite of contaminants to be analyzed will be determined in conjunction with the EPA during PED, examples of materials tested include heavy metals and hydrocarbons. (Appendix B – Environmental Resources, Section 4.9.4)

The DMMP was updated by removing PA ER3/D. NOTE: In 2002, the NFS and Alcoa Inc. entered into a Settlement Agreement WHEREAS, if mercury is present in, or on, or under all or part of the CCND owned lands, including submerged lands, described in the Lease Agreement dated June 16, 1982, those contaminated materials will be deposited in PA ER3/D. It includes a CONTRACT FOR DREDGE DISPOLSAL CAPACITY and TERM EASEMENT AND RIGHT OF WAY FOR ACCESS TO AND USE OF DREDGE ISLAND. See Volume 356, Page 681, of the Official Public Records of Calhoun County, Texas.

5.3.13 Hazardous Materials

The potential for encountering impacted material during the construction of the project is limited. Impacts associated with regulated facilities are most likely to be encountered near the source of the contaminants. These sources include, but are not limited to, industry located in the Point Comfort area. According to a review of database records and research of the environmental history of the region, the industrial activity adjacent to Lavaca Bay has caused measurable impacts to the terrestrials and marine environments adjacent to this and adjacent waterways.

The industrial activity adjacent to Lavaca Bay is extensive and primarily related to two large industrial complexes located immediately adjacent to the project. Industrial activity at Alcoa Point Comfort Operation and Formosa has resulted in quantifiable impacts to groundwater, surface water, soil, and sediment. Corrective action performed at both facilities has minimized the potential to encounter media during project construction. In spite of remedial activities, the potential for the project to encounter impacted media remains. The documented areas impacted by previous industrial activity are isolated to the Lavaca Bay adjacent to Point Comfort. According to the regulatory agency database report, the northern extent of the project enters into an area defined as a National Priority List (NPL or Superfund) site. This area has been defined as having been impacted by contaminant releases from the Alcoa facility. Data provided

by NOAA delineates elevated levels of mercury within sediment near Dredge Island. The concentrations of mercury within the impacted area range from below detection limits to 2.00 mg/kg.

Due to the prolonged use of portions of the area as military training, the potential of unexploded ordnance within the project area does exist. However, the potential to encounter unexploded ordnance during dredging activity is considered to be quite low. The existing channel has been maintained through maintenance dredging for the last 50 years and there has been no reported incidences of unexploded ordnance encountered in the Matagorda Bay area.

Dredge material will be tested for contaminants and if any are found, the Sponsor will be 100% responsible for investigation, removal and disposal of any HTRW involved with construction and O&M of the project in accordance with ER 1165-2-132 and PGL No. 34. (Appendix B – Environmental Resources, Section 4.8)

5.3.14 Environmental Justice – Executive Order 12989

This EO directs Federal agencies to determine whether their programs, policies, and activities would have a disproportionately high or adverse effect on minority or low-income population groups within the Project Area. Most of the project area is in the open waters of Matagorda Bay and the industrial part of the MSC, with large, relatively sparsely populated census tracts (due to the land use and water). As documented in Section 2.8.1, examination of the census where populated land was closest to the recommended plan indicated an average of 51% minority and an average median household income of $22,939 in Matagorda County, slightly below the state average. These blocks would be closest to the recommended plan footprint where direct effects experienced would be their greatest. Given the income and percent minority of those blocks, an EJ issue would not be expected. Therefore, the proposed action is not expected to have any disproportionately high or adverse effect on low-income or minority population groups. (Appendix B – Environmental Resources, Section 6.14)

5.3.15 Summary

The proposed project may affect federally listed endangered or threatened species. While interior least tern may be present in the project area, the species only needs to be considered under ESA for wind related projects along its migratory route. The golden orb, listed whale species, and listed coral species are unlikely to occur in the project area, and therefore, no effects are expected for these species. The project may affect, but is not likely adversely affect, the following species: Gulf coast jaguarondi, West Indian manatee, northern aplomado falcon, piping plover, red knot, and whooping crane.

Placement of dredged material may affect, but not likely adversely affect sea turtle species (green, hawksbill, Kemp’s ridley, leatherback and loggerhead). Dredging activities may affect, but not likely adversely affect some sea turtle species (green, hawksbill, Kemp’s ridley, and leatherback). Dredging activities are likely to adversely affect loggerhead sea turtles, but it is unlikely to jeopardize the continued survival or eventual recovery of these species. The project is unlikely to jeopardize/destroy or adversely modify critical habitat for any listed species. (Appendix B – Environmental Resources, Enclosure 3)

5.4 Cumulative Effects

The Council on Environmental Quality (CEQ) defines cumulative impacts as those impacts "on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or persons undertake such actions." Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Impacts include both direct effects (caused by the action and occurring at the same time and place as the action), and indirect effects (caused by the action but removed in distance and later in time, and reasonably foreseeable).

Cumulative effects can result from a wide range of activities including the addition of materials to the affected environment, repeated removal of materials or organisms from the affected environment, and repeated environmental changes over large areas and long periods. Complex cumulative effects can occur when different types combine to produce a single effect or suite of effects. Cumulative impacts may also occur when individual disturbances are clustered, creating conditions where effects of one episode have not dissipated before the next occurs (timing) or are so close that their effects overlap (distance).

In assessing cumulative impact, consideration is given to the following:

- The degree to which the proposed action affects public health or safety.
- Unique characteristics (physical, biological, and socioeconomic factors) of the geographic area.
- The degree to which the effects on the quality of the human environment are likely to be highly controversial.
- The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks, and
- Whether the action is related to other actions with individually insignificant, but cumulatively significant, impacts on the environment.

The methodology is consistent with similar Federal projects. (Appendix B – Environmental Resources, Section 5)

5.4.1 Assessment Method

The MSC, Texas, integrated EIS follows a traditional cumulative impact assessment method, addressing impacts for a finite set of criteria, comparing projects within the study area to the Recommended Plan. Thirteen cumulative impact criteria were identified to evaluate projects relevant to the future condition of the study area (project area and surrounding Calhoun and Victoria Counties). Eleven projects were considered; seven Past or Present Projects / Activities, and three Reasonably Foreseeable Projects / Activities (Appendix B – Environmental Resources, Section 5.2 and 5.3). (Appendix B – Environmental Resources, Section 5.1, and Table 5.2)

5.4.1.1 Evaluation Criteria

Criteria include ecological, physical, chemical, socioeconomic, and cultural attributes, listed in Table 48. These parameters were identified as key resources discussed in NEPA documents

and project reports, and they form a basis for comparison of other projects in the area with the Recommended Plan. (Appendix B – Environmental Resources, Section 5.1.1)

Table 48 - Cumulative Impacts Criteria

Ecological Environment	Physical/Chemical Environment	Socioeconomic Environment
Wetlands	**Air Quality**	**Recreational Fisheries**
Benthos	**Noise Impacts**	**Commercial Fisheries**
Essential Fish Habitat	**Sediment Quality**	
Threatened/Endangered Species	**Water Quality**	

5.4.1.2 Individual Project Evaluation

Ten past, present, and reasonably foreseeable projects/activities within the study area were determined relevant for this cumulative impacts analysis (in no particular order). These projects are listed in Table 49 and are compared to the Recommended Plan. (Appendix B – Environmental Resources, Section 5.1.2)

Table 49 - Past, Present, and Reasonably Foreseeable Actions within the Study Area

Past or Present Projects / Activities	Reasonably Foreseeable Projects / Activities
GIWW	**Jetty Stabilization Project**
Mouth of the Colorado River	**GIWW Reroute**
Formosa Plastics Corporation	**Port of Calhoun Expansion**
E.S. Joslin Power Station	**MSC Maintenance Dredging**
Alcoa	**Brazos River Floodgates / CO River Locks**
Palmetto Bend Project	
LCRA-SAWS Water Project	

5.4.2 Reasonably Foreseeable Future Actions

5.4.2.1 Jetty Deficiency Project

The entrance to the MSC passes through a man-made cut in the western end of the Matagorda Peninsula. North and south jetties were constructed in the 1960s on the Gulf-ward side of the entrance. The purpose of the jetties is to provide reliable and safe navigation through the Matagorda Peninsula to local ports. The jetties also protect the man-made cut through the peninsula from scour and erosion. The existing jetty channel is -38’ deep, 300’ wide, and about four miles long from the Gulf through the jetties to the inner channel.

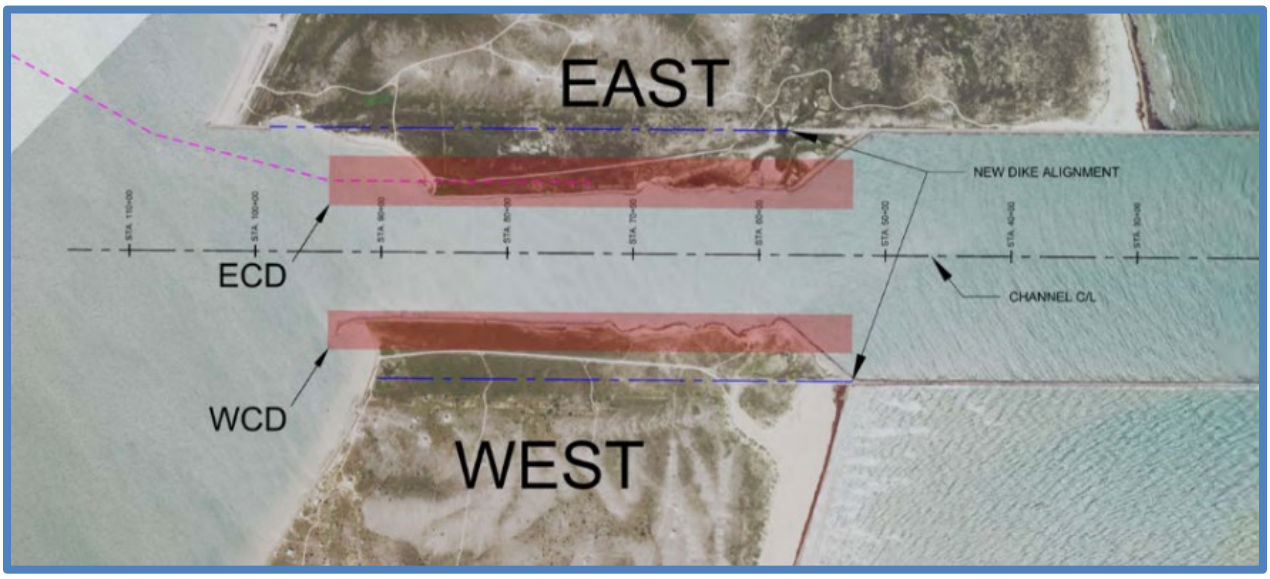
The Galveston and New Orleans Districts are in the process of completing a draft-jetty deficiency-report for a proposal to stabilize the MSC jetty at the entrance channel (USACE, 2018). In the report, the objectives of the jetty stabilization project are:

1. To improve the efficiency and safety of the deep-draft navigation jetty system, and
2. To maintain or enhance the quality of the area's coastal and estuarine resources. The current proposal is to remove the north and south bottlenecks and flange the bay entrance (USACE, 2018).

The removal of the bottleneck as currently proposed may increase tidal amplitude in the Matagorda Bay system. (Appendix B – Environmental Resources, Section 5.2.1)

The MSC Section 216 project is <u>not</u> dependent upon implementation of the Jetty Deficiency Project fix.

- The width of the current channel, with bottleneck (sides of channel in red polygons below), is already sufficient for Aframax vessels to pass.
- The Jetty Deficiency Project will remove the bottleneck making the distance between the two sides of the channel wider.
    - NOTE: This area corresponds to MSC ~Sta 0+000 to Sta 3+000 (Appendix F – Plate C-9).
- Currents through Matagorda Peninsula already scour the bottom of the channel of sediments. This is not expected to change. Dredged material is not expected to be removed between Sta -5+000 and Sta 6+000.



5.4.2.2 <u>GIWW Re-route</u>

The Galveston District proposes to reroute the GIWW across Matagorda Bay to provide safety improvements for shipping and reduce maintenance dredging frequency. The proposed alignment crosses the bay about a mile north of the existing channel. This will allow for both two-way traffic and safe navigational passage of vessels across strong currents at the MSC.

The GIWW reroute will affect ~350 ac of open-bay bottom from construction of the new channel. Up to 326 ac of bay bottom would be converted to marsh or bird habitat from placement of dredged material. Up to 70 ac of seagrass beds, 295 ac of marsh, and 31 ac of bird habitat could potentially be created in Matagorda Bay as a result of the project (USACE, 2002).

Remote-sensing surveys, including a close-order survey, and coordination with the Texas State Marine Archeologist determined that no cultural resources are present along the proposed channel alignment. PAs will be designed to avoid documented shipwrecks and anomalies with signatures similar to that of historic shipwrecks. Thus, no impacts to cultural resources are expected (USACE, 2002). (Appendix B – Environmental Resources, Section 5.2.2)

According to the Finding of No Significant Impact (FONSI) prepared by the USACE for the project (USACE, 2002), the following summarizes potential impacts associated with the project:

- Temporary impacts to aquatic habitat, fish, and invertebrates during dredging and placement activities.
- Impacts to seagrass, marsh, and terrestrial habitats from pipeline crossings on Matagorda Peninsula.
- No significant negative impacts to threatened and endangered species or historic resources.
- Temporary impacts to air quality and noise during dredging operations.
- No impact to water or sediment quality in Matagorda Bay, and
- No disproportionate impact to minority, low-income, or Native American tribal populations.

Potential benefits resulting from the proposed GIWW reroute include:

- Reduced risk of spills.
- Increased productivity in the bay from marsh creation.
- Benefits to endangered brown pelican from placement at Sundown Island.
- Benefits to threatened piping plover from beach nourishment.
- Decreased frequency of maintenance dredging reduces overall effects.
- Shoreline erosion protection from marsh creation and beach nourishment.
- Potential increase in seagrass beds.
- Increased recreational use from beach nourishment at Port O'Connor, and
- Contributing to littoral drift within the surf zone of Matagorda Peninsula and Island.

5.4.2.3 Port of Calhoun Expansion

Three current facilities are planning, or undergoing, expansion in anticipation of the increase of commodities traffic. Arrowhead Offshore is currently constructing a terminal with 250,000 barrels of crude oil storage. This terminal should be completed in June 2018. NorthStar Midstream is currently expanding their storage tank facility to allow for an additional 500,000 to 700,000 bbl. Formosa Plastics is expanding the operations of their chemical plant and should be completed in late 2018.

These impacts and benefits of these expansions are accounted for in the future-with-project conditions taking into account the increase in vessel traffic expected with the MSC. (Appendix B – Environmental Resources, Section 5.2.3)

5.4.2.4 MSC Maintenance Dredging

Ongoing maintenance dredging of Matagorda Ship Channel may effect oyster reefs through sedimentation and increases in turbidity during removal and placement of dredged material. If hopper dredging is used for the maintenance dredging activities there may be lethal take of sea turtles, particularly Kemp's ridleys. However, no lethal takes of sea turtles during maintenance dredging has occurred since before October 2008. (Appendix B – Environmental Resources, Section 5.2.4)

5.4.2.5 Brazos River Floodgates / Colorado River Locks

The Galveston District proposes to modify the flood gates where the GIWW meets the Brazos River and the locks where the GIWW meets the Colorado River. These modifications would alleviate navigational difficulties, delays, and accidents occurring as tow operators transit through the flood gates and lock structures and across the Brazos and Colorado Rivers. The plan includes removing the existing 75-foot Brazos River flood gates and building a 125-foot wide flood gate on the east side of the river. Construction of an open channel would occur on the west side of the river with a minimum width of 125 feet. The locks on both sides of the Colorado River would be removed and replaced with 125-foot sector gates. (Appendix B – Environmental Resources, Section 5.2.5)

5.4.3 Past or Present Actions

5.4.3.1 GIWW

On July 23, 1942, Congress authorized enlargement of the Gulf Section of the Intracoastal Waterway from Apalachee Bay, Florida, to Corpus Christi, Texas, for a 12-ft-deep and 125-ft-wide channel. Since that time, many improvements have been made. Impacts to the study area are primarily associated with maintenance dredging activities and include periodic impacts to bay bottom at the dredge and placement sites, temporary increases in turbidity, and potential for sea turtle takes. (Appendix B – Environmental Resources, Section 5.3.1)

5.4.3.2 Mouth of the Colorado River

The River Diversion Project, constructed in 1989–1992, diverted the flow of the Colorado River to the eastern arm of Matagorda Bay and closed Parker's Cut. The diversion cut was made to restore inflow from the river into the bay, and thus partially restore the fishery conditions that existed before deltaic growth and related dredging produced the direct discharge of river flow into the Gulf. The primary goal was to benefit bay and Gulf commercial fisheries by improving habitat. This included reducing bay salinities, increasing input of nutrients, and creating new intertidal marsh. The diversion cut has lowered bay salinities by 1.6 ppt (eastern arm of Matagorda Bay) and created intertidal marsh that serve as high-quality nursery area (Bass, 2003). Although dredging of the channel removed 104 ac of intertidal marsh, 305 ac of marsh had been created by 2004 as the new delta developed. The original EIS (USACE, 1981) predicted the eventual creation of 4,000 ac of new delta before 2100.

An additional 37 ac of viable oyster reef were created. Catch per unit effort (CPUE) and mean length for oysters remained stable. However, the project led to further burial of the remnants of Dog Island Reef, which had already been impacted by river deposits and dredging. The major oyster-producing reefs, Mad Island and Shell Island, are distant enough to avoid or minimize impacts from bacterial contaminations associated with increased inflow and should benefit from decreased occurrences of Dermo, a parasite that thrives in warm, high-salinity, warm-temperature waters.

There has been no change in finfish landings (i.e., Gulf menhaden, striped mullet, spotted seatrout, red drum); however, mean lengths for all species (except red drum) have decreased. Brown shrimp CPUE has increased, and white shrimp CPUE has decreased. There has been an increase in mean abundance of blue crab.

The diversion cut led to increased currents and navigation dangers at the intersection of the river and the GIWW. This has led to proposals to create another cut from the diversion channel to the old channel. (Appendix B – Environmental Resources, Section 5.3.2)

5.4.3.3 Formosa Plastics Corporation

Formosa currently operates eight plants and a variety of support facilities at a 1,800-ac complex in Point Comfort. Construction of the plant began in 1980, and it was in continuous production by 1983. In 1994 a $1.5 billion expansion was completed at the plant. The facility, which manufactures plastic resins and petrochemicals for a multitude of products and processes, is a major employer in the study area, employing 3,600 people in 2004. The facility was cited for environmental violations in 1990 by the Texas Water Commission and EPA. Violations included improper storage of oil and other waste, cracked wastewater retention ponds, and releases of acidic wastewater into surface water. Groundwater contamination also exists beneath the facility. Corrective action was taken under an EPA enforcement order in 1991 and entered into an EPA Region 6 – Texas Natural Resource Conservation Commission (now TCEQ) Corrective Action Strategy (CAS) pilot project. This was an aggressive program to assist in streamlining the RCRA Corrective Action Process and is a useful approach for facilities willing to commit resources up front to manage risk at their sites. As a result, approximately one-quarter of the cost for the $1.5 billion expansion in 1994 was for environmental protection features.

In addition, a Formosa Plastics Receiving Water Monitoring Program was established in 1993 to monitor the discharge of treated wastewater into Lavaca Bay from the Point Comfort Facility. The objectives of the Receiving Water Monitoring Program are as follows:

1. To establish baseline background conditions in Lavaca Bay in the area that receives the Outfall 001 discharge.
2. To monitor the health and structure of the biological community near the Outfall 001 discharge.
3. To monitor the sediment and water quality near the outfall discharge.
4. To evaluate compliance with the Texas Water Quality Standards (TWQS) (TAC Chapter 307).
5. To monitor fish and shellfish tissue constituent concentrations for animals in the vicinity of the outfall discharge to assess any potential human health risks, and
6. To comply with the requirements of the National Pollutant Discharge Elimination System (NPDES) Sampling and Analysis Program.

Data collection began in 1993 and is conducted quarterly as required by the TCEQ and the EPA. Over 43 sampling events have occurred, and more than 10 Annual Reports for the Receiving Water Monitoring Program have been submitted. The results of the monitoring program, to date, indicate that there are no adverse impacts to the health or structure of the biological community in Lavaca Bay. No adverse impacts have been noted in the water and sediment quality of Lavaca Bay near the discharge outfall since discharges first began. (Appendix B – Environmental Resources, Section 5.3.3)

5.4.3.4 E.S. Joslin Power Station

The E.S. Joslin Power Station generating facility is a 261-MW natural gas–fired facility that began power production in 1971. The facility was shut down in 2004.

The power station was built and activated before it was necessary to obtain an air emissions permit. Instead, several units had been operating under Permit by Rules designed for smaller air emission sources. However, in November 2002 the station did obtain a TCEQ Electric Generating Facility permit that covered the existing parameters for the site at that time, limiting sulfur content in the fuel oil and establishing a NO_x emissions allocation.

Studies were conducted by Central Power and Light Company (Moseley and Copeland, 1971) to assess potential impacts on bay resources from the release of heated effluent from the power station. Baseline field sampling was conducted in Cox Bay for 21 months prior to operation of the facility and post-operation sampling was conducted for 12 months. Sampling was conducted for nekton (i.e., fishes and large, free-swimming invertebrates such as shrimp) and phytoplankton. Environmental temperature ranges for 11 abundant vertebrate and invertebrate species were established, and results indicated no significant decrease in phytoplankton abundance or distribution as a result of power plant operations. (Appendix B – Environmental Resources, Section 5.3.4)

5.4.3.5 Alcoa

The Alcoa PCO plant currently operates one plant and a variety of support facilities at a 3,500-ac complex in Point Comfort, Texas. The PCO produced alumina between 1948 and 2016. Other facilities and operations have taken place at the PCO, including chloro-alkali processing from 1966 and into the 1970s, natural gas from 1958 to 1988, and coal tar from 1968 to 1985.

During the chloro-alkali processing operation from 1966 into the 1970s, mercury-laden wastewater was discharged into Lavaca Bay (mercury is involved in the processing). Additional unsuitable water may have entered Lavaca Bay through groundwater seepage. In 1988, the TDSHS issued a closure order banning consumption of finfish and crabs due to elevated mercury level in tissues. In 1994, the EPA added PCO contaminated sites to the NPL list and signed an Administrative Order on Consent to conduct a RI/FS under CERCLA.

The RI/FS revealed mercury contamination within the Lavaca Bay System, PCO soils, and groundwater. Within the bay system, the Witco Channel was found to contain 200,000 CY of mercury-impacted sediment. Proposed remediation measures included dredging and disposal of all mercury-impacted sediments within an on-site confined disposal facility on Dredge Island. The Witco marsh was also identified as a problematic site due to the high potential for bioaccumulation of mercury in local flora and fauna. Remedial measures of the marsh may include dredging or filling of the site. Bay bottoms in areas north of Dredge Island were also found to have high contamination. Two areas within the PCO were identified to have high mercury levels in soils. They are found below the former Witco area and the former chloro-alkali

processing area. These will be capped with clays, and then crushed rock. Lastly, groundwater below the PCO revealed unsafe mercury levels, and this water will be extracted, treated, and then discharged into Lavaca Bay. (Appendix B – Environmental Resources, Section 5.3.5)

5.4.3.6 Palmetto Bend Project

The Palmetto Bend Project, which included construction of a dam across the Navidad River, concrete spillway, multi-level river outlet works for water releases, and the impoundment of water in an 11,000-ac reservoir, was completed in 1981. The project uses Lake Texana to regulate flows of the Lavaca and Navidad rivers for supplying municipal and industrial water for Jackson and Calhoun counties, and for recreation and fish and wildlife habitat (US Bureau of Reclamation, 2008).

An EIS was conducted by the US Bureau of Reclamation (1974) to assess potential impacts to area habitats. As a result of the project, the most apparent losses include 16,300 ac of land, 11,000 ac of wildlife habitat, and 47 miles of stream and associated riverine habitat. Conversely, there were gains of 11,000 surface ac of water-oriented wildlife habitat, 11,000 surface ac of freshwater recreational opportunities, and a gain of 40,000 waterfowl using the reservoir (US Bureau of Reclamation, 1974). (Appendix B – Environmental Resources, Section 5.3.6)

5.4.3.7 Lower Colorado River Authority (LCRA) – San Antonio Water System (SAWS) Water Project

The LCRA and SAWS have joined together in the LCRA-SAWS Water Project. The goal of the project was to conserve and develop water for the lower Colorado River basin and the San Antonio area in the twenty-first century by conserving irrigation water and capturing excess river flows. Additionally, limited amounts of groundwater would be pumped for use by farmers in the lower Colorado River basin when surface water is lacking. The project can divert up to 1.5 million acre-feet per year (LCRA-SAWS, 2018).

The three main components of the LCRA-SAWS Water Project were:

1. Conservation of irrigation water used by rice farmers by improving irrigation canals, leveling farmland with laser technology, and planting higher-yielding and more-water-efficient varieties of rice.
2. Construction of off-channel reservoirs in the lower Colorado River basin to store excess surface water during flooding, and
3. Use of groundwater for agriculture in the Lower Colorado River basin when surface water is lacking.

The project included a 6-year study that began in 2004 to assess benefits and detriments to the community, Colorado River, and Matagorda Bay. The implementation of the proposed LCRA-SAWS Water Project could reduce freshwater inflows into Matagorda Bay. Studies unrelated to the proposed MSCIP are currently under way to assess potential impacts resulting from reduced freshwater inflows in the Matagorda Bay System. It is unknown at this time whether or not changes in salinities would affect marshes, seagrasses, oysters, or other aquatic species and/or habitats in the bay. (Appendix B – Environmental Resources, Section 5.3.7)

5.4.4 Cumulative Effects – Results

The following sections provide discussion regarding potential cumulative impacts resulting from the Recommended Plan combined with past, present, and reasonably foreseeable actions affecting the study area. (Appendix B – Environmental Resources, Section 5.4)

5.4.4.1 Wetlands and Submerged Aquatic Vegetation

Past actions in Matagorda Bay have negatively affected wetland habitat within the system. However, recent and future actions are subject to regulatory authority and impacts would be mitigated. Additionally, although the Colorado River diversion project affected about 104 ac of wetland, it is expected to create 4,000 ac of wetland habitat by 2092 as the new river delta builds. Planned projects in the bay are expected to impact ~60 ac of wetland and create about 905 ac, resulting in a net increase in wetland acreage in the bay. Potential changes in salinity and tidal amplitude due to the Recommended Plan and the USACE jetty stability project, combined, could result in a transition of marshes from freshwater to saline/brackish marshes.

Over 5,000 ac of bay bottom would be impacted in the bay. These impacts could result in the loss of SAV. However, ~325 ac of sand platform may be created as a result of the GIWW reroute. This sand platform is likely to recruit seagrass. Thus, no significant cumulative impacts to SAV in Matagorda or Lavaca bays are expected. (Appendix B – Environmental Resources, Section 5.4.6)

5.4.4.2 Aquatic Resources

Recreational and Commercial Fisheries

Past projects in the study area have resulted in impacts to fisheries in the Matagorda Bay system. There have been consumption bans on certain finfish and shellfish because of the mercury spill in Lavaca Bay, and decreases in CPUE have been noted. Additionally, although the GIWW resulted in a benefit for navigation access to the area, the Colorado River diversion resulted in increased currents and navigational hazards where the diversion channel meets the GIWW. None of the proposed future projects is expected to impact commercial or recreational fisheries in the study area. However, it should be noted that the net increase in marsh habitat expected in the bay could result in increased productivity, providing a benefit to fisheries in the bay. (Appendix B – Environmental Resources, Section 5.4.7)

Benthos and Oyster Reef

Information available at the time of this analysis for each of the past, present, and reasonably foreseeable projects in the study area indicated that greater than 9,358 ac of bay bottom was or will be directly impacted by 2092. This includes the loss of bay bottom associated with the diversion of the Colorado River, which is expected to continue to build marsh habitat as the delta builds. Approximately 5,900 ac would be or have been directly impacted by dredging operations. Organisms living in the benthos recover fairly quickly following a disturbance. However, the benthos in areas periodically disturbed for maintenance dredging, such as the GIWW and MSC, never fully returns to the pre-disturbed benthic fauna. Impacts to oyster reef associated with the proposed project are mitigated for by creating 133 acres of new oyster reef. The proposed GIWW reroute project was expected to result in the conversion of 305 ac of bay bottom to marsh and create 70 ac of seagrass habitat by 2004 and a total of 4,000 ac of marsh are expected to be created by 2092. Thus, although several acres of open-bay bottom are impacted, habitat created or protected in the bay is expected to increase productivity and

potentially benefit the health of the bay system. (Appendix B – Environmental Resources, Section 5.4.8)

5.4.4.3 Threatened and Endangered Species

In the past, actions that occurred in the study area have resulted in negative impacts to protected species. Hopper dredging activities have resulted in the take of three loggerheads, two Kemp's ridleys, and one green sea turtle in the entrance channel to the MSC since October 1996 (USACE, 2017). However, over time, mitigation measures applied to dredging activities and habitat creation, enhancement, and restoration activities resulting from enforcement of the ESA and other regulatory programs and conservation efforts have assisted in an increase in sea turtle populations in the area, particularly for Kemp's ridley (NPS, 2018). Due to past mitigation measures and the associated increase in sea turtle populations, it is reasonable to expect that hopper dredging activities associated with the

Recommended Plan for both construction and maintenance could result in the take of protected sea turtles. However, many of the mitigation measures proposed for the Recommended Plan and other reasonably foreseeable future actions discussed here would result in the creation of marsh and seagrass habitat that would increase the productivity within the bay beyond existing conditions. The increased productivity may be beneficial to sea turtles in the area. Because hopper dredges would not be used during the GIWW Reroute or the Jetty Stability project, no take of sea turtles is expected from these activities.

Shoreline erosion and increases in tidal amplitude over time have negatively affected habitat in the Matagorda Bay system, including habitat that may have previously supported piping plovers and other shoreline birds. Critical habitat for the piping plover is present in the study area, including on Matagorda Peninsula where the MSC enters Matagorda Bay. The Jetty Stabilization Project could result in impacts to that habitat. On the other hand, placement of beach-quality material from the GIWW Reroute on Matagorda Peninsula and Sundown Island could result in additional potential habitat for the piping plover. The Kemp's ridley sea turtle has nested on Matagorda Peninsula and Matagorda Island (NPS, 2018). Thus, placement of beach-quality material on Sundown Island, providing such placement follows USFWS guidelines, may be beneficial to nesting sea turtles. (Appendix B – Environmental Resources, Section 5.4.10)

5.4.4.4 Essential Fish Habitat

Although past, present, and reasonably foreseeable projects have or will impact EFH in the bay, as noted above, the creation, enhancement, or protection of more-productive habitats, such as marsh and seagrass beds, would benefit these species by providing productive feeding and potential nursery grounds. Thus, cumulative impacts to EFH are not expected to be significant. (Appendix B – Environmental Resources, Section 5.4.9)

5.4.4.5 Air Quality

The study area is currently considered an attainment area. Existing industrial facilities in the area are operating within regulated parameters. Temporary impacts from dredging activities have occurred and will continue to occur for maintenance dredging of channels in the bay. Air emissions associated with construction of the Recommended Plan and the GIWW reroute may temporarily affect the air quality of the study area. However, with both projects there is potential that maintenance dredging would need to occur less frequently, thus reducing the frequency of

maintenance dredging. Therefore, no cumulative long-term impacts to air quality are anticipated. (Appendix B – Environmental Resources, Section 5.4.1)

5.4.4.6 Noise

Noise receptors are located primarily along the west shoreline in Matagorda Bay. These receptors are far enough away from the MSC and GIWW reroute that vessel traffic and dredging operations are not likely to increase noise levels from ambient conditions. Likewise, industrial activities in Lavaca Bay are not likely to affect noise levels at receptors nearest them. Thus, no cumulative impacts to noise are anticipated. (Appendix B – Environmental Resources, Section 5.4.2)

5.4.4.7 Water Quality

The high mercury levels in sediments, resulting from the Alcoa discharges that led to the Superfund site investigations, caused water quality concerns. However, the water quality in the area is good, and should not be negatively impacted by the proposed dredging and dredged material placement. While the Colorado River Diversion lowered the salinity in the eastern arm of the bay system, there will be some increase in the salinity in the bay system with the present project. (Appendix B – Environmental Resources, Section 5.4.4)

5.4.4.8 Sediment Quality

As a result of discharges by Alcoa, there are wide areas of Lavaca Bay where the mercury concentrations in sediments are high, but none of these sediments will be dredged for the proposed project. (Appendix B – Environmental Resources, Section 5.4.5)

5.4.4.9 Hazardous Materials

Past actions in Matagorda Bay have negatively affected the bay system. Industrial activity by Alcoa and Formosa has resulted in quantifiable impacts to groundwater, surface water, soil, and sediment. Corrective actions were performed to minimize the potential for encountering impacted media. In addition, there are elevated levels of mercury at Dredge Island due to past releases by Alcoa. Due to prolonged use of portions of the Matagorda Bay area for military training, the potential of unexploded ordnance within the area does exist. However, the potential to encounter unexploded ordnance is considered to be quite low. (Appendix B – Environmental Resources, Section 5.4.3)

5.4.5 Cumulative Effects – Conclusion

Cumulative impacts due to past, existing, and reasonably foreseeable future projects, along with the Recommended Plan, are not expected to have significant adverse effects to resources in the study area. The majority of impacts associated with these projects would be temporary, and some result in positive impacts for the area. Existing governmental regulations, in conjunction with the goals and coordination of community planning efforts, address the issues that influence local and ecosystem-level conditions. Resources in the area are provided some protection through the coordination of the numerous stakeholder groups, local organizations, and State and Federal regulatory agencies, and through regulations such as the Texas Coastal Management Program (TCMP), the Clean Water Act, and the Clean Air Act. This coordination

and regulation of resources should prevent or minimize negative impacts that could threaten the general health and sustainability of the region.

Several of the projects included in the analysis involve dredging operations, which result in temporary impacts such as increased turbidity and air emissions and long-term impacts such as impacts to bay bottom. As described above, there would be a net increase in the productivity in the bay system as a result of mitigation associated with many of the proposed or ongoing projects. Overall, this would benefit the bay. Perhaps the most substantial impact would be potential for increased salinity and tidal amplitude in the bay, which could affect shoreline habitat. However, as previously discussed, the expected salinity changes are not outside the normal ranges for the species present in the system and changes in tidal amplitude are fairly minor. (Appendix B – Environmental Resources, Section 5.5)

5.5 Any Irreversible or Irretrievable Commitments of Resources

Involved in the Implementation of the Recommended Plan

The labor, capital, and material resources expended in the planning and construction of the Recommended Plan would be irreversible and irretrievable commitments of human, economic, and natural resources. Material resources would chiefly be the fuel spent in dredging, and the minor portion would be steel and concrete for the few structural components of the Recommended Plan, such as sheet piling and mooring dolphins. These commitments would be a relatively minor portion of the available material resources. The commitment of economic resources would be for a plan analyzed to reasonably maximize NED benefits to the Nation, producing more in net annual benefits than cost, as demonstrated in the economic analysis for this study. The oyster reef, an impacted fisheries resource, would be mitigated, and would therefore be replaceable. (Appendix B – Environmental Resources, Section 5.4.11, and Section 7)

5.6 Cultural Resources

The proposed action includes deepening and widening of the existing channel, and the construction of new PAs, and the expansion of existing PAs, along the margins of the channel and in upland areas. The area of potential effect (APE) for the proposed action consists of the footprint of all areas directly affected by deepening, widening, and dredged material placement.

Based on the current information for the proposed action, there is a potential to affect historic properties. These affects consist of direct impacts from dredging activities related to construction and impacts from dredged material placement, specifically disturbance of the gulf and bay bottoms. The USACE recommends intensive cultural resources investigations to identify and evaluate any historic properties within proposed construction areas. The scope of these investigations will be determined in concert with the Texas State Historic Preservation Officer and Native American Tribes and in accordance with the Programmatic Agreement for this project (Appendix C).

5.7 Real Estate

The CPA owns ~63,010 acres of submerged land located in Matagorda and Lavaca Bays, Calhoun County, Texas. The CPA is required to furnish all lands, easements, rights-of-way,

relocations, and disposals (LERRD) required for the construction, operation and maintenance of the proposed project, including those required for relocations (i.e., PL 91-646 relocations and utility/facility relocations), borrow material, and dredged or excavated material disposal for the proposed cost-share project. The CPA has authority and capabilities to furnish lands, easements, and right-of-way in accordance to the project cost agreement (Appendix D – Real Estate, Section 4).

Utilizing Railroad Commission of Texas data[10], as well as CPA easement documents and records, 16 pipelines were identified within the channel that may require removal or relocation. There are eight in-service pipelines and one abandoned pipeline in Lavaca Bay, five in-service and one abandoned pipeline in Matagorda Bay, and one in-service pipeline crossing the Entrance Channel (Appendix D – Real Estate, Section 12).

5.7.1 New Real Estate Requirements

The NFS owns the land for upland PA P1, which will only be used in the unlikely event additional capacity is needed as determined in PED. If needed for the project, a utility/pipeline easement will be necessary to move the dredged material from the bay to PA P1. The NFS has already secured the right-of-way for approximately half of the lands necessary for the utility/pipeline easement to PA P1; however an additional easement totaling 1.33 acres will need to be acquired. If PA P1 is used for the project, the NFS will receive LERRD crediting (Appendix D – Real Estate, Section 4.2).

The use of PA P1 will result in the loss of 1.5 acres of marsh, requiring acquisition of 2 acres of mitigation land. A location for mitigation has not yet been identified, but an estimated cost of acquisition of mitigation lands is included in the REP.

The new least cost placement plan creates several new open water PAs to include an offshore dispersive site (O5) and a SE to the south east of the entrance channel. It also includes the creation of several in-bay PAs (NP1-7 and OP1-10). Under navigational servitude, no acquisitions of lands are necessary for this aspect of the project.

5.8 Socioeconomics

The deepening and widening of the channel is not anticipated to affect the distribution of these socioeconomic and demographic metrics within the study area.

Detailed socioeconomic and demographic information characterizing industry, income, unemployment, age, and race in the study area can be located in Section 2.8 of this report, and in Appendix A - Economics, Section 8.

[10] https://rrc.texas.gov/about-us/resource-center/research/gis-viewers/

6 Plan Implementation

6.1 Placement of Dredged Materials on Beaches

The DMMP developed for the MSC, Texas study is the least cost Placement plan (Appendix E – DMMP, Section 6.2). Assessment by the USACE Hydraulics and Hydrology Branch concluded that if the land surrounding jetty continues to erode the southwest jetty will fail and likely cause closure of the entrance channel. Therefore, a SE was formulated to address this). The SE is an approximate 165-acre, rectangular shaped site located at the entrance channel southwest of the jetties. The SE was not in previous DMMPs, but deemed as a necessity to reduce erosion at the southwest jetty.

The SE will accept both new work and maintenance materials in the 50-year DMMP. The material in the SE will also nourish the beach as dredge material is carried west by virtue of longshore drift. (Appendix F – Engineering, Section 6.10)

Reach Description	Reach Stationing	Dredging Quantity (cy)	Placement Area	Type of Dredge
New Entrance Channel Extension	-33+000 to -20+000	2,383,334	New Work ODMDS 05	Hopper
Entrance Channel	-20+000 to -6+000	2,265,543	ODMDS 05	Hopper
Jetty Channel	-6+000 to 0+000	549,977	Sundown Island	Pipeline
Matagorda Bay	0+000 to 45+000	4,917,397	Sundown NP1,NP2	Pipeline
Matagorda Bay	45+000 to 75+000	3,775,899	NP2,NP3	Pipeline
Lavaca Bay	75+000 to 95+000	2,260,593	NP3,NP4, NP5	Pipeline
Lavaca Bay	95+000 to 105+000	1,532,673	NP5,NP6	Pipeline
Lavaca Bay and New 1,200' Turning Basin	105+000 to 116+223	2,707,704	NP6,NP7	Pipeline
Point Comfort Turning Basin	116+223 to 117+223	293,024	NP7	Pipeline
Point Comfort North and South Basins	117+223 to 118+502	277,253	NP7	Pipeline
Total New Work		20,963,397		

Figure 44 - New Work Quantities with Placement Areas

6.2 Dredged Material Management Plan

A DMMP is prepared for any alternative plan, except for the No Action Plan.

All federally maintained navigation projects must demonstrate that there is sufficient dredged material disposal capacity for a minimum of 50-years. A preliminary assessment is required for all Federal navigation projects to document the continued viability of the project and the availability of dredged material disposal capacity sufficient to accommodate 50-years of maintenance dredging. If the preliminary assessment determines that there is not sufficient capacity to accommodate maintenance dredging for the next 50-years, then a dredged material management study must be performed.

The MSC DMMP (Appendix E) addresses the dredging needs, disposal capabilities, capacities of PAs, environmental compliance requirements, and potential for beneficial usage of dredged material, and indicators of continued economic justification. The MSC DMMPs would be updated periodically to identify any potentially changed conditions.

The MSC DMMP identifies specific measures necessary to manage the volume of material likely to be dredged over a 50-year period, from both construction and maintenance dredging. Non-Federal, permitted dredging within the related geographic area shall be considered in formulating Management Plans to the extent that disposal of material from these sources affects the size and capacity of PAs required for the MSC.

It is the USACE policy to accomplish the disposal of dredged material associated with the construction or maintenance dredging of navigation projects in the least costly manner. Disposal would be consistent with sound engineering practice and meet all Federal environmental standards, including the environmental standards established by Section 404 of the Clean Water Act of 1972 and Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972, as amended.

6.2.1 Initial Dredging (New Work)

The volume calculations are based on the channel dimensions. The volume calculations include both the overdepth and advanced maintenance requirements (Appendix E – DMMP, Section 4.1).

6.2.2 Maintenance Dredging

The estimated annual maintenance dredging volume is based on a CSAT modeling software that calculates the volume using: historic dredging records, total suspended sediment concentrations, hydrodynamics of the proposed channel, and the amount and location of material placed in unconfined placement areas. Projected annual maintenance volumes for each reach of the channel are provided Appendix E – DMMP, Section 4.2. All open water placement areas for maintenance material theoretically have an unlimited capacity since they are unconfined and dispersive.

6.2.3 Typical Dredging Equipment

The type of dredging equipment considered depends on the type of material, the depth of the channel, the depth of access to the disposal or placement area (PA), the amount of material, the distance to the disposal or PA, the wave-energy environment, and so forth (Appendix E – DMMP, Section 5). Based on these considerations, three types of dredging equipment will be utilized as follows:

1. Hydraulic Pipeline Dredges in Lavaca Bay and Matagorda Bay Reaches,
2. Hopper dredge or clamshell dredge with dump scows in portions of the Matagorda Bay Reach, and
3. Hopper dredge and Hydraulic Pipeline Dredges in the Offshore Reach.

A detailed description of the types of dredging equipment can be found in EM 1110-2-5025, *Dredging and Dredged Material Management* (USACE, 1983.).

6.2.4 New Least Cost Placement Plan

Redundant placement areas have been removed from the placement plan to reduce costs due to cutting construction costs and less material required to be dredged at longer distances (Appendix E – DMMP, Section 6.2). PA ER3/D was determined to be unnecessary to construct since sheet pilings would have to be placed along the entire perimeter of the newly constructed portion of the placement area to contain existing unsuitable material that may be stirred up while dumping new material. The construction of PA P1 has been determined to be unnecessary unless additional placement capacity is needed for new work dredge material. The SE was added to the placement plan under advisement of Galveston Hydraulics and Hydrology Branch to reduce erosion at the southwest jetty. Placement areas will remain on the west side of the channel with exception of NP7, OP10 and Sundown Island on the east side of the channel. Updated placement plan is illustrated in Appendix F – Engineering, Plate D-01.

6.2.5 Description of Placement Areas

See Main Report Section 4.11.12 and Appendix E – DMMP, Section 7.

6.3 Mitigation

There are unavoidable impacts to oysters and marshes, after minimization and avoidance efforts were completed. Placement of dredged material would result in the loss of 1.5 acres of marsh at PA1. The Habitat Suitability Index (HSI) model for clapper rail (Lewis and Garrison, 1983) was used to estimate impacts and mitigation requirements. The model indicates the loss of 0.8 Average Annualized Habitat Units (AAHUs) from the material placement. The clapper rail model indicated 2 acres of marsh mitigation would be required to achieve a replacement value of 0.9 AAHUs.

During the construction phase of the TSP, 129.2, or ~130 acres of oyster reef habitat will be dredged during the construction of the channel. Use of the American Oyster HSI model found a net loss of 79.3 AAHUs. The model calculated that ~130 acres of new oyster reef would provide 79.8 AAHUs.

The HSI was used to quantify the loss of functional value of oyster reef habitats impacted. A second HSI was used to quantify the loss of functional value of marsh and farmed wetlands.

The HSI addresses losses due to placement of new work and maintenance material over a 50-year planning period. The analysis is also used to ensure that proposed mitigation would restore all lost functional value over the 50-year analysis period. The HSI for marsh and farmed wetland was calculated using the model for clapper rail using a spreadsheet certified for one-time use by the USACE Eco-PCX.

The recommended plan channel modifications would not impact any wetlands. The placement of dredged material will impact 1.5 acres of marsh lands. Two acres of marsh mitigation will be done in accordance with ER 1165-2-27 (Establishment of Wetland Areas in Connection with Dredging).

Selection of potential mitigation sites and modeling of benefits will be conducted in coordination with resource agencies during PED. The location of the marsh mitigation sites will be, to the extent practicable, within the areas surrounding Matagorda Bay. In addition, the location of oyster reef mitigation will be within the Matagorda Bay system. Periodic meetings with the resource agencies have been ongoing to try to narrow down locations for the mitigation. (Appendix B – Environmental Resources)

6.4 Design and Construction Considerations

- Construction occurs between 2020 and 2024.
- The Non-Federal Sponsor shall be responsible, as between the Government and the Non-Federal Sponsor, for the costs of HTRW cleanup and response, including the costs of any studies and investigations necessary to determine an appropriate response to the contamination as stated in the Project Partnership Agreement (PPA). Such costs shall be paid solely by the Non-Federal Sponsor without reimbursement, or credit, by the Government.
- The DMMP was updated by removing PA ER3/D. NOTE: In 2002, the NFS and Alcoa Inc. entered into a Settlement Agreement WHEREAS, if mercury is present in, or on, or under all or part of the CCND owned lands, including submerged lands, described in the Lease Agreement dated June 16, 1982, those contaminated materials will be deposited in PA ER3/D. It includes a CONTRACT FOR DREDGE DISPOLSAL CAPACITY and TERM EASEMENT AND RIGHT OF WAY FOR ACCESS TO AND USE OF DREDGE ISLAND. See Volume 356, Page 681, of the Official Public Records of Calhoun County, Texas.

6.5 LERRD Considerations

The MSC is an existing Federal project. The Lands, Easements, Rights-of-way, Relocations, and Disposal areas (LERRDs) required to construct, operate, and maintain the recommended alternative are identified in the Real Estate Plan (Appendix D). The non-Federal sponsor (NFS) is required to furnish all LERRD for this proposed cost-shared project.

The NFS will be responsible for removal of pipelines obstructing the channel. The Galveston District's policy states that existing pipelines (measured from the top of the pipe) shall have, "a minimum of 20 ft. below the authorized project depth of the channel plus a distance of 50 ft. on each side of the channel measured from the bottom edge of cut and perpendicular to the centerline". Any pipelines that are not deep enough to comply with the District's clearance requirements within the proposed channel template will have to be removed or relocated. During this study, 16 pipelines were identified for removal or relocation. This number will need to be

verified in PED. The NFS must bear at least 50% of the cost of utility relocation for projects with an authorized depth of greater than 45' as required by WRDA Section 101(a)(4) and explained in PGL 44. The law apportions the remaining payment responsibility to the pipeline owner. Costs borne by the NFS for utility relocations are credited toward the NFS's additional payment of 10% of the cost of the general navigation features. To the extent that the total amount eligible for credit under Section 101(a)(2) exceeds 10% of the total cost of the general navigation features, the NFS shall not be entitled to reimbursement.

The NFS has already secured the right-of-way for approximately half the lands necessary for the utility/pipeline easement from the bay to PA P1, however, an additional easement totaling 1.33 acres will need to be acquired. As a result of affecting the marshland in upland PA P1, up to 2 acres of mitigation lands will need to be acquired by the NFS. The NFS will be eligible for LERRD credits for all land costs and the administrative costs associated with providing LERRD. (Appendix D – Real Estate)

6.6 Operations and Maintenance Considerations

- Deeper dredging, both new and maintenance, at the offshore bar is being implemented, since the bar is limiting the draft of vessels. (Appendix F – Engineering, Section 9.0)

6.7 Institutional Requirements

6.7.1 Coast Guard Coordination

The Galveston District, in cooperation with the Pilots, would coordinate directly with the Coast Guard concerning the installation and modifications of aids to navigation, the regulation of lightering areas (docking and loading areas used to off-load heavy cargo from larger vessels to smaller vessels and vice versa), anchorage and channels. (Appendix F – Engineering, Section 6.7)

6.7.2 The USACE Campaign Plan[11]

The USACE has developed a campaign plan with a mission to "deliver vital engineering solutions, in collaboration with our partners, to secure our Nation, energize our economy, and reduce risk from disaster." This Campaign Plan shapes the USACE command priorities, focuses transformation initiatives, measures and guides progress, and helps the USACE adapt to the needs of the future.

The Recommended Plan does address Goals 2 and 4 of the Campaign Plan.

- Campaign Plan Goal 2: Deliver enduring and essential water resource solutions using effective transformation strategies
    - Objective 2c: Deliver quality solutions and services
    - Objective 2d: Deliver reliable, resilient, and sustainable infrastructure systems

[11] http://www.usace.army.mil/about/campaignplan.aspx.

- Campaign Plan Goal 4: Build resilient people, teams, systems, and processes to sustain a diverse culture of collaboration, innovation, and participation to shape and deliver strategic solutions
    - Objective 4b: Enhance trust and understanding with customers, stakeholders, teammates, and the public through strategic engagement and communication

6.7.2.1 Environmental Operating Principles[12]

In 2002 and again in 2012, the USACE formalized a set of Environmental Operating Principles (EOPs) applicable to decision-making in all programs. The principles are consistent with the National Environmental Policy Act (NEPA), the Army Strategy for the Environment, other environmental statutes, and the Water Resourced Development Act (WRDA) of 2007. The EOPs inform the plan formulation process. They are integrated into all project management processes.

The Recommended Plan is consistent with the EOPs, which are as follows:

- Foster sustainability as a way of life throughout the organization
- Proactively consider environmental consequences of all the USACE activities and act accordingly
- Create mutually supporting economic and environmentally sustainable solutions
- Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the USACE, which may affect human and natural environments
- Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs
- Leverage scientific, economic, and social knowledge to understand the environmental context and effects of the USACE actions in a collaborative manner
- Employ an open, transparent process that respects the views of individuals and groups who are interested in the USACE activities

[12] http://www.usace.army.mil/Missions/Environmental/Environmental-Operating-Principles/

7 Summary of Coordination, Public Views, and Comments

7.1 Compliance with Environmental Requirements

7.1.1 Clean Air Act

It is not anticipated emissions would be above de minimis requiring a Formal Determination of Conformity. A Draft General Conformity Determination (GCD) would be prepared to help determine if emissions that would result from construction of the proposed action are in conformity with the Texas State Implementation Plan (SIP) for the Corpus Christi-Victoria AQCR and consultation and coordination with the TCEQ and the EPA would be initiated. The Draft GCD will be publicly coordinated in accordance with 40 CFR Part 93, and a Final GCD, with the results and details of the air conformity threshold analysis issued after the coordination and required public noticing and comment period. A public notice of availability for the Final GCD will also be published as required by 40 CFR Part 93. (Appendix B – Environmental Resources, Section 6.1)

7.1.2 Clean Water Act

An extensive review of existing past maintenance and new work sediment testing data covering the MSC was performed to determine the next steps in applying the procedures pursuant to USACE Regulatory Guidance Letter (RGL) 06-02, the Section 404(b)(1) guidelines, and the related joint testing manuals developed for them, including the Upland, and Inland Testing Manuals, as needed and appropriate, for the placement methods and sites selected during the development of the DMMP for the recommended plan. A draft 404(b)(1) Evaluation Form for the recommended plan channel modifications and DMMP has been prepared and was released concurrent with the release of the Draft EIS. (Appendix B – Environmental Resources, Section 6.2)

7.1.3 Marine Protection, Research, and Sanctuaries Act – Section 103

The currently permitted Offshore Dredged Material Disposal Site (ODMDS) has been identified as one of the existing placement areas in the Matagorda Bay system that will be considered for maintaining recommended plan features. New work Material from the existing channel is approved to be placed in the ODMDS. It is expected that maintenance material from the recommended plan improvements directly adjacent to the existing MSC in this reach is similarly of suitable quality and would be approved for placement there. This necessary testing to establish suitability according to the Ocean Testing Manual will be identified and performed in later planning phases and coordination with EPA Region 6 will be conducted to verify the suitability. (Appendix B – Environmental Resources, Section 6.3)

7.1.4 Endangered Species Act – Section 7

Compliance with the Endangered Species Act (7 USC. 136; 16 USC. 460 et seq.) is being coordinated with the USFWS and the National Marine Fisheries Service (NMFS) for those species under their respective jurisdictions. A final BA is included with the FIFR-EIS. The

USACE has provided a copy of the BA to the USFWS and NMFS. Discussions with NMFS have confirmed that the BO issued for the MSCIP study in 2009 is still valid and reinitiating is not necessary unless the impacts change significantly. Formal consultation with USFWS was reinitiated due to the listing of the red knot in 2015. There are two versions of the BA included in the Environmental Appendix. The first is the original BA used by NMFS for their BO in 2009. The second version is the revised BA that was used for the reinitiated consultation with USFWS in 2018.

The BA covers the proposed action of the recommended channel modifications and the DMMP. The determination of may affect, but not likely to adversely affect, was made for sea turtles with respect to placement of material. The determination of may affect, but not likely to adversely affect, was made for leatherback sea turtle, but a determination of likely to adversely affect was made for sea turtles with respect to dredging. The existing ODMDS offshore placement site approved under MPRSA is located in the Sargassum critical habitat designated in 2014 for the Loggerhead turtle, which are essentially offshore Gulf waters from the 10-meter contour. The conditions placed on dredging within the MSC are identical to those for avoiding loggerheads in their critical habitat. Discussions with NMFS have indicated that this will not be cause for reinitiating of consultation. In order to limit impacts to nesting sea turtles from sand placement geotechnical cores will be taken to determine the suitability of the material for beach placement.

The determination of no effect was made for Gulf Coast jaguarondi and northern aplomado falcon with respect to both dredging and placement of material. The determination of may affect, but not likely to adversely affect, was made for whooping crane, piping plover, red knot, and West Indian manatee with respect to both dredging and placement of material.

Though it is not likely that West Indian manatee, and the other listed marine and shorebird species would be encountered within the recommended plan's project area, their presence in the area is possible. An advisory for construction contractors to be aware of their possible presence, and contact numbers to immediately call in case of contact with any of these species for the USFWS's Corpus Christi Coastal Ecological Services Field Office in the case of listed shorebirds, or the Marine Mammal Stranding Network in the case of a turtle or manatee, will be added to the USACE contract specifications for this project.

Best management practices would be utilized, to the maximum extent practicable, to avoid project construction impacts to any T&E species or their critical habitat within the project area. The USACE will continue to closely coordinate and consult with the USFWS and the NMFS regarding T&E species under their jurisdiction that may be potentially impacted by implementing the proposed action. Consultation will not be considered complete until the Record of Decision is signed. (Appendix B – Environmental Resources, Section 6.4)

7.1.5 Magnuson-Stevens Fishery Conservation and Management Act

EFH consists of habitat necessary for spawning, breeding, feeding, or growth to maturity of species managed by Regional Fishery Management Councils (RFMC) in a series of Fishery Management Plans (FMPs). The Gulf of Mexico Fisheries Management Council (GMFMC) is the RFMC applicable to the project location. EFH is designated for the project area in which the recommended plan is located. Consultation with NMFS had been initiated. (Appendix B – Environmental Resources, Section 6.5)

7.1.6 National Historic Preservation Act – Section 106

It has been determined that there is a potential for new construction, improvements to existing facilities, and maintenance of existing facilities to cause effects to historic properties.

Therefore, in accordance with 36 CFR 800.14, the USACE executed a Programmatic Agreement between the USACE and the Texas SHPO to address the identification and discovery of cultural resources that may occur during the construction and maintenance of proposed or existing facilities. The USACE will also invite the ACHP and Native American tribes to participate as signatories to the Programmatic Agreement prior to construction activities. A draft of the Programmatic Agreement is provided in Appendix C – Cultural Resources. (Appendix B – Environmental Resources, Section 6.6, and Appendix C – Cultural Resources)

7.1.7 Coastal Zone Management Act

The Texas Coastal Management Program (TCMP) is the State entity that participates in the Federal Coastal Zone Management Program created by the Coastal Zone Management Act (CZMA). The TCMP designates the coastal zone and coastal natural resource areas (CNRA) requiring special management in that zone, including coastal waters, waters under tidal influence, coastal wetlands, submerged lands and aquatic vegetation, dunes, coastal historic areas, and other resources. Five CNRAs are in the footprint of the recommended plan. An in-progress Statement of Compliance with the TCMP has been prepared and will be delivered to the Texas General Land Office (TxGLO). (Appendix B – Environmental Resources, Section 6.7)

7.1.8 USFWS Coordination Act

The USACE's proposed action under the recommended plan is being coordinated with the

USFWS, NMFS, TPWD and other State and Federal resource agencies through resource agency meetings being held for this study, and additional coordination and consultation. Additionally, the USFWS, NMFS and TPWD were sent copies of the DIFR-EIS for review and comment during the agency and public review period. Pursuant to Fish and Wildlife Coordination Act (FWCA), the USFWS provided a draft Planning Aid Letter (PAL) to assist with the planning of the proposed project by providing comments and recommendations related to impacts on fish and wildlife resources. The Coordination Act Report (CAR) was completed and delivered to USACE on July 10, 2019. A copy of the PAL and CAR are provided in Enclosure 5 of Appendix B – Environment Resources. (Appendix B – Environmental Resources, Section 6.8)

The CAR includes recommendations for modeling and analysis efforts that USACE has agreed to undertake, or that USACE has already undertaken. Some of the recommended analyses are beyond the scope of the project and USACE has not concurred with the application of those undertakings. USFWS has offered mitigation and restoration recommendations as part of the CAR. USACE has concurred with recommendations such as mitigating for oyster impacts and coordinating with Audubon Texas for Chester Island restoration. In addition the USFWS has recommended setting up an interagency team for coordination of mitigation and restoration during the PED phase of the project, a recommendation which the USACE fully supports. For a full listing of the recommendations and USACE's response see Appendix B – Enclosure 5.

7.1.9 Marine Mammal Protection Act of 1972

Review and consultation for the MMPA is triggered via the ESA when actions involve marine mammals. The only marine mammals covered under the MMPA expected to regularly be present in Matagorda Bay are bottlenose dolphins. These are highly mobile species that would be able to readily avoid dredging activities and vessels. As avoidance of the area would be only during construction, and there is an abundance of similar habitat within the area, the proposed action would have minimal and temporary impacts, by way of disturbance, to the individuals present. (Appendix B – Environmental Resources, Section 6.9)

7.1.10 Farmland Protection Policy Act of 1981

This also includes the CEQ Memorandum on Prime and Unique Farmlands. No terrestrial resources other than very small amounts of urbanized, disturbed land at the channel margins are impacted by the recommended plan channel modifications, and therefore, no prime or unique farmlands would be affected. Placement area PA/P1 is in an agricultural area, but no prime or unique farmland, as determined by soil survey maps, is present within the placement area. (Appendix B – Environmental Resources, Section 6.11)

7.1.11 EO 11988, Floodplain Management

The recommended plan is in sections of the Calhoun County Coastal Project Area and Matagorda Bay mapped by the Federal Emergency Management Agency as either subject to inundation by the one percent annual chance event (Zone AE) or floodways designated for Zone AE, or coastal flood zone with velocity hazard (Zone VE). As discussed in Appendix F – Engineering, the recommended plan is not expected to have substantial hydrodynamic impacts including tidal variations or surge conditions, based on recent modeling studies for other channel modification projects, which will be confirmed by hydrodynamic modeling PED. (Appendix B – Environmental Resources, Section 6.12)

7.1.12 EO 11990, Protection of Wetlands

The recommended plan channel modifications would not impact any wetlands. The placement of dredged material will impact 1.5 acres of marsh lands. Two acres of marsh mitigation will be done in accordance with ER 1165-2-27 (Establishment of Wetland Areas in Connection with Dredging). (Appendix B – Environmental Resources, Section 6.13)

7.1.13 EO 12898, Environmental Justice

Most of the project area is in the open waters of Matagorda Bay and the industrial part of the MSC, with large, relatively sparsely populated census tracts (due to the land use and water). As documented in Section 2.8, examination of the census where populated land was closest to the recommended plan indicated an average of 51 percent minority and an average median household income of $22,939 in Matagorda County, slightly below the state average. These blocks would be closest to the recommended plan footprint where direct effects experienced would be their greatest. Given the income and percent minority of those blocks, an EJ issue would not be expected. Therefore, the proposed action is not expected to have any disproportionately high or adverse effect on low-income or minority population groups. (Appendix B – Environmental Resources, Section 6.14)

7.1.14 EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds and the Migratory Bird Treaty Act

The proposed action is not expected to permanently impact migratory bird populations. Options to avoid migratory and nesting bird impacts may include adjusting the construction timeline to accommodate the nesting season or re-sequencing construction activities to work in areas where no active nests are present. Maintenance dredged material placement cycles in these and other PAs have been conducted successfully with minimal disturbance to migratory species. (Appendix B – Environmental Resources, Section 6.15)

7.1.15 EO 13045, Protection of Children from Environmental and Safety Risks

The proposed action of building the recommended plan was evaluated for disproportionate effects towards children. Construction dredging of the recommended plan and the associated temporary ambient air and noise emissions will not have an impact that particularly targets or disproportionately affects children given the distance and general nature of the temporary impacts. Therefore, there would be no disproportionate effects on children due to environmental health or safety risks. (Appendix B – Environmental Resources, Section 6.16)

7.1.16 Rivers and Harbors Act of 1899 – Section 10

The Final Integrated Feasibility Report – Environmental Impact Statement will be provided to the Chief of Engineers for approval of the excavation and fill with the Matagorda Bay as it relates to the recommended plan. (Appendix B – Environmental Resources, Section 6.19)

7.1.17 Coastal Barrier Resources Act

The existing Matagorda Ship Channel and the deepening and widening of the channel proposed under the recommended plan cross System Unit T07, and Otherwise Protected Area T07P. A portion of the Entrance Channel sits within CBRS unit T07. This section will be deepened from the current depth of -47 feet MLLW to -49 feet MLLW and widened from the existing bottom width of 200 feet to 600 feet. Dredged material from the entrance channel will placed in a sand engine located within T07. No other work will be done within a CBRS unit. Construction authority for the Matagorda Ship Channel was provided by Congress in the Rivers and Harbors Act of July 3, 1958 (PL 85-500). Therefore, the recommended plan meets the exceptions set forth in Sections 6(a)(2) and 6(b). Coordination with USFWS and USACE Office of Legal Counsel is ongoing. (Appendix B – Environmental Resources, Section 6.20)

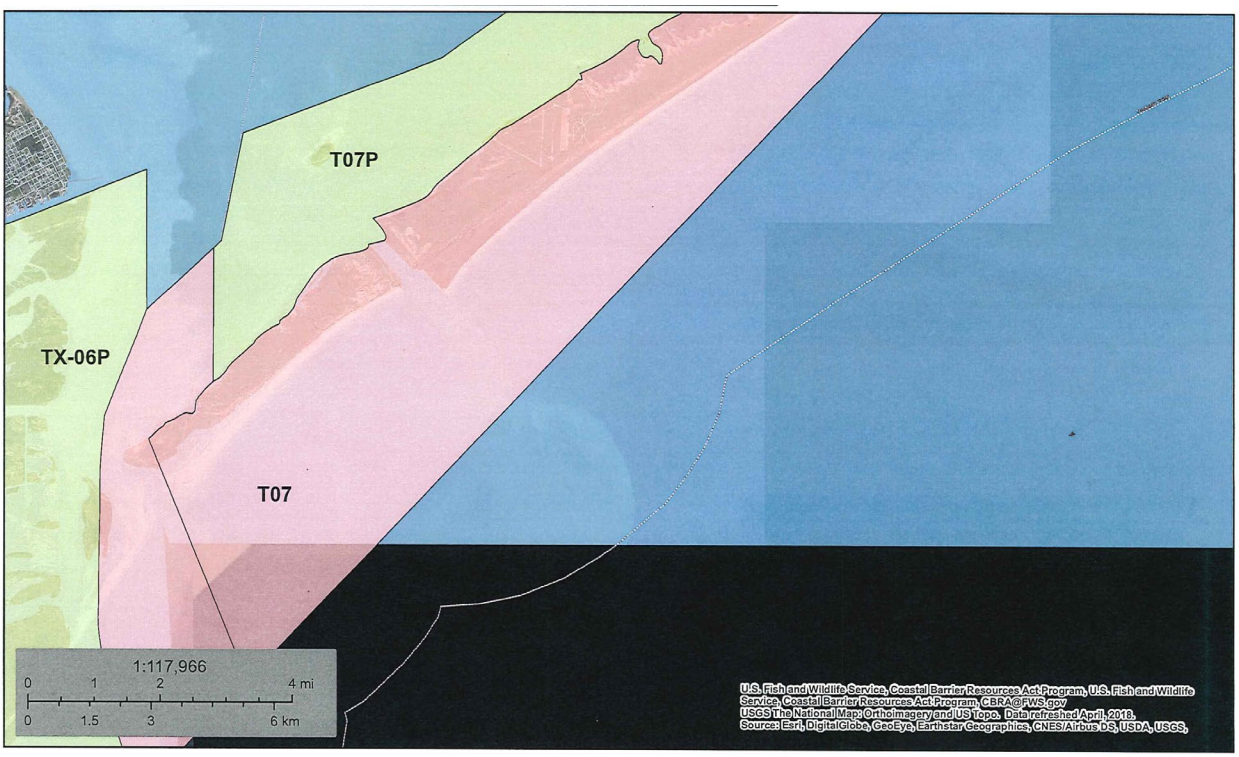


Figure 45 - Map of CBRS units within the MSC project area

7.2 Public Involvement

The Notice of Intent to Prepare a Draft Environmental Impact Statement for the Matagorda Ship Channel, TX was prepared by the USACE and published in the Federal Register, Volume 81, No. 247, on Friday, December 23, 2016. The Federal Register notice is included in Attachment A of Enclosure 4 of Appendix B – Environmental Resources.

Six tribal consultation letters were distributed on December 23, 2016, and Texas tribes were invited to participate in the interagency meeting. Copies of the letters are included in Attachment C of Enclosure 4 of Appendix B – Environmental Resources.

On January 24, 2017, a public scoping meeting was held to provide the public with information about the preparation of a Draft Environmental Impact Statement (DEIS) and concurrent USACE Feasibility Study, the proposed project, how the public can participate in the process, and gather information regarding public questions, concerns, and issues regarding the proposed Project. Copies of the sign-in sheets can be found in Attachment D of Enclosure 4 of Appendix B – Environmental Resources.

The public scoping meeting took place on May 15, 2018, at Bauer Exhibit Building, 186 Henry Barber Way, County Road 101, Port Lavaca, Texas, 77979 from 6:00 p.m. to 8:00 p.m. The Notice of Availability of Draft Feasibility Report-Environmental Impact Statement (FR-EIS) was published in the Federal Register on Friday May 4, 2018. The Notice of Availability can be found in Attachment G of Enclosure 4 of Appendix B – Environmental Resources.

The Public Scoping Process consisted of the following:

- Publishing a Notice of Intent to Prepare a Draft Environmental Impact Statement for the Matagorda Ship Channel, TX in the Federal Register,
- Legal notices were published in the Victoria Advocate announcing the date, time, location, purpose of the public scoping meeting, and the opportunity for hearing impaired or language translation services if requested (Affidavits of publication and copies of the legal notices Attachment D of Enclosure 4 of Appendix B – Environmental Resources.),
- Distributing public notices by mail to federal, state, and other government agencies and officials, and other interested parties,
- Holding an interagency workshop with state and federal agencies to discuss problems and opportunities related to the project,
- Holding a public scoping meeting to provide the public with information about the preparation of a Draft DEIS and concurrent USACE Feasibility Study, the proposed project, how the public may participate in the process, and gather information regarding public questions, concerns, and issues regarding the proposed project, and
- Reviewing and considering all comments received during the comment period, and those received after the comment period to the extent practicable.

7.2.1 Cooperating Agencies

Letters inviting stakeholder agencies to participate as cooperating agencies were distributed on December 16, 2016. Copies of the letters are included in Attachment C of Enclosure 4 of Appendix B – Environmental Resources. The entities that agreed to sign on cooperating agencies include USFWS, NMFS, TPWD, and TXDOT.

The interagency workshop took place on April 27, 2017, from 1:00 to 3:00 p.m., at the USACE Galveston District Headquarters, 2000 Fort Point Road, Galveston, Texas. The purpose of the workshop was to gain early agency stakeholder input as recommended by ER 1105-2-100 on the problems and opportunities related to improving deep draft navigation in the planned reaches of the Matagorda Ship Channel. (Appendix B – Environmental Resources, Enclosure 4)

7.2.2 Non-Federal Views and Preferences

Texas Mid-Coast Region industries depend on the CPA to provide berths from which they can import and export their products all over the world. The widening and deepening of the MSC would aid in the movement of crude oil, natural gas condensate and other liquid petrochemical products. This project would allow both current and future port users to have the ability to import and export products overseas in larger vessels, which in turn would decrease their transportation costs and would add to the growing economic activity in the State. The CPA is supportive of the features in the Recommended Plan.

7.3 Comments

7.3.1 Public Scoping

Following the scoping meeting thirteen comments were received regarding the Matagorda Ship Channel, TX project. There were three supportive comments included in those letters and emails. These comments will not be addressed below, though we appreciate the support and

the commenters taking time to reach out to us. Some comment letters included multiple topics and many of the letters contained similar comments. Two commenters asked for meeting notes, they were emailed and informed the meeting information would be included in the draft report and would be publicly available upon release. The comments are addressed by topic and not by individual commenter below.

USACE accepted and considered all comments throughout the NEPA process; however, those submitted after February 13, 2017, may not be represented in the FEIS. USACE responses to these comments are found in Attachment F of Enclosure 4 of Appendix B – Environmental Resources.

1. The most comment topic was in regards to shoreline erosion on the western side of the Matagorda Bay, in particular the Alamo Beach area;
    a. The concern regarding the erosion of the shoreline along the western side of Matagorda Bay is an important topic. We believe the widening and deepening project, as currently designed, will not exacerbate the erosion. The placement of the dredged material on the western side of the channel should help to tamp down the ship wakes and result in lower force wave action. To address this concern a ship wake analysis was performed by USACE. The model estimated an increase of ship wake wave heights of only 0.1 feet. This minimal increase in ship wake should not exacerbate shoreline erosion. (See Main Report Section 3.1 and Appendix F – Section 2.6).
2. A couple of commenters asked about the suitability of the dredged material for placement within the bay or in upland placement areas. This comment concerned the presence of toxins in the sediments and in relation to the Alcoa Superfund site;
    a. To address this concern USACE will coordinate with EPA prior to the widening and deepening of the ship channel to develop a sediment sampling and analysis plan. This testing is required for placement of materials offshore and in the waters of the bay. This testing includes bioassays of material for offshore placement, testing of the sediments and elutriate testing. The specific pollutants to be tested will be determined in discussion with the US EPA. For further discussion of this plan see Main Report -Sections 5.3.12 and 5.3.13, and Appendix B – Section 4.9.4.
3. One comment was concerned that the project would include the closure of Pass Cavallo and the resulting hydrologic and environmental damage that would cause;
    a. The closure of Pass Cavallo is not a part of the current project. Hydrologic analysis for the study do not indicate any danger of the Pass closing (See Main Report – Section 5.1 and Appendix F – Section 2.6).
4. One commenter requested that we work with local and state agencies to find beneficial use opportunities for the dredged material;
    a. The USACE is always willing to find beneficial use for dredged material. This is the preferable use of dredged material whenever possible. We are by regulation required to find the least cost and environmentally acceptable plan for placement, however. Any costs above and beyond that would be strictly that of the sponsor and can lead to a project being economically unjustifiable. We are working with the Audubon Society to beneficially place both new work and maintenance material on Chester Island. This material will help to stabilize the island and create habitat for endangered species and other species of concern (See Main

Report – Sections 4.11.10, Appendix B – Section 5.4.10, and Appendix E – Section 4.1).

5. One commenter does not want the non-sandy dredge material placed on the beaches as part of a beneficial use plan;
    a. The DMMP was developed with multiple goals in mind. One of those was to be environmentally acceptable. Placement of non-sandy dredge material on the beach would not be environmentally acceptable and, therefore, there is no plan to place material on the beaches. (See Main Report – Sections 4.11.10, Appendix B – Section 5.4.10, and Appendix E – Section 4.1)
6. One commenter requested that a full economic analysis, along with an analysis of the environmental impacts and hydrologic modeling be conducted and fully articulated in the report;
    a. These analyses are a regular part of the feasibility report and the environmental impact statement. The economic analyses can be found in the Main Report – Sections 2.2, 3.2, 4.8, 4.11, and Appendix A. The Hydrologic modeling and analyses can be found in Appendix F. The environmental impacts analyses can be found in the Main Report – Section 5.3 and Appendix B.
7. A request was made by a commenter to place any sandy dredge material outside the entrance channel jetties to help with erosion that has occurred;
    a. The DMMP was developed with multiple goals in mind. One of those was to be environmentally acceptable. A hydraulic shoaling analysis was performed which indicated the need for such placement south of the jetty. (See Main Report – Sections 4.11.10, Appendix B – Section 5.4.10, and Appendix E – Section 4.1)
8. One commenter questioned whether the placement of material in the open bay placement areas would create “islands” within the bay that my effect the beauty of the bay; and,
    a. The DMMP was developed with multiple goals in mind. One of those was to be environmentally acceptable. Any placement being considered in the bay as unconfined placement areas would be placed at a height that would not be emergent. In addition, the maximum height of the placement areas would still allow for the movement of recreational boaters. See Main Report – Sections 4.11.10, Appendix B – Section 5.4.10, and Appendix E – Section 4.1.
9. One commenter was concerned that the Corps would place dredged material on their land without any concern for the landowner’s desires.
    a. The DMMP was developed with multiple goals in mind. One of those was economics. Placement on land which would need to be purchased, or acquired, would add additional expense to the project. There is no plan to place dredged material on any landowner’s property without consulting them and negotiation of a proper financial accommodation. See Main Report – Sections 4.11.10, Appendix B – Section 5.4.10, and Appendix E – Section 4.1.

7.3.2 Public Review of DRAFT Integrated Feasibility Report and EIS

Following the public meeting to present the Draft Integrated Feasibility Report and EIS, eleven comments were received regarding the MSC project. There were two supportive comments

included in those letters and emails. These comments will not be addressed below, though we appreciate the support and the commenters taking time to reach out to us. Some comment letters included multiple topics and many of the letters contained similar comments. The comments are addressed by topic and not by individual commenter below. Copies of written comments received are included in Attachment J of Enclosure 4 of Appendix B – Environmental Resources. USACE accepted and considered all comments throughout the NEPA process; however, those submitted, or postmarked, after June 21, 2018, may not be represented in the EIS. USACE responses to these comments are found in Attachment J of Enclosure 4 of Appendix B – Environmental Resources. Summaries of some of the comments are below.

1. The most comment topic was in regards to shoreline erosion on the western side of the Matagorda Bay, in particular the Alamo Beach area;
    a. The concern regarding the erosion of the shoreline along the western side of Matagorda Bay is an important topic. We believe the widening and deepening project, as currently designed, will not exacerbate the erosion. The placement of the dredged material on the western side of the channel should help to tamp down the ship wakes and result in lower force wave action. To address this concern a ship wake analysis was performed by USACE. The model estimated an increase of ship wake wave heights of only 0.1 feet. This minimal increase in ship wake should not exacerbate shoreline erosion (See Main Report Section 3.1.1 and Appendix F – Section 2.6.2).
2. A few of the commenters asked about the suitability of the dredged material for placement within the bay or in upland placement areas. This comment concerned the presence of toxins in the sediments and in relation to the Alcoa Superfund site;
    a. To address this concern USACE will coordinate with EPA prior to the widening and deepening of the ship channel to develop a sediment sampling and analysis plan. This testing is required for placement of materials offshore and in the waters of the bay. This testing includes bioassays of material for offshore placement, testing of the sediments and elutriate testing. The specific pollutants to be tested will be determined in discussion with the US EPA. For further discussion of this plan see Main Report -Section 5.3.12 and Appendix B – Section 4.9.4.
3. One commenter does not want the non-sandy dredge material placed on the beaches as part of a beneficial use plan;
    a. The DMMP was developed with multiple goals in mind. One of those was to be environmentally acceptable. Placement of non-sandy dredge material on the beach would not be environmentally acceptable and, therefore, there is no plan to place material on the beaches. See Main Report – Section 4.11.10 and Appendix E for more discussion on the DMMP.
4. One commenter was concerned with the impacts to Pass Cavallo. The current trend is shoaling around the pass and a decrease in water passing through the pass;
    a. The closure of Pass Cavallo is not a part of the current project. Hydrologic analysis for the study do not indicate any danger of the Pass closing (See Main Report – Section 5.1.2 and Appendix F – Section 2.6.4).
5. One commenter offered multiple suggestions of where beneficial use could be done to help protect existing resources that are in danger;

a. The USACE is always willing to find beneficial use for dredged material. This is the preferable use of dredged material whenever possible. In the current DMMP approximately 2.3 mcy of new work material and 12.9 mcy of maintenance material will be used beneficially on Chester Island. Since the development of the Draft Report an additional beneficial use site was developed. Approximately 1.4 mcy of new work material and 9.0 mcy of maintenance material will be placed just offshore and to the west of the Entrance Channel jetty in a sand engine to feed the peninsula's south side beach. For more information on the project's DMMP and its development see Main Report – Section 4.11.10 and Appendix E.

6. One commenter has suggested that the impacts resulting from a possible increase in storm surge that may result from the deeper and wider channel were not analyzed;

    a. The potential for increased storm surge will be modeled by the Hydrology and Hydraulics section at the Galveston District during the pre-construction and design phase of the project.

7. One commenter has suggested that the models used to estimate impacts to wetlands and oysters are not sufficient or are outdated. The commenter has suggested alternate models;

    a. The USACE Civil Works group is limited to models that have been certified by the ECO-PCX. The models selected for this study are certified and their use has been supported by the ECO-PCX. The model suggested by the commenter is not certified for use in Civil Works studies. For more information about the models use and their application see Main Report – Section 6.3, Appendix B – Section 4.12.13, and Appendix B, Enclosure 1.

8. One commenter has suggested that mitigation has either not been proposed or does not sufficiently account for temporal ecological functional losses;

    a. Since the preparation of the Draft Report the mitigation plan has been more thoroughly examined and methodologies proposed. The impacts of the project were estimated using HSI models and acreages of required mitigation estimated. For more information on the mitigation plans for this project see Main Report – Sections 4.12.3 and 6.3, and Appendix B – Section 4.12.13 and Enclosures 1 and 10.

7.4 List of Preparers

Name	Technical Specialty
Franchelle Craft	Project Management
Kathy Skalbeck	Plan Formulation
Dr. Thomas White	Hydrology and Hydraulic Engineering
Jennifer Purcell	Economics
Todd Nettles	Economics – DDN PCX
Janelle Stokes	Environmental Resources
Harmon Brown III	Environmental Resources
John Campbell	Cultural Resources
Brandon Crawford	Geotechnical Engineering
David Clark	HTRW
Lisa Mairs	Real Estate
Nichole Schlund	Real Estate
Brenda Hayden	Civil Engineering
Dale Williams	Cost Engineering
Brandon Crawford	Cost Engineering

(NOTE: This page intentionally left blank.)

8 District Engineer's Recommendation

This chapter contains the findings and recommendation of the SWG Commander and may serve as the basis for new additional authorization and costs.

8.1 About Recommendations

When a project is authorized by Congress, the recommendations contained in the feasibility report become the basis for proceeding with the project as a Federal undertaking. Authorizing legislation normally references the "recommendations" of the Chief of Engineers, which are derived from the recommendations of the District Commander. The provisions of the recommendations provide a legislative basis that would not change unless modified by Congress through applicable general legislation or by specific legislative action for the particular authorization in question. Accordingly, the wording of recommendations, incorporated by reference in the authorizing act, has the force of law for the project.

8.2 Disclaimer

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels with the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorizations and implementation funding. However, prior to transmittal to the Congress, the NON-FEDERAL SPONSOR, the State, interested Federal agencies, and other parties would be advised of any modifications and would be afforded an opportunity to comment further.

8.3 Recommendation

Recommendation For the Proposed Implementation of the Section 216, Matagorda Ship Channel, Texas, FINAL Integrated Feasibility Report and Environmental Impact Statement

I recommend implementation of the NED plan, identified as Alternative Plan A at -47' MLLW in the Matagorda Ship Channel, Texas, FINAL Integrated Feasibility Report and Environmental Impact Statement, in the Vicinity of the City of Point Comfort, Texas, May 2019, with such modifications thereof as in the discretion of the Commander, Headquarters, US Army Corps of Engineers (HQUSACE), may be advisable.

The total project first cost is estimated to be $212,498,000 at October 2018 prices, with a Federal share of $ 134,913,000 (Federal) and the NFS share of $77,585,000. Annual operation, maintenance, repair, rehabilitation, and replacement costs are estimated to be $8,774,000 at October 2018 prices, a Federal discount rate of 2.875%, and a period of analysis of 50 years. Total First Cost for Aids to Navigation are 100% Federal with funds going to the US Coast Guard for $1,883,000.

The NFS would be the Calhoun Port Authority.

I make this recommendation with the provision that prior to implementation the NFS enter into a binding project partnership agreement (PPA) with the Secretary of the Army that defines the terms and conditions of cooperation for the project. In this agreement, the NFS would agree to

comply with applicable Federal laws and policies, including, but not limited to, the items of local cooperation, as specified below:

a. Provide 10% of the total cost of construction of the general navigation features (GNFs) attributable to dredging to a depth not in excess of 20', plus 25% of the total cost of construction of the GNFs attributable to dredging to a depth in excess of 20' but not in excess of 50', as further specified below:

    i. Provide 50% of design costs allocated by the Government to commercial navigation in accordance with the terms of a design agreement entered into prior to commencement of design work for the project.

    ii. Provide, during construction, any additional funds necessary to make its total contribution for commercial navigation equal to 10% of the total cost of construction of the GNFs attributable to dredging to a depth not in excess of 20', plus 25% of the total cost of construction of the GNFs attributable to dredging to a depth in excess of 20' but not in excess of 50'.

b. Provide all lands, easement, rights-of-way, relocations and disposal (LERRD), including those necessary for the borrowing of material and disposal of dredged or excavated material, and perform or assure the performance of all relocations, including utility relocations, all as determined by the Government to be necessary for the construction or operation and maintenance of the GNFs;.

c. Pay with interest, over a period not to exceed 30 years following completion of the period of construction of the GNFs, an additional amount equal to 10% of the total cost of construction of GNFs less the amount of credit afforded by the Government for the value of the LER and relocations, including utility relocations, provided by the Sponsor for the GNFs. If the amount of credit afforded by the Government for the value of LER, and relocations, including utility relocations, provided by the Sponsor equals or exceeds 10% of the total cost of construction of the GNFs, the Sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of LER and relocations, including utility relocations, in excess of 10% of the total costs of construction of the GNFs;

d. Provide, operate, and maintain, at no cost to the Government, the local service facilities in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Government;

e. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, and maintaining the GNFs;

f. Hold and save the US free from all damages arising from the construction or operation and maintenance of the project, any betterments, and the local service facilities, except for damages due to the fault or negligence of the US or its contractors:

g. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of three years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as would properly reflect total cost of construction of the project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants

and Cooperative Agreements to State and local governments at 32 C.F.R., Section 33.20;

Perform, or ensure performance of, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC. 9601–9675, that may exist in, on, or under LERRD that the Government determines to be necessary for the construction or operation and maintenance of the GNFs. However, for lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigations unless the Government provides the Sponsor with prior specific written direction, in which case the Sponsor shall perform such investigations in accordance with such written direction;

h. Assume complete financial responsibility, as between the Government and the Sponsor, for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under LERRD that the Government determines to be necessary for the construction or operation and maintenance of the project;

i. To the maximum extent practicable, perform its obligations in a manner that would not cause liability to arise under CERCLA;

j. Comply with Section 221 of PL 91-611, Flood Control Act of 1970, as amended, (42 USC. 1962d-5b) and Section 101(e) of the WRDA 86, PL 99-662, as amended, (33 USC. 2211(e)) which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the Sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

k. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended, (42 USC. 4601-4655) and the Uniform Regulations contained in 49 C.F.R. 24, in acquiring lands, easements, and rights-of-way necessary for construction, operation, and maintenance of the project including those necessary for relocations, the borrowing of material, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

l. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, PL 88-352 (42 USC. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled “Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army”; and all applicable Federal labor standards requirements including, but not limited to, 40 USC. 3141-3148 and 40 USC. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 USC. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 USC. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 USC. 276c));

m. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation that are in excess of one percent of the total amount authorized to be appropriated for the project; and

n. Not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the Sponsor's obligations for the project costs unless the Federal agency providing the Federal portion of such funds verifies in writing that such funds are authorized to be used to carry out the project.

o. Construction of the recommended channel improvements is estimated to take four years to complete (2020 – 2024). During this period, the Government and the Sponsor shall diligently maintain the projects at their previously authorized dimensions according to the previous cooperation agreement. Maintenance materials that have accumulated in the channels at the time that "before dredging" profiles are taken for construction payment shall be considered as new work material and cost-shared according to the new cooperation agreement. Any dredging in a construction contract reach after the improvements have been completed and the construction contract closed would be considered to be maintenance material and cost-shared according to the new agreement.

_____ _____

TIMOTHY R. VAIL
COLONEL, EN
Commanding

Date

The recommendations contained herein reflect the information available at this time, and current Department of the Army, and US Army Corps of Engineer policies governing formulation of individual projects. The recommendations do not reflect the program and budget priorities inherent to the formulation of a national Civil Works construction program, nor the perspective of higher review levels within the Executive Branch of the US Government. Consequently, the recommendations may be modified before they are transmitted to Congress as proposals for implementation funding. However, prior to transmittal to Congress, the sponsor, the State, interested Federal agencies, and other interested parties would be advised of any modifications, and be afforded the opportunity to comment further.

9 References

Alperin, Lynn. 1977. *Custodians of the Coast: History of the US Army Engineers at Galveston, Texas*.

Bass RJ. 2003. *GIWW modifications, Colorado River locks, Texas: The environmental impact of opening Parkers Cut or Diversion Dam Cut to Matagorda Bay Southwest Cut to East Matagorda Bay.*

Borgens et al. 2007. Archaeological Investigations Related to Calhoun County Navigation District's Proposed Turning Basin and Marine Improvements and Associated Placement Areas, Lavaca Bay, Calhoun County, Texas.

Britton, JC and B Morton. 1989. *Shore ecology of the Gulf of Mexico.*

Brown, CL and R Clark. 1968. *Observations on dredging and dissolved oxygen in a tidal waterway.*

Cowardin, LM, et. al. 1979. *Classification of wetlands and deep-water habitats of the United States.*

Gulf of Mexico Fisheries Management Council. 2004. *DRAFT final environmental impact statement for the Generic Essential Fish Habitat Amendment to the following fishery management plans of the Gulf of Mexico (GOM): Shrimp fishery of the Gulf of Mexico; Red drum fishery of the Gulf of Mexico; Reef fish fishery of the Gulf of Mexico; Stone crab fishery of the Gulf of Mexico; Coral and coral reef fishery of the Gulf of Mexico; Spiny lobster fishery of the Gulf of Mexico and South Atlantic; Coastal migratory pelagic resources of the Gulf of Mexico and South Atlantic.*

Hackett, B. 2003. *National Dredging Needs Study of US Ports and Harbors*. Prepared for USACE Institute for Water Resources – Navigation Division.

Hopkins, TS. 1972. *The effects of physical alteration on water quality in Mulatto Bayou, Escambia Bay.*

Kraus, NC et. al. 2006. *Matagorda Ship Channel, Texas: Jetty Stability Study.*

Kraus, NC and BK Batten. 2006. *Morphological Examination of the Stability of Pass Cavallo, Texas.*

Lewis, JC and RL Garrison. 1983. *Habitat Suitability Index Models: clapper rail*. USFWS/OBS/10.51.

Lower Colorado River Authority – San Antonio Water System (LCRA-SAWS). 2018. *Managing the region's water supply*. https://www.lcra.org/water/water-supply/Pages/default.aspx

Maritime Institute of Technology and Graduate Studies. 2014. *Proposed Deepening and Widening of the Matagorda Ship Channel, Texas – A Ship Maneuvering Simulation Study*.

May, EB. 1973. *Environment effects of hydraulic dredging in estuaries.*

McGowen et. al. 1975. *Historical changes and related coastal processes, Gulf and Mainland Shorelines Matagorda Bay Area.*

McGowen et. al. 1976. *Environmental Geologic Atlas of the Texas Coastal Zone – Port Lavaca Area.*

Moffatt & Nichol. 2007. *Matagorda Ship Channel Improvement Project, Point Comfort, Texas – Sedimentation Study*.

Moseley FN and BJ Copeland. 1971. *Ecology of Cox Bay, Texas.*

National Climate Data Center. 2016a. *Local Climatological Data Annual Summary with Comparative Data – Texas, Victoria (KVCT).*

Natural Resources Conservation Service. 2017. https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

NCDC. 2016b. *Summary of Monthly Normals – Point Comfort, TX*.

Pearce, JB. 1972. *Biological survey of submerged refuse.*

PIANC. 2008. *Report n°102-2008. Minimising harbor siltation.*

Post, Buckley, Schuh and Jernigan, Inc. (PBS&J). 2005. *Freeport Harbor Entrance Channel contaminant assessment. Document No. 050194.*

PBS&J. 2009. *Final Environmental Impact Statement for the proposed Matagorda Ship Channel improvement project, Calhoun and Matagorda Counties, Texas: Appendix L.*

Swannack, TM, M Reif, and TM Soniat. 2014. *A Robust, Spatially Explicit Model for Identifying Oyster Restoration Sites: Case Studies on the Atlantic and Gulf coasts*. Journal of Shellfish Research, 33(2): 395-408.

Texas Commission of Environmental Quality. 2000. *Texas surface water quality standards. Sections 307.1-307.10*. Adopted July 26, 2000.

TCEQ. 2004. *Guidance for assessing Texas surface and finished drinking water quality data.*

Tuttle, Michael C. 2018. *Marine Archaeological Survey for the Lavaca Bay LNG Project off Calhoun County, Texas*.

US Army Corps of Engineers. 1961. *Matagorda Ship Channel, Texas, Design Memorandum No. 1*.

USACE. 1961. *Matagorda Ship Channel, Texas, Design Memorandum No. 2, Second Dredging Contract, Vicinity Light 51 to Vicinity Indian Point*.

USACE. 1962. *Design of Matagorda Bay Deep-Draft Channel from Gulf of Mexico into Matagorda Bay, Texas*.

USACE. 1962a. *Matagorda Ship Channel, Texas, Design Memorandum No. 3 (General Design Memorandum)*

USACE. 1963. *Matagorda Ship Channel, Texas, Design Memorandum No. 3 (General Design Memorandum) including Supplement No. 1*.

USACE. 1964. *Problems in Connection with Matagorda Ship Channel Project. The Committee on Tidal Hydraulics*.

USACE. 1982. ER 1165-2-119 *Modifications to Completed Projects*.

USACE. 1983. EM 1110-2-5025 *Dredging and Dredged Material Management*.

USACE. 1989. *Matagorda Ship Channel, Texas – Reconnaissance Report*.

USACE. 1989. ER 1165-2-27. *Establishment of Westland Areas in Connection with Dredging*.

USACE. 1992. ER 1165-2-123. *Single-Owner Situations*.

USACE. 2000. ER 1105-2-100 *Planning Guidance Notebook* (as amended).

USACE. 2000. *Matagorda Ship Channel, Texas – Preliminary Project Assessment*.

USACE. 2002. *Gulf Intercoastal Waterway, Brazos River to Port O'Connor, Matagorda Bay Re-Route, Feasibility Report and Environmental Assessment.*

USACE. 2006. *Matagorda Ship Channel, Texas: Jetty Stability Study*.

USACE. 2007. *Morphologic Examination of the Stability of Pas Cavallo, Texas*.

USACE. 2009. *Final Environmental Impact Statement for the Proposed Matagorda Ship Channel Improvement Project, Calhoun and Matagorda Counties, Texas*.

USACE. 2010. *Deep-Draft Navigation*. IWR Report 10-R-4.

USACE. 2011. *Analysis of Dredged Material Placement Alternative plans for Bottleneck Removal, Matagorda Ship Channel, Texas*.

USACE. 2012. *Matagorda Ship Channel, Texas – Studies on the Entrance Channel through Matagorda Peninsula*.

USACE. 2013. *Regional Sediment Management Studies of Matagorda Ship Channel and Matagorda Bay System, Texas*.

USACE. 2015. *Identification of Alternative plans to Reduce Shoaling in the Lower Matagorda Ship Channel*.

US Bureau of Reclamation. 1974. *Final Environmental Impact Statement, Palmetto Bend Project – Texas.*

US BOR. 2008. *Palmetto Bend Project.*

US Coast Guard. 2001. *Port and Waterway Safety Assessment.* http://www.navcen.uscg.gov/mwv/projects/pawsa/PAWSA_home.htm

US Geological Survey. 1951, 1989a, 1989b, and 1995. *Point Comfort, Texas 7.5-minute topographic map*.

US National Park Service. 2018. *Nature and Science.* https://www.nps.gov/pais/learn/nature/index.htm

URS Corporation. 2006. *Matagorda Ship Channel Improvement Project – Sedimentation Analysis*.

URS Corporation. 2014. *Section 204(f) Feasibility Report – Matagorda Ship Channel Improvement Project*.

Wakeman, TH. 1974. *Release of trace constituents from sediments resuspended during dredging operations.*

Ward, GH Jr., and NE Armstrong. 1980. *Matagorda Bay, Texas: Its Hydrography, Ecology and Fishery Resources*. USFWS, Biological Services Program.

Waters, J.K., R.H. Mayer, and D.H. Kriebel. 2000. *Shipping Trends Analysis, Dept. of Naval Architecture and Ocean Engineering. United States Naval Academy for Institute for Water Resources*. USACE (September 2000).

Windom, HL. 1972. E*nvironmental aspects of dredging in estuaries.*

Wide, Larry. 2006. *Matagorda Navigation Channel – Shoreline Impact Analysis.*

10 Quality Control

District Quality Control (DQC) Reviewers	
Name	**Title**
Natalie Garrett	DQC Lead (RPEC)
Cheryl Jaynes	DQC Lead (RPEC)
Marc Masnor	Plan Formulation, CESWF (RPEC)
Michael Kauffman	Hydrology, Hydraulics and Coastal, CESWG
Mark Haab	Economics, Deep-Draft Navigation PCX
Melinda Fisher	Environmental Resources and NEPA, CESWF (RPEC)
Joseph Murphey	Cultural Resources and Section 106, CESWF
David Boothby	Geotechnical Engineering, CESWG
Lori Thomas	Chief, Geotech and Structures, CESWG
David Clark	Environmental Engineering (HTRW), CESWF
Rob Thomas	Chief, Engineering and Construction, CESWG
Michael Diaz	Civil Engineering, CESWG
Joseph King	Chief, Engineer Branch, CESWG
Dale Williams	Cost Engineering, CESWG
Adam Tallman	Cost Engineering, CESWG
Brian Murphy	Real Estate, CESWG

Agency Technical Review (ATR) Team	
Name	**Title**
Rachel Mesko (NWS)	ATR Team Lead
George Kallie (POA)	Plan Formulation
KW Wiggins (SAW)	Hydrology, Hydraulics and Sediment
Matthew Napolitano (MVN)	Economics - HarborSym
Idris Dobbs (SAJ)	Economics
Terri Jordan Sellers (SAJ)	Environmental Resources and NEPA
Craig Baldwin (MVN)	Geotechnical Engineering
KW Wiggins (SAW)	Civil Engineering
Gary Smith (Contractor)	Cost Engineering
Russell Blount (SAM)	Real Estate
Jeffrey Corbino (MVN)	Operations

11 Acronyms and Abbreviations

~	Approximate or Approximately
º	Degree
$	US Dollars
F	Fahrenheit
‘	Foot or Feet
“	Inch or Inches
#	Number
/	Per
%	Percent
AAEQ	Average Annual Equivalent
AAHU	Average Annual Habitat Unit
ac	Acre
ADCIRC	Advanced Circulation Model
AEO	American Energy Outlook
Alcoa	Alcoa Corporation
AQCR	Air Quality Control Region
ARRA	American Recovery and Reinvestment Act
ASA-(CW)	Office of the Assistant Secretary of the Army For Civil Works
ATR	Agency Technical Review
BA	Biological Assessment
BMP	Best Management Practice
BCR	Benefit Cost Ratio
BLT	Bulk Loading Tool
BO	Biological Opinion
Bpd	Barrels per Day
BU	Beneficial Use
CAGR	Compound Annual Growth Rate
CCPA	Clean Coal Power Initiative Program
CCSC	Corpus Christi Ship Channel
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations

cfu	Colony Forming Unit
CM	Construction Management
CNRA	Coastal Natural Resource Area
CPA	Calhoun Port Authority of Calhoun County, Texas
CPT	Cone Penetrometer Test
CPUE	Catch Per Unit Effort
CSAT	Corps Shoaling Analysis Tool
CZMA	Coastal Zone Management Act
dBA	A-Weighted Sound Level
DDN	Deep-Draft Navigation
dL	Deciliter
DMMP	Dredged Material Management Plan
DO	Dissolved Oxygen
DQC	District Quality Control
DWT	Dead Weight Ton
E	Exceptional Aquatic Life Use Subcategory
EIA	US Department of Energy's Energy Information Administration
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EM	Engineering Manual
EO	Executive Order
EOPs	Environmental Operating Principles
EOR	Enhanced Oil Recovery
EPA	Environmental Protection Agency
ER	Engineering Regulation
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FC	Fecal Coliform
FCSA	Feasibility Cost Share Agreement
FMP	Fisheries Management Plan
Formosa	Formosa Plastics Corporation
FPPA	Farmland Protection Policy Act of 1981
ft	Foot or Feet
FUSRAP	Formally Utilized Site Remedial Action Program

FWOP	Future Without-Project
FWP	Future With-Project
FY	Fiscal Year
GCD	General Conformity Determination
GDM	General Design Memorandum
GMFMC	Gulf of Mexico Fisheries Management Council
GIS	Geo-Information Service
GIWW	Gulf Intracoastal Waterway
GNF	General Navigation Feature
Gulf	Gulf of Mexico
HMST	Very Large Crude Carriers
HQ	Headquarters
HTRW	Hazardous, Toxic, and Radioactive Waste
IDC	Interest During Construction
ITM	Inland Testing Manual
IWR	Institute for Water Resources
L	Liter
LCRA	Lower Colorado River Authority
Ldn	Day-Night Sound Level
LNG	Liquefied Natural Gas
LNGC	LNG Carrier
LOA	Length Overall
mcy	Million Cubic Yards
mg	Milligram
mg/L	Milligrams per Liter
mi	Mile
mL	Milliliter
MLT	Mean Low Tide
MLLW	Mean Lower Low Water
MPRSA	Marine Protection, Research, and Sanctuaries Act
MSC	Matagorda Ship Channel
MSCIP	Matagorda Ship Channel Improvement Project
NAAQS	National Ambient Air Quality Standards
NCDC	National Climatic Data Center

NCF	National Channel Framework
NED	National Economic Development
NEMS	National Energy Modeling System
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOx	Nitrogen Oxide
NPL	National Priority List
NRCS	Natural Resources Conservation Service
NRDA	Natural Resources Damage Assessment
NRHP	National Register of Historic Places
O	Oyster Waters (waters producing edible oysters)
OD	Origin-Destination
ODMDS	Ocean Dredged Material Disposal Site
OM	Operations Manual
OMRR&R	Operations, Maintenance, Repair, Replacement, and Rehabilitation
OPEC	Organization of the Petroleum Exporting
OSE	Other Social Effects
PA	Placement Area (For Dredged Material)
PAWSA	Ports and Waterways Safety Assessment
PCC	Port of Corpus Christi
PCO	Point Comfort Operations
PCX	Planning Center of Expertise
PDT	Project Delivery Team
PED	Pre-construction, Engineering and Design Phase
P&G	Principles and Guidelines
PIANC	Permanent International Association of Navigation Congresses
Pilots	Matagorda Bay Pilots Association (pilots)
PL	Public Law
Port	Port of Port Lavaca–Point Comfort
PPA	Preliminary Project Assessment
ppt	Parts per Thousand
PSU	Practical Salinity Unit
RCRA	Resource Conservation and Recovery Act

RED	Regional Economic Development
RFMC	Regional Fishery Management Council
RHA	Rivers and Harbor Act
RIA	Regional Implementation Agreement
ROD	Record of Decision
RRC	Railroad Commission of Texas
RSLR	Relative Seal Level Rise
SAV	Submerged Aquatic Vegetation
SE	Sand Engine
SHPO	State Historic Preservation officer
SO_2	Sulfur Dioxide
STA	Station
State	State of Texas
SWG	Galveston District
TBP	Texas Biotic Province
TCEQ	Texas Commission On Environmental Quality
TCMP	Texas Coastal Management Program
TCOON	Texas Coastal Ocean Observation Network
TCWC	Texas Colonial Waterbird Census
TDSHS	Texas Department of State Health Services
T&E	Threatened and Endangered
THC	Texas Historical Commission
TSHA	Texas State Historical Association
TSP	Tentatively Selected Plan
TWQS	Texas Water Quality Standards
UKC	Under-keel Clearance
ULCC	Ultra-Large Crude Containers
US	United States
USACE	US Army Corps of Engineers
USFWS	US Fish and Wildlife Service
USGS	US Geological Service
VLCC	Very Large Crude Carriers
WCSC	Waterborne Commerce Statistics Center
WIS	Wave Information Studies

WMA	Wildlife Management Area
WQC	Water Quality Criteria
WRDA	Water Resources Development Act
WTS	World Trade Service

12 Definitions

Aframax Tankers – These are medium sized merchant vessels that weigh between 80,000 and 120,000 DWT, and are mainly oil tankers. The name Aframax comes from the Average Freight Rate Assessment (AFRA) system. (www.marineinsight.com)

Attainment Area – An area that currently meets all the NAAQS.

Average Freight Rate Assessment (AFRA) System -

Backhaul – As it relates to the transportation of goods, it is the return trip of a commercial mode of transportation that moving cargo back over all, or part, of the same route it took to get to its current location.

Bird Island / Chester Island / Sundown Island – Island to the NNE of the MSC Entrance Channel created with dredge material.

Break Bulk Cargo / General Cargo – These are goods that must be loaded individually, not in intermodal containers, nor can they be loaded in bulk.

Bulk Cargo – Cargo that is transported unpackaged and in large quantities. It can be either liquid, granular, or as particulates. Examples are petroleum or crude oil, grain, coal, or gravel.

Chemical Tanker – These vessels transport chemicals in various forms. (www.marineinsight.com)

Cross-Channel Currents – These are currents that travel across the channel perpendicularly, as opposed to along the channel parallel.

Entrance Channel – This is that part of the MSC from Gulf anchors, through the jetty channel at Matagorda Peninsula. This may also be known as the “Offshore.”

Feedstocks – This refers to any unprocessed material used to supply a manufacturing process. Feedstocks are bottleneck assets because their availability determines the ability to make products.

Fluorspar / Flourite – This is the mineral form of calcium fluoride. It is used in the smelting process.

Heavy Lift Cargo – This generally means individual goods weighing over five long tons.

Know – A unit of speed equal to one nautical mile per hour, exactly 1.852 kilometers per hour, or ~1.15078 miles per hour.

LNG Carrier – These vessels carry Liquefied Natural Gas (LNG). (www.marineinsight.com)

Long Ton / Imperial Ton / Displacement Ton / Weight Ton – Used in the United Kingdom and British Commonwealth Nations, it is exactly 2,240 pounds or 20 hundredweight. It is 1.12 short tons or 1.0160 metric tonnes.

Main Channel – This is that part of the MSC from Matagorda Peninsula to turning basin at Point Comfort.

Mean Low Tide (MLT) – The mean average of all the low tides (high low tides and low low tides) occurring over a certain period of time, usually 18.6 years (one lunar epoch). (Coastal States Organization 1997). MLT in the Galveston District was a locally defined navigation datum used for project authorization and construction. Historic projects are referenced to this datum. It has since been superseded by MLLW which is a tidal datum as described herein.

MLLW = MLT + .303'. Vertical datum conversion, MLT to MLLW per USACE Engineering Documentation Report dated July 2015.

Mean Lower Low Water (MLLW) - The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch. For stations with shorter series, comparison of simultaneous observations with a control tide station is made in order to derive the equivalent datum of the National Tidal Datum Epoch. (NOAA)

Naphtha – This is a flammable hydrocarbon mixture. Crude oil is often called naphtha.

Nautical Mile – A unit of distance defined as 6,076', 1.1508 miles, or 1,852 meters.

Non-Attainment Area – An area that currently does not meet the NAAQS for at least one criteria pollutant.

Offshore Bar – A submarine feature that is the principle bypassing mechanism for long-shore sediment transport.

Oil Tankers – These vessels carry oil and its by-products. Oil Tanker is a generic name. (www.marineinsight.com)

Panamax Tanker – These vessels measure around 950' LOA, with a 106' beam, and with 39.5' of depth. They weight between 60,000 and 78,000 DWT. Panamax tankers were designed for the Panama Canal whose lock chambers measure somewhere around 1,050' long, by 110' wide, and 85' deep. (www.marineinsight.com)

Petrochemicals / Petroleum Distillates – These are chemical products derived from petroleum. Examples of petrochemicals are olefins and aromatics.

Short Ton / Ton – It is an American unit of weight measuring 2,000 pounds or 907.18474 kilograms.

Station (STA) – A horizontal distance in feet measured along the centerline of the channel and is used to indicate the relative location of a particular portion of the channel

Turning Basin – It is a constructed water body that is wider than the channel, or port, that allows vessels to turn and reverse their direction of travel, or to enable long narrow vessels to turn a sharp corner.

Ultra-Large Crude Carriers (ULCCs) – These vessels are considered to be cargo carrying super tanker, with a DWT ranger between 320,000 and 550,000. They are the biggest carrying tanker vessels with select areas of operations in Europe, North America, and Asia. (www.marineinsight.com)

Under-keel Clearance – This is measured by the vertical difference between the lowest protruding section of the hull, sometimes referred to as "scantling draft," and the minimum actual channel depth (including advance maintenance dredging). It cannot include vessel hull measurements above the waterline. It must be estimated from the vessel characteristics, sailing draft and trim, and channel dredging conditions relative to the authorized depth and actual depth.

Very Large Crude Carriers (VLCCs) – These are supertankers with a maximum DWT of 320,000. These sail mainly in the Mediterranean Sea, off the coasts of West Africa, and in the North Atlantic. (www.marineinsight.com)