Matagorda Ship Channel, Port Lavaca, Texas

Feasibility Report and Environmental Impact Statement,

Review of Completed Projects,

Calhoun and Matagorda Counties

May 2018

DRAFT

US Army Corps of Engineers®
Galveston District

Southwestern Division

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DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
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STUDY DESCRIPTION

The Calhoun Port Authority, of Port 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, P.L. 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 I – 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

Public Law 91-611; Title II - River and Harbor and Flood Control Act of 1970, Section 216, dated December 31, 1970, 33 U.S.C. § 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."*

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 MSC. Per 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. 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.

This feasibility report and environmental impact statement provides recommendations for the modification of the existing Matagorda Ship Channel (MSC).

SCOPE

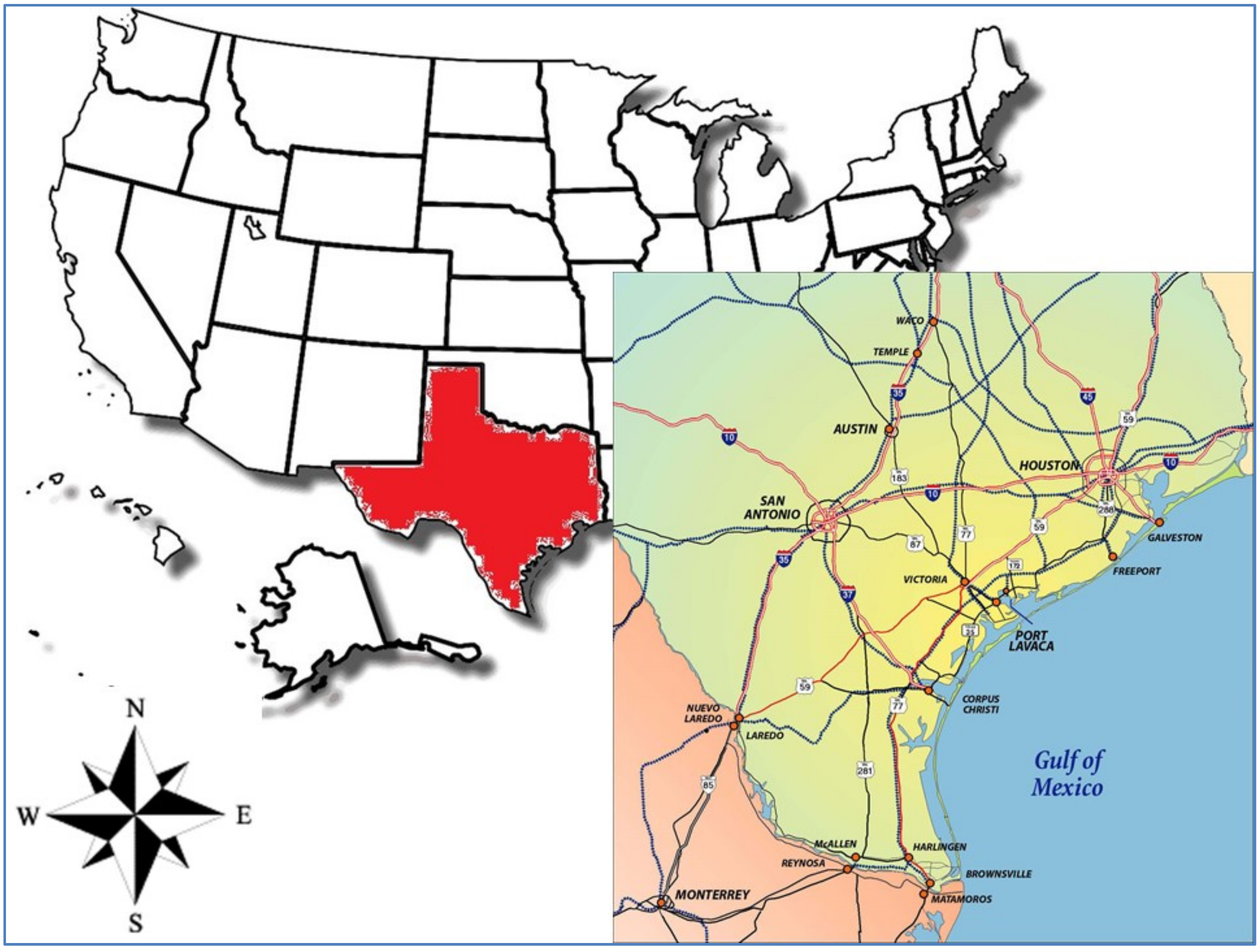
The scope of the study area includes the entire MSC, which would be evaluated for current and projected vessel size and traffic. Beginning at the Gulf of Mexico (Gulf) end of the MSC, the study would examine various management measures to provide for safe and efficient meeting opportunities, including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

Additional analysis would be conducted after selection of the Tentatively Selected Plan (TSP), including modeling, 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 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’ 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 would 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 ships, 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 and safety of the deep-draft navigation system over the period of analysis (2024 – 2074)
- Manage environmental quality effects in the project area over the period of analysis (2024 – 2074)
- Establish environmentally suitable PAs & utilize beneficial use (BU) of dredged material for placement of the dredged material over the period of analysis (2024 – 2074)
  - Identify the Least Cost Plan

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

TENTATIVELY SELECTED PLAN (TSP)

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 non-Federal sponsor, 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

The USACE, CPA, and the resource agencies, have not identified any issues that would prevent environmental compliance.

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.

Alt A	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	Benefit / Cost Ratio
47' MLLW	$24,051,000	$30,590,000	**$6,539,000**	$3,664,000	**1.3**

PUBLIC COORDINATION

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

The USACE and local sponsor held a public scoping meeting in Port Lavaca, Texas on January 24, 2017. Public concerns and comments were solicited. Public review of the draft feasibility report and integrated Environmental Impact Statement (EIS) is scheduled to begin on May 7, 2018 with a public meeting schedule for May 15, 2018.

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 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 of Texas (State). The CPA is supportive of the features in the Tentative Selected Plan.

DREDGED MATERIAL MANAGEMENT PLAN

The MSC Dredged Material Management Plan (DMMP) addresses the dredging needs, disposal capabilities, capacities of disposal areas (DAs), 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 DAs required for the MSC.

CONCLUSIONS

The selection of Alternative Plan A at 47' MLLW as the TSP reflects the information available at the time of 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 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.

REQUIRED LANGUAGE

Section 404(r) of Public Law 92-500, as amended: "The discharge of dredged or fill material as part of the construction of a Federal project specifically authorized by Congress, whether prior to or on or after the date of enactment of this subsection, is not prohibited by or otherwise subject to regulation under this section, or a State program approved under this section, or section 301(a) or 402 of the Act (except for effluent standards or prohibitions under section 307), if information on the effects of such discharge, including consideration of the guidelines developed under subsection (b)(1) of this section, is included in an environmental impact statement for such project pursuant to the National Environmental Policy Act of 1969 and such environmental impact statement has been submitted to Congress before the actual discharge of dredged or fill material in connection with the construction of such project and prior to either authorization of such project or an appropriation of funds for each construction." The requirements of this Section, as amended, have been met.

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1 General Information

The Calhoun Port Authority, of Port 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 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, P.L. 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 8-mile long channel measuring seven feet deep and 80' 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 approximately 1 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 9 feet and a width of 100 feet and was approximately 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 3 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.

Public Law (PL) 85-500, RHA of July 3, 1958, Title I – 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-foot 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 through Pass Cavallo. This channel was 38' deep, 300' wide and approximately 6 miles long; an inner channel 36' deep, 200' wide and approximately 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

Public Law 91-611; Title II - River and Harbor and Flood Control Act of 1970, Section 216, dated December 31, 1970, 33 U.S.C. § 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 MSC. Per 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. 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.

The need for changes to the MSC is derived from an analysis of current and projected vessel transits, cargo tonnage, and capacity at existing and proposed terminal facilities. This need is becoming more critical given increasing levels of maritime traffic, increasing vessel size, and the desire of Port users to capture transportation efficiencies. By expanding channel dimensions, cargo vessels could reduce or eliminate light loading measures, and larger cargo vessels, unable to transit the existing channel configuration, could begin calling on the Port and adjacent facilities.

This feasibility report and environmental impact statement provides recommendations for the modification of the existing Matagorda Ship Channel (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 1). The channel extends from offshore in the Gulf through Matagorda Bay and Lavaca Bay to the Port.

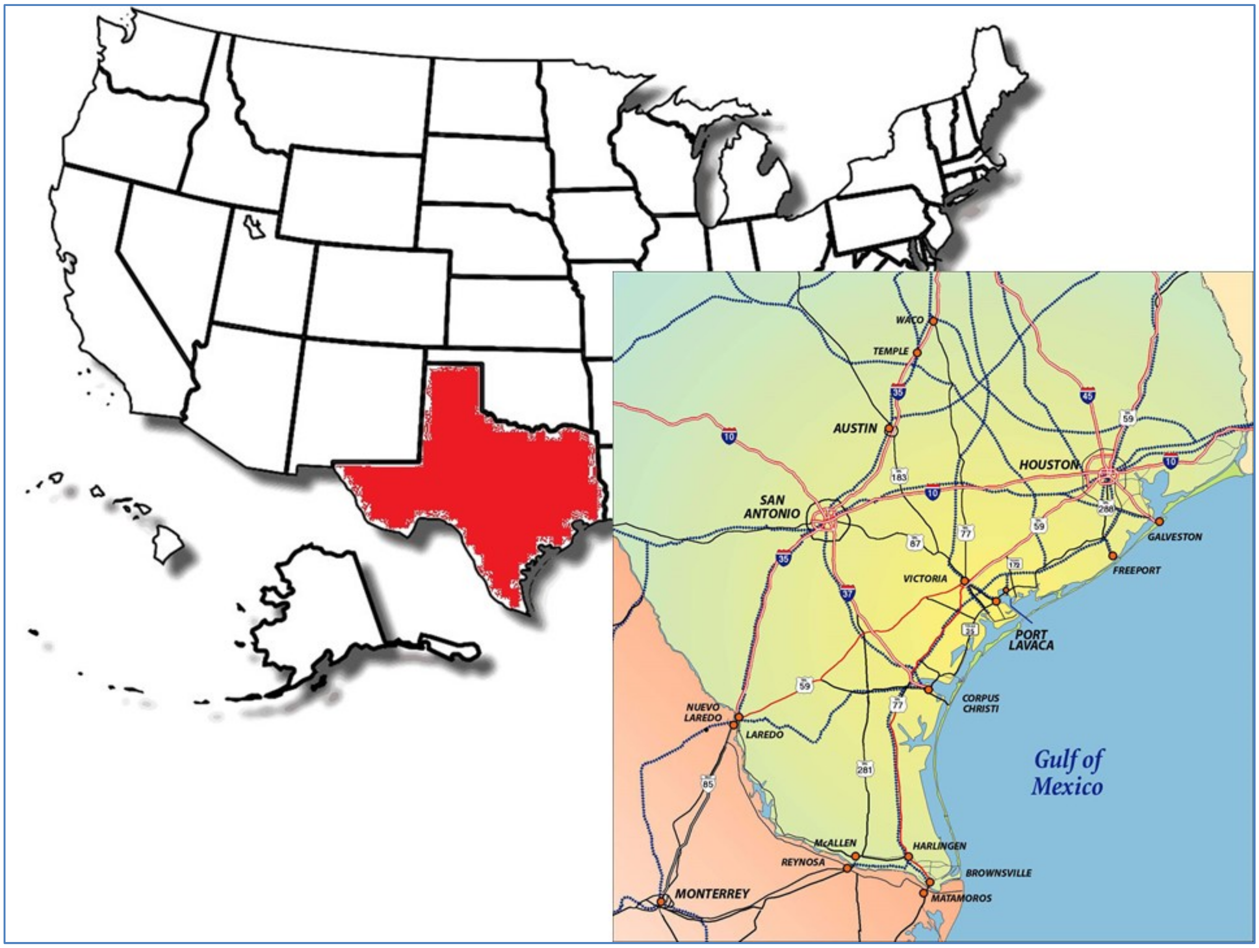

Figure 1 – MSC, Texas Location Map

Matagorda Bay (Figure 2) 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 of Mexico (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 (Figure 2) 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.

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)

MLLW = MLT + 1.69'. Vertical datum conversion, MLT to MLLW per USACE Engineering Documentation Report dated July 2015.

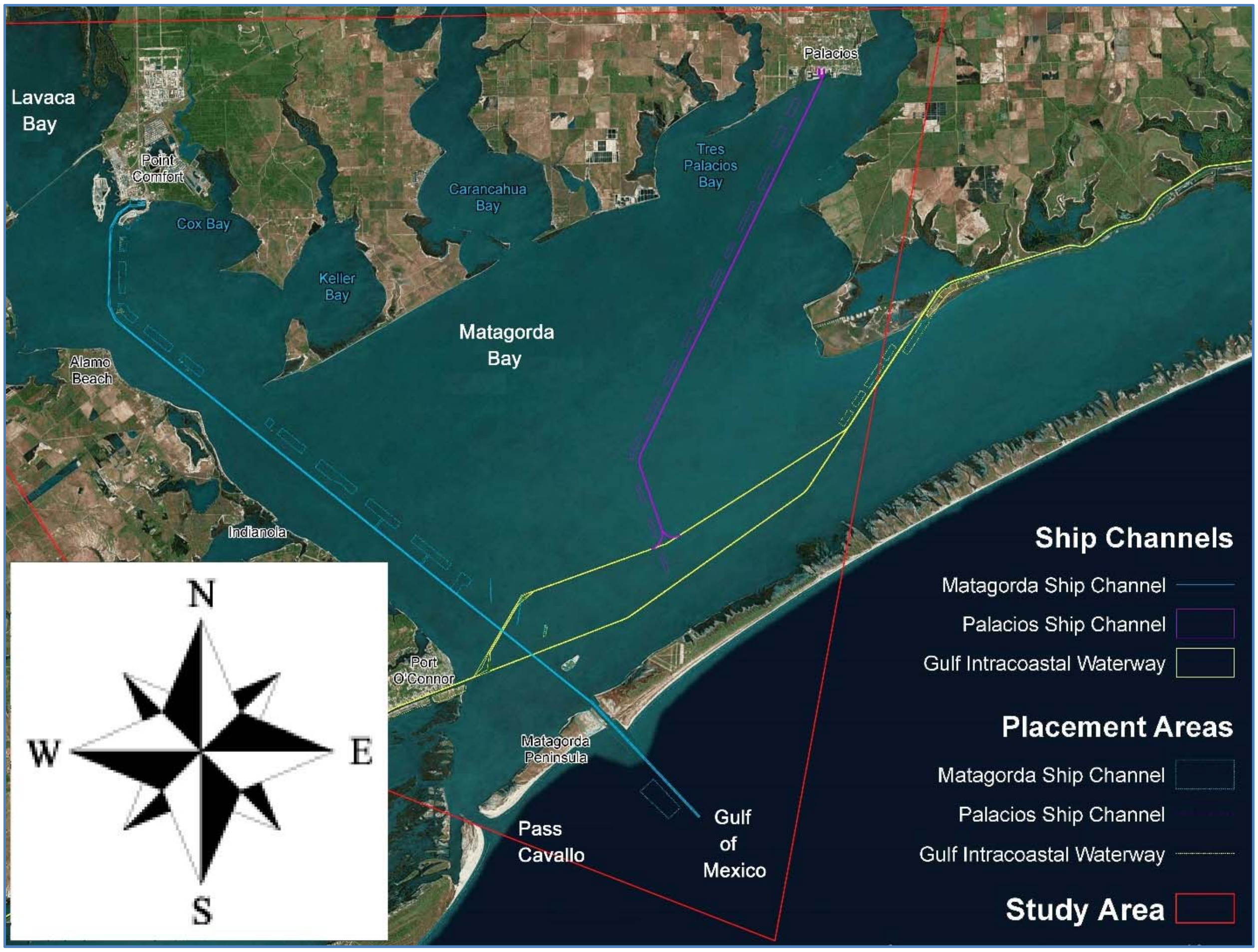

Figure 2 - MSC, Texas Study Area (aerial)

1.5.1 Non-Federal Sponsor

The non-Federal sponsor for this study is the Calhoun Port Authority (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 every conference call, and meeting, coordinating with the Matagorda Bay Pilots Association, 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, Vacant

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 36' deep Mean Low Tide (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' deep by 1,000'-square turning basin at Point Comfort. Texas (Figure 3).

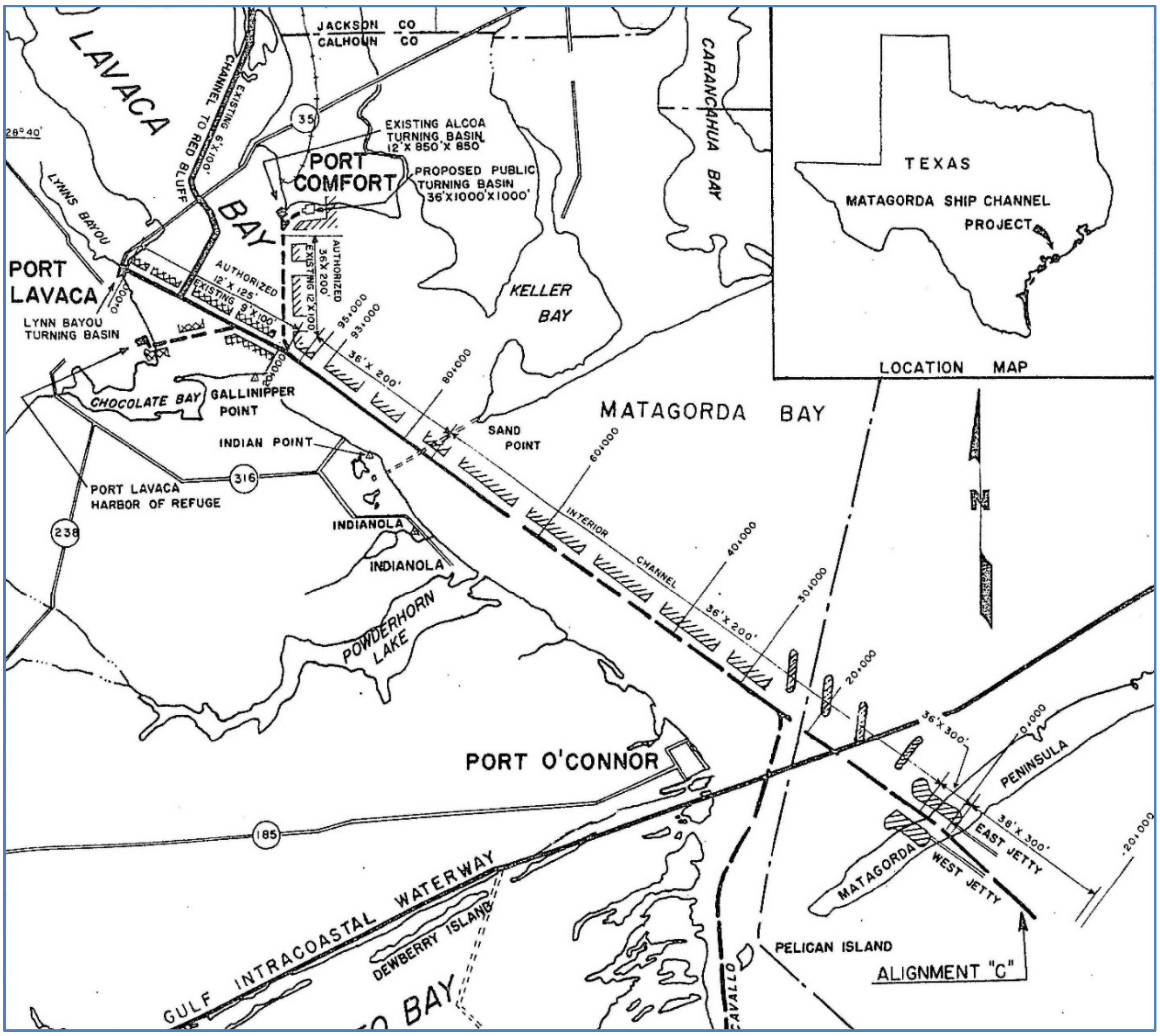

Figure 3 - General Map section from the 1963 GDM No. 3

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. Spoil 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 Port Comfort and up this channel to a turning basin at Port Comfort (Figure 4).

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 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 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.

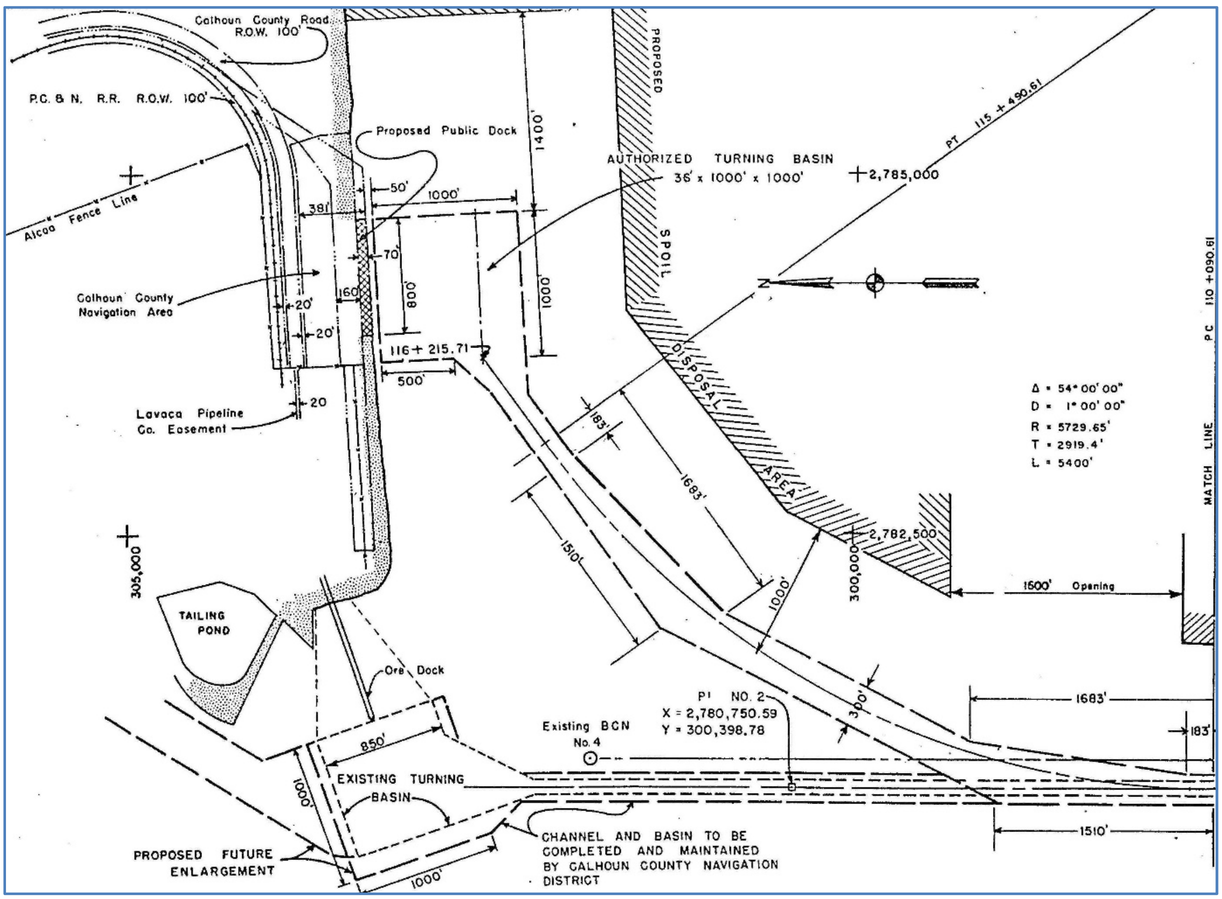

Figure 4 - Original MSC Turning Basin at Port Comfort, Texas

The authorized public turning basin was constructed adjacent to a track of land containing approximately 13 acres (ac) owned by the Calhoun County Navigation District. Public wharf facilities were to be provided by local interests (Figure 4).

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 2). 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 approximately 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 5).

The current MSC was constructed for a 25,000-30,000 dead weight ton (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 ship 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.

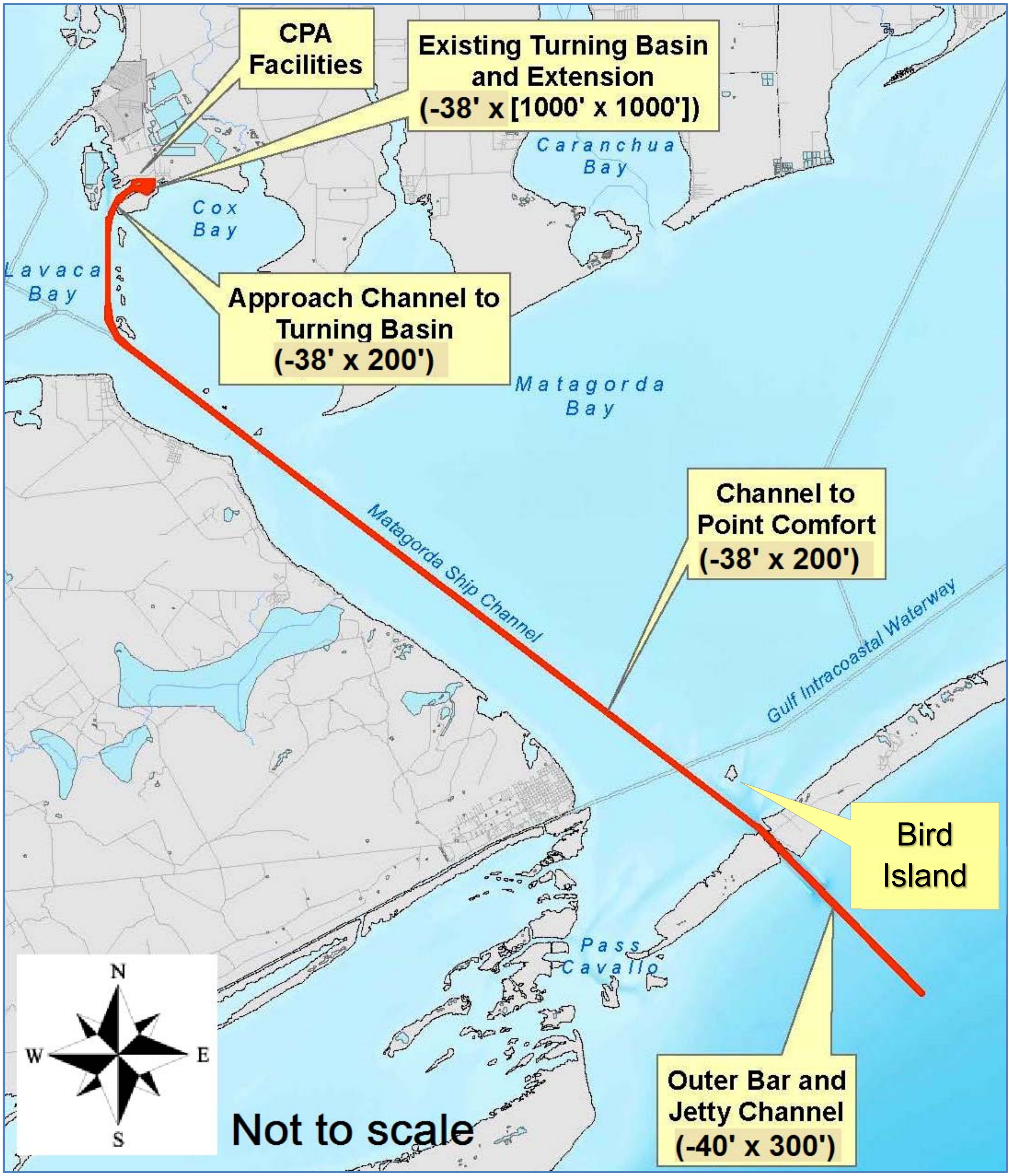

Figure 5 - MSC Current Path and Dimensions

Channel and Basin Descriptions and Maintenance

Offshore (Entrance Channel), the channel has a 300' bottom width, 10H: 1V side-slopes, and is maintained at a depth of 40' MLLW plus three feet of advance maintenance depth and two feet of allowable over-depth (Figure 6).

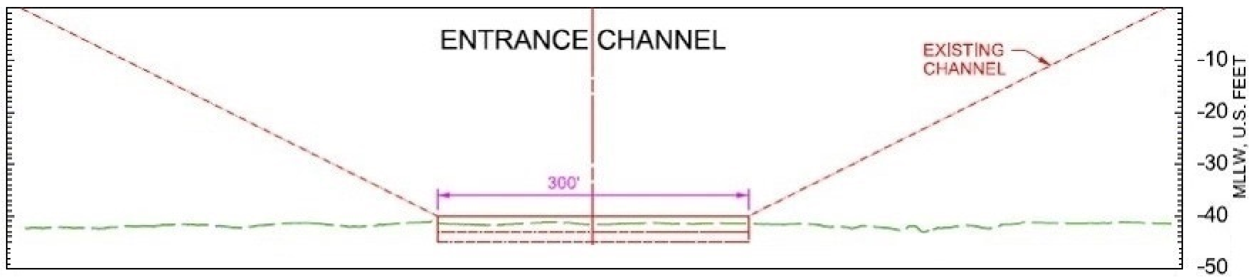

Figure 6 - Existing Entrance Channel Cross Section

Through Matagorda Peninsula, the MSC is authorized to a depth of 38' MLLW, 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 7).

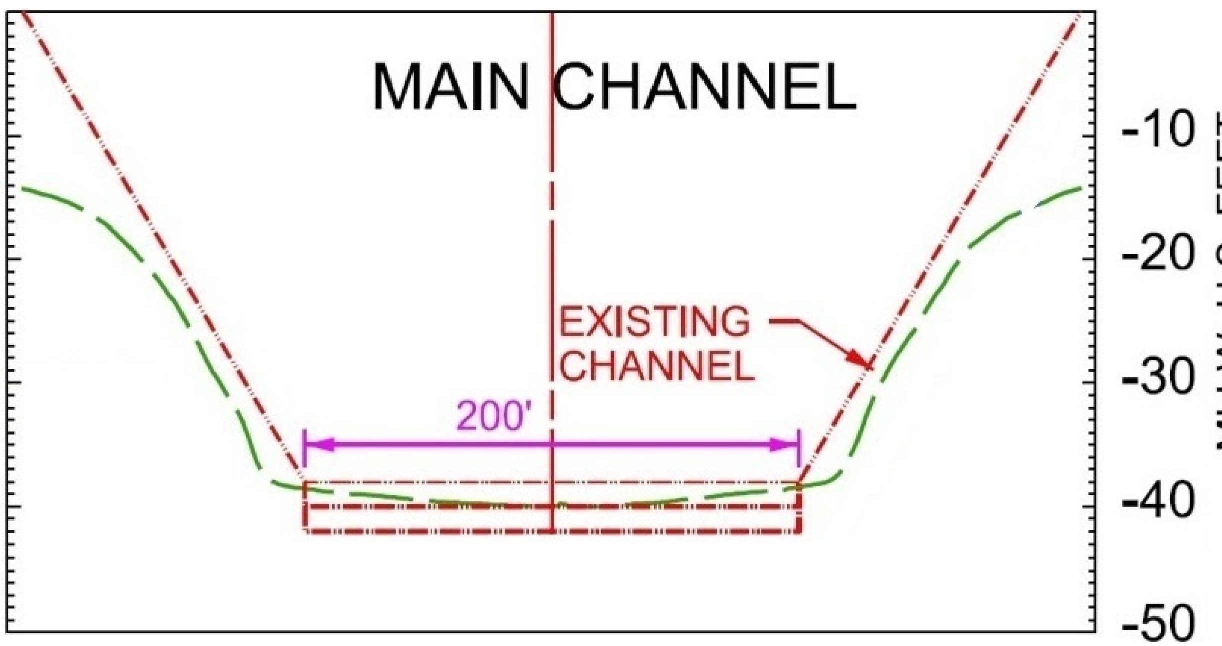

Figure 7 - Existing Main Channel Cross Section

The primary turning basin is maintained to a depth of 38' MLLW, and is 1,000' by 1,000' (Figure 8).

Figure 8 - Existing Turning Basin Cross Section

Dimensions of the channel segments, that are part of this study, are provided below (Table 1).

Table 1 – Currently Authorized MSC Sections and Dimensions

Channel Section	Authorized Depth[1] (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 ft
Point Comfort Turning Basin Extensions (North & South)	38	300	1,279 ft
[1] Authorized depth referenced as MLLW			

Per guidance from HQ, 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 36ft MLT to 38ft MLLW, rather than 37.697ft MLLW (effectively increasing the authorized depth by 1 – 0.37 = 0.69ft).

Port of Point Comfort

The primary turning basin is maintained to a depth of 38' MLLW, 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 9). There are no aerial restrictions (such as bridges) to vessels entering from the MSC or the GIWW. Principal cargoes imported are liquid fertilizer, 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.

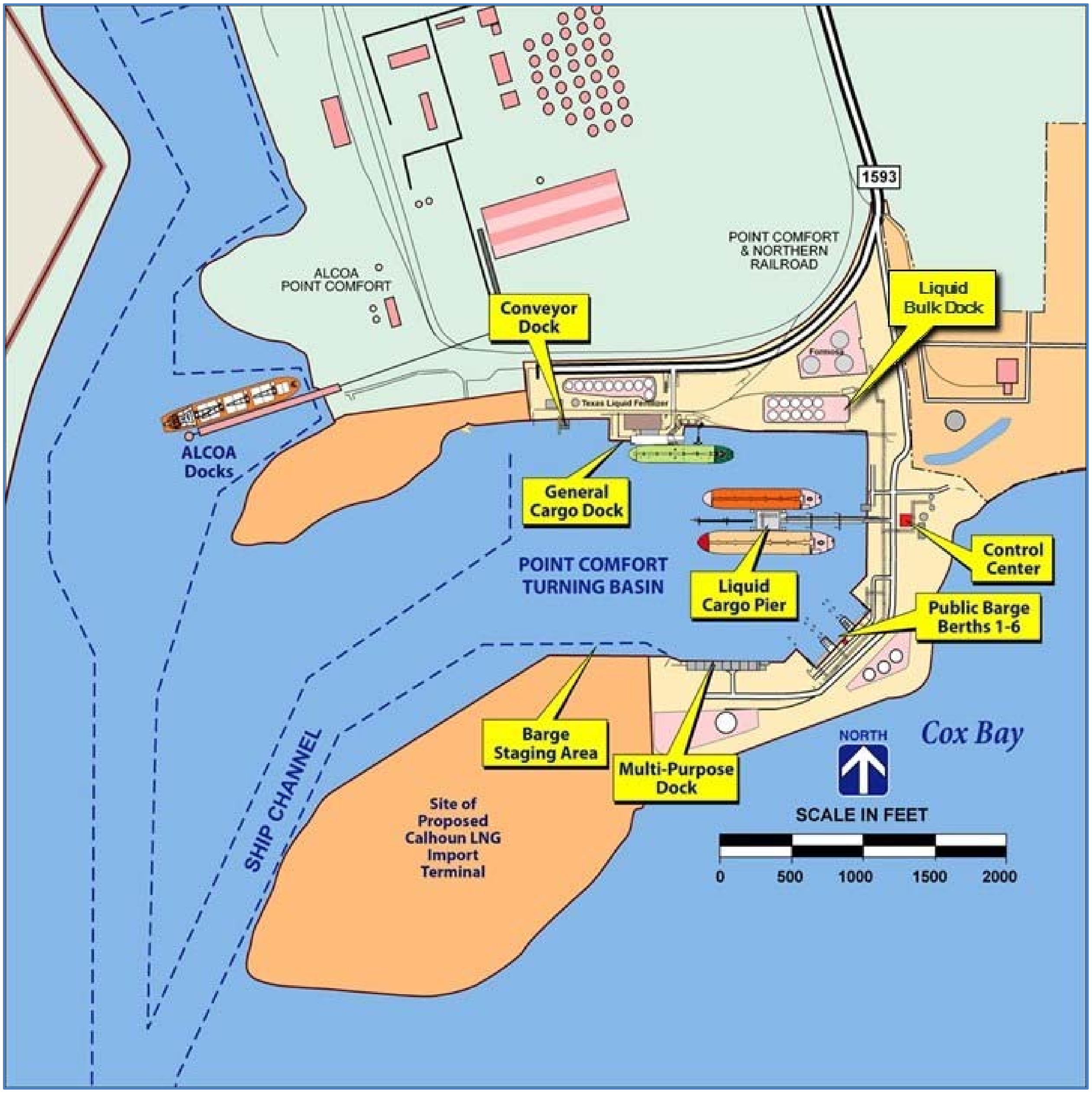

Figure 9 - Port Comfort Existing Facilities

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 ship berths at an operating depth of 38’ MLLW, with positions for 12 marine liquid loading arms. The piers were constructed to accommodate a dredged berth depth of 47’ MLLW 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 Matagorda Bay Pilots Association (Pilots) was consulted during this study to provide input on the rules associated with the MSC. The Pilots indicated that 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’) 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 4 knots.

Under-keel clearance (UKC) requirements in the MSC are stipulated by the vessel owners rather than the Pilots. However, the Pilots have indicated that in general, the UKC requirement is either 10% of the sailing/design draft or three feet. The USACE engineers have confirmed the three feet UKC requirement in the MSC. Therefore, a three-foot UKC requirement was used for this analysis.

Dredged Material Management Plan

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. 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 area (Figure 10). The Matagorda Peninsula - Point Comfort Reach is maintained on a two-year cycle dredging cycle. This reach contains 13 open water areas, 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.

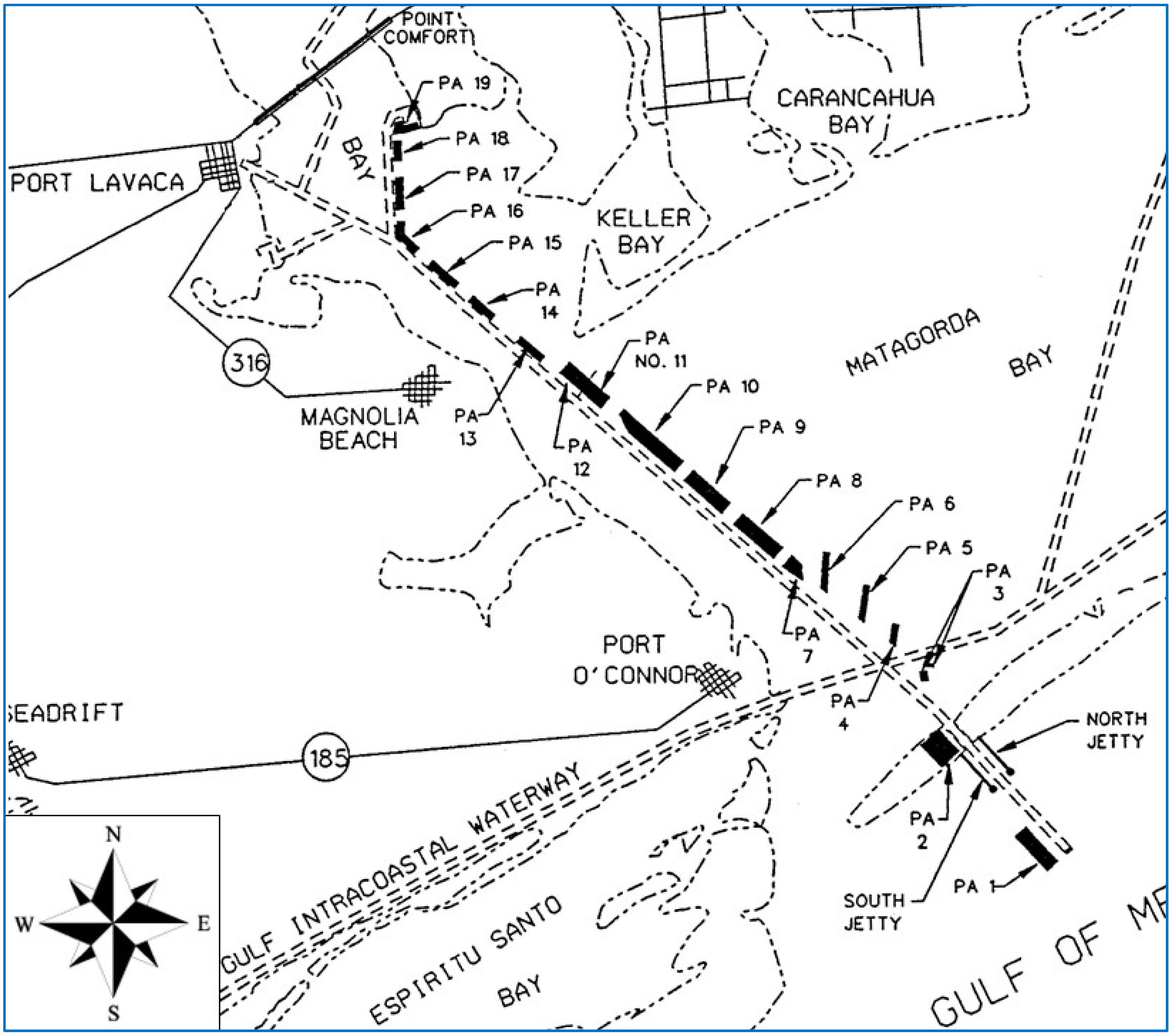

Figure 10 - Map of Current DMMP for the MSC

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 tentatively selected plan (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 above. 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 ships have continued to increase in size (length, beam, and displacement) since the MSC was completed (Figure 11); with large numbers unable to use the existing channel and turning basin.

Figure 11 - Drawing showing examples of changes in vessel size since the MSC was constructed

Specific Problem and Opportunity Statements

Initial Problem Identification – The USACE and local sponsor 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 local sponsor at that time.

- The existing designed channel depth limits channel use to vessels whose drafts are 38’ 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 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.
- 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 would 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 ships, 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.

1.7.2 Public Concerns

- Shoreline Erosion – Enlarging the depth and width of the MSC to accommodate larger and heavier cargo ships, and increased cargo ship traffic could create additional shoreline erosion from Alamo Beach southward to Port O’Connor. Increased cargo ship traffic, compounded by larger and heavier cargo ships, could create larger and more powerful waves, accelerating beach and shoreline erosion.

1.7.3 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 will effectively constitute 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.

1.7.3.1 Federal Goals

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

1.7.3.2 Specific Study Planning Objectives

- Improve the navigational efficiency of the deep-draft navigation system over the period of analysis (2024 – 2074)
- Improve the operational safety of the deep-draft navigation system over the period of analysis (2024 – 2074)
- Manage environmental quality effects in the project area over the period of analysis (2024 – 2074)
- Establish environmentally suitable PAs & utilize beneficial use (BU) of dredged material for placement of the dredged material over the period of analysis (2024 – 2074)
    - Identify the Least Cost Plan

1.7.3.3 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 Dredged Material Management Plan (DMMP) that includes environmentally suitable PAs
- Plans should include a Least Cost DMMP that includes the use the Beneficial Use of dredged material, if possible

1.7.4 Key Assumptions

Economics

Benefits of the deepening project would be based 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 a net energy importer.

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 Port;
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 channel users.

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.

Environmental

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

An existing ODMDS designated for maintenance material would continue to be used as needed for maintenance dredging.

Geotechnical Engineering

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

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 PED.

Geotechnical Data

Potential Impacts: Inaccurate Levee Geotechnical Analyses and Design Stability Feature Design and Project Cost estimate - The study relies on existing geotechnical information for characterization, analyses, design, and project cost estimates. The data are old, less technically precise, and may contain errors.

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.

Real Estate

Based on available information, approximately 22 pipelines would need to be removed or relocated.

Clearance requirements for underground pipelines, cables, and conduits crossing deep draft channels are given in the USACE Galveston District (SWG) (1998) 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.

1.7.5 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

(See Section on Transportation Cost Savings Benefit Analysis) 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, crude oil exports were restrictions on exporting US crude oil overseas. 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 benefit-to-cost 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 has been in operation since 1948 was considered to produce zero benefits for this project. The indefinite closure 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 (and east of the berm), 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 6 to 11 percent. The increase is not dependent on whether the dredged material is confined to the existing area or spread out over a wider placement area (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.
- 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.

- USACE. 2009. *Final Environmental Impact Statement for the Proposed Matagorda Ship Channel Improvement Project, Calhoun, and Matagorda Counties, Texas.* This Final Environmental Impact Statement was prepared as required by the National Environmental Policy Act to present an evaluation of potential impacts of the CPA's proposed Matagorda Ship Channel 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-feet wide by 44-feet deep" widening and deepening project.

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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 future with-project 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 approximately 13’ MLLW while depth in the adjacent bays ranges from seven to either feet.

2.1.1 Hydraulic Conditions

Existing hydraulic conditions at this site present several unique challenges:

- Dangerous currents between the jetties (>4 knots at the peak of every tidal cycle)
- 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 ships entering the channel
- No wave measurements between the jetties or offshore (only Sep-Dec 2005 in the Bay)
- Current-meter data sets that disagree with each other

2.1.2 Waves

Wave measurements at the Entrance Channel do not appear in public or the USACE databases.

CONCLUSION from the Pilots (Captain David Adrian, 12/28/2017 email): "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 2 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'."

2.1.3 Currents

Analysis of currents from five data sources is underway. Unfortunately, the only overlap in the measurements is the ongoing measurements at the Bird Island and Entrance Channel sites in the Google Earth photo below. Thus there is only one inter-comparison possible. Currents measured by the entrance-channel current meter installed in November 2017 have not yet been received. Past measurements did not coincide with each other in space or time.

2.1.4 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.

2.1.5 Bathymetry

Two vital measurements are missing. The offshore bar has not been surveyed, which is the limiting factor for the draft of the ships entering the channel. Without such a survey, design of a safe depth/draft at the entrance cannot be performed. The second missing measurement is wave height.

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 17). The Corpus Christi Ship Channel (CCSC), which provides access to the Port, is a 36-mile, 47' MLLW channel that handles both international and domestic marine commerce. Like the MSC, the CCSC handles liquid chemicals and petroleum products, among other commodities.

To assist with assumptions that would 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 is in the form of liquid bulk. Annual throughput tonnage levels by commodity for the latest available years of Waterborne Commerce Statistics Center (WCSC) data (2004-2016) (Figure 12).

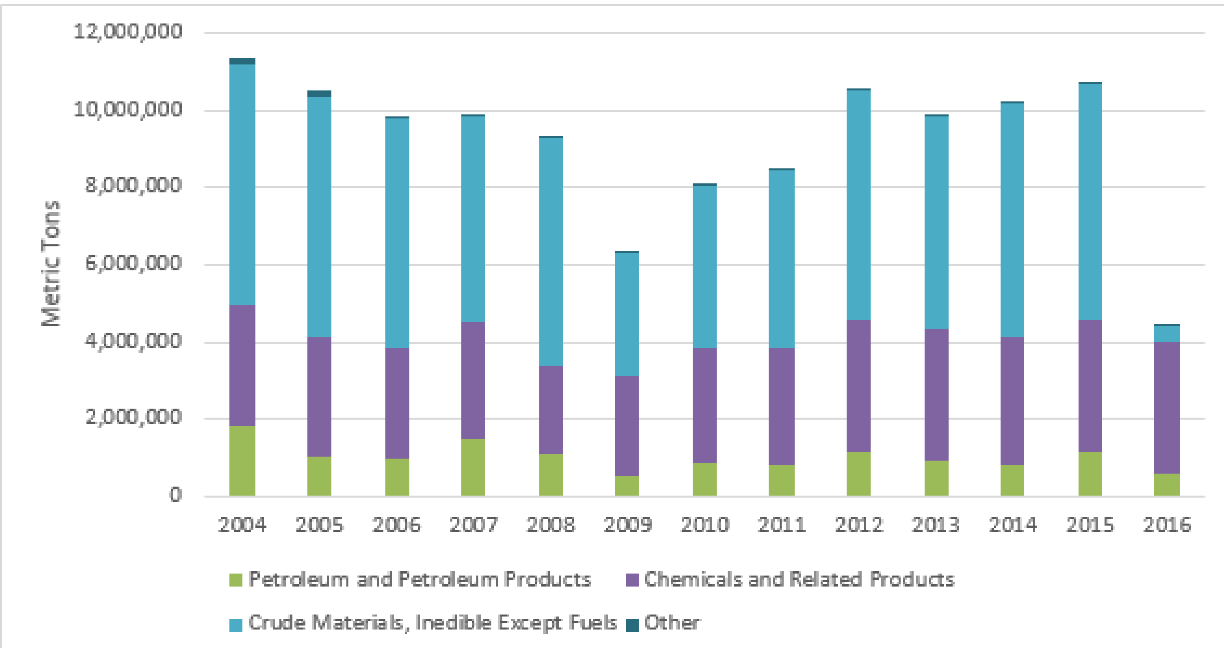

Figure 12 - MSC Tonnage by Commodity (Receipts and Shipments 2004 - 2016)

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.

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.

Figure 13 displays a recent history of crude oil exports from the United States in terms of thousands of bpd. For the time period December 2016 through November 2017, exports of crude oil averaged 55% of foreign shipments out of the MSC.

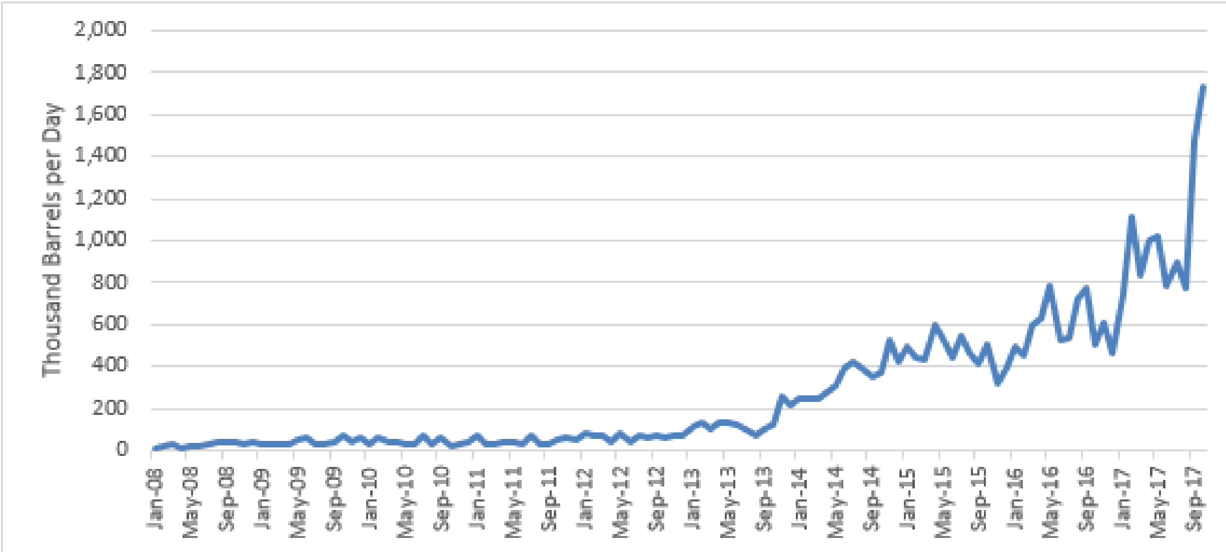

Figure 13 - US Exports of Crude Oil January 2008 - September 2017 (1,000 barrels per day or bpd)

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 14).

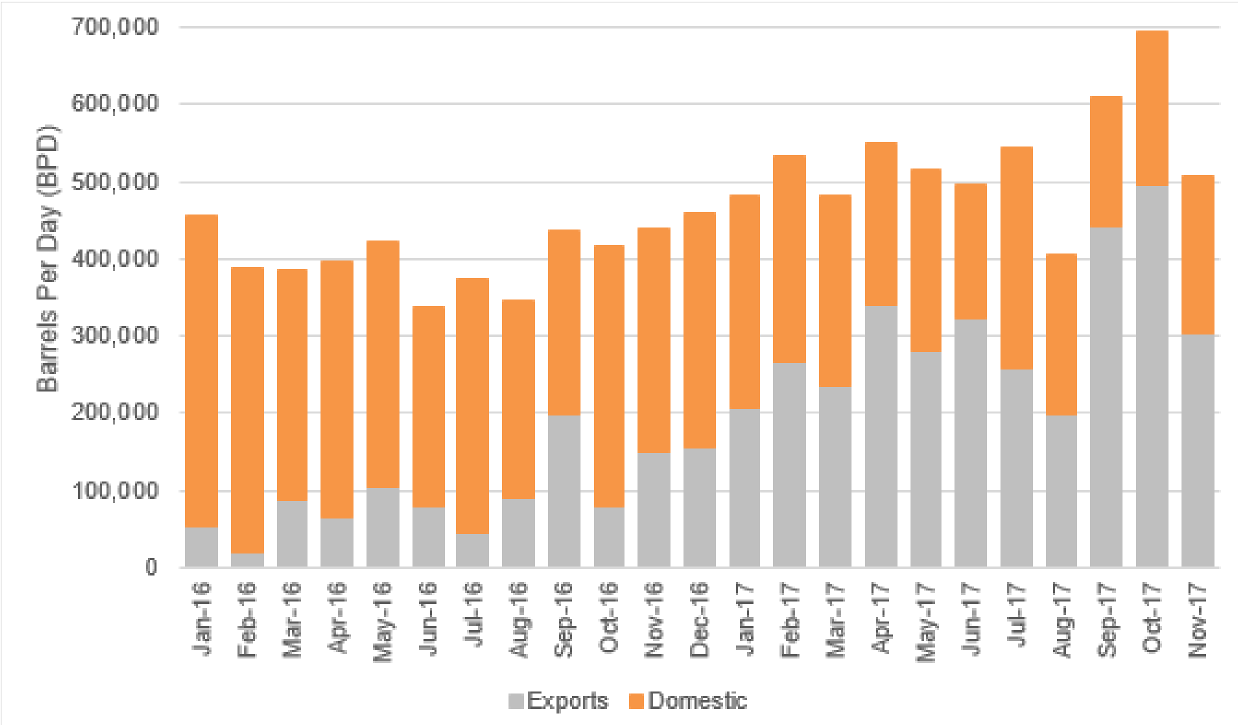

Figure 14 - Crude Oil & Condensate Shipments January 2016 - November 2017 (bpd)

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 purposed only.

The vast majority of the 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 WCSC and verified by the Pilot's log provided by the Port. 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 PCC 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 <u>Chemical Fleet</u>

Vessels carrying chemicals range in size from 4,500 to 60,000 DWTs and are split into three classes (Table 2).

Table 2 - 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, approximately 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 15).

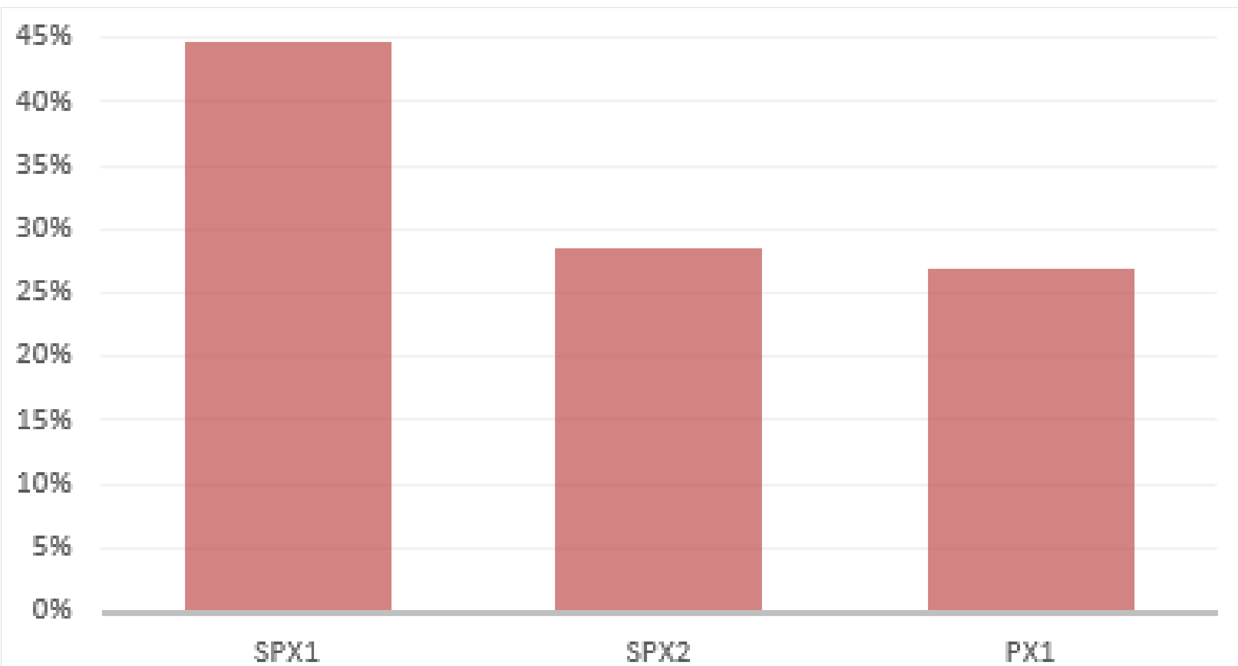

Figure 15 - MSC Chemical Tonnage Distribution by Vessel Type (2015)

2.2.3.2 Petroleum Product Fleet

Because 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. 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 3). Like chemical tankers, DWT was used to categorize the vessels into classes.

Table 3 - 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

In 2015, approximately 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 16).

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.

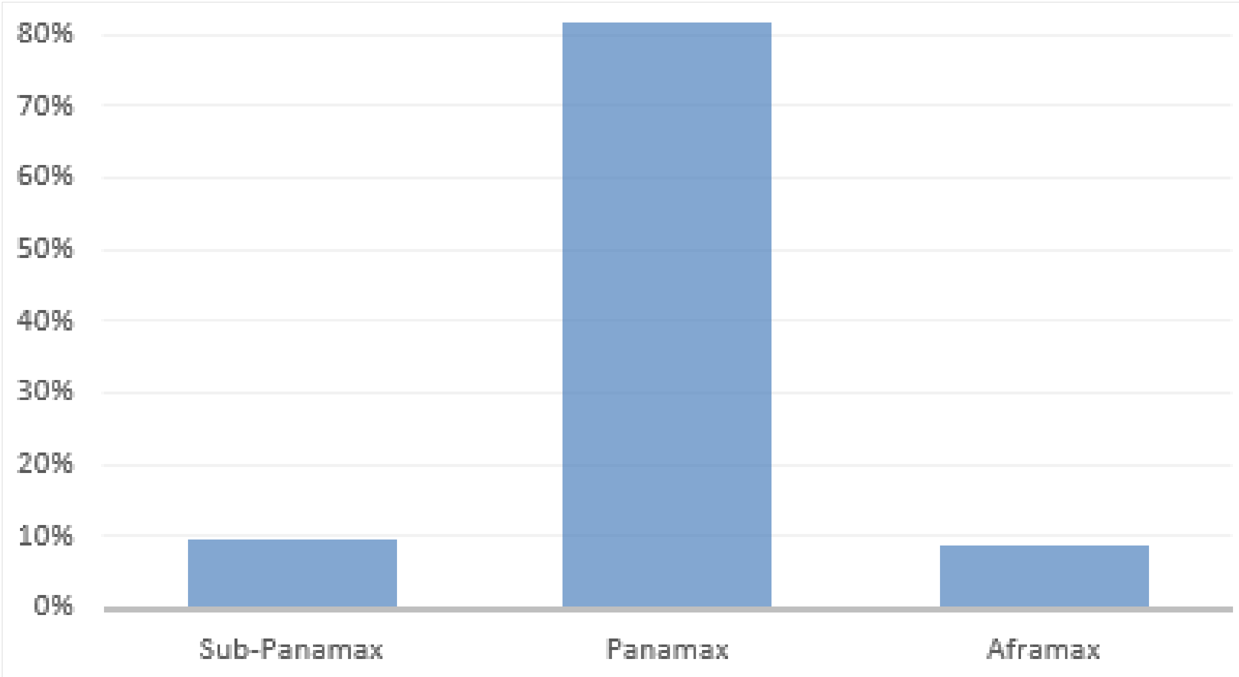

Figure 16 - Petroluem Product Tonnage Distribution by Vessel Type, 2015

2.2.4 Existing Commerce

The composition of Point Comfort's commodity profile has changed in recent years. 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 Chemicals

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 approximately 25% of its foreign chemical tonnage and exporting approximately 75%. Most of the chemicals imported to the Port are used as raw materials for specialty chemicals produced and exported by the Port users.

2.2.4.2 Dry Bulk

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.

2.2.4.3 Crude Oil and Condensate (Petroleum Products)

Crude oil and condensate is a new type of commerce at the Port beginning in 2015. 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 would remain aggregated.

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 (Table 4). 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 4 - 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

The Eagle Ford Shale was discovered in 2008 in South Texas and stretches northeast from the US-Mexico border to just below Houston. The formation is approximately 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 would continue to be developed for decades (http://eaglefordshale.com/). Eagle Ford Shale's proximity to the Port (Figure 17) positions the Port to be an efficient exporter of commodities produced by the Shale.

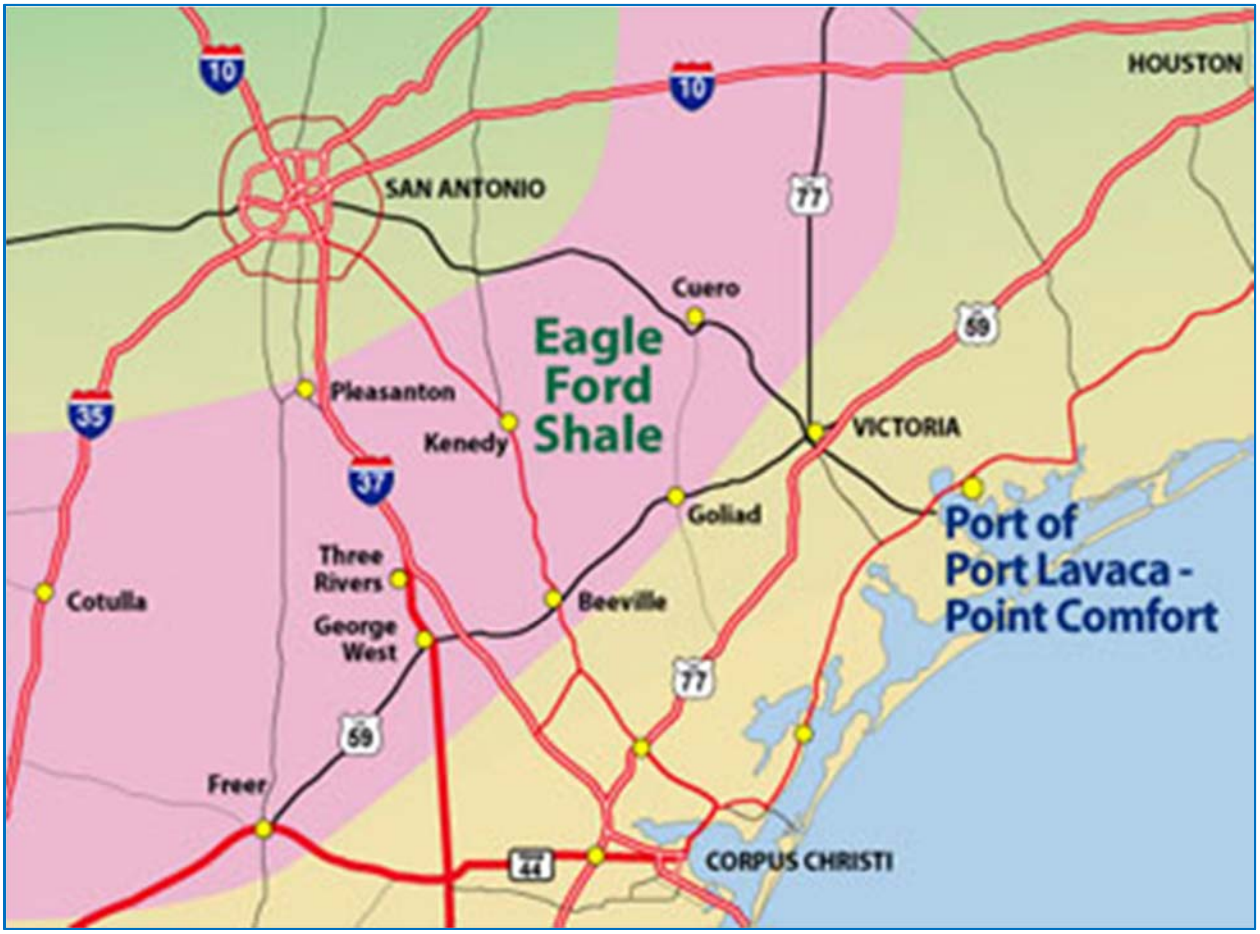

Figure 17 - Map of Eagle Ford Shale Area

2.2.4.5 Petra Nova Project

The Petra Nova Project (Figure 18) came online in 2016. It is the world's largest post-combustion carbon-capture facility 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 would be used in a process called Enhanced Oil Recovery (EOR) to recover previously unreachable oil and then would be stored permanently underground. Oil production at the West Ranch oil field is expected to increase from 300 bpd to 15,000 as a result of the project.

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 based on its proximity to the West Ranch oil field.

Figure 18 - Petra Nova Project

2.3 Environmental Resources

2.3.1 Affected Environment

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.

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.

2.3.1.1 <u>Wetlands</u>

In the Matagorda Bay area, the tidal inundation of seawater and inflow of fresh water leads to a mixture of the saline and brackish marshes. Smooth cord grass is typically found along the open-water areas in what may be a fringe only a few feet wide. A rapid transition from low saline marsh to low brackish marsh can occur within a band a few feet wide.

The areal coverage of estuarine marsh on, and near, the barrier islands has increased since the 1950s in West Matagorda Peninsula due to wash over fans deposited by Hurricane Carla in 1961 and from accretion into Pass Cavallo due to long-shore drift.

Relative sea level change has also played an important role in the decline of interior marshes and increased shoreline erosion within the bay.

The area also includes low and high scrub-shrub estuarine wetlands dominated by black mangrove. See Appendix B for species lists.

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. The area also includes low fresh-intermediate marshes and wet meadows.

2.3.1.2 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 Submerged Aquatic Vegetation (SAV). The open-water habitats support communities of benthic organisms, plankton, nekton, and numerous fish species.

Phytoplankton is the primary producers in the open Lavaca Bay and is fed upon by zooplankton, fishes, and benthic organisms. The phytoplankton of Lavaca Bay is dominated by diatom species, and achieves their highest level of abundance in the winter, with the lowest abundance numbers in the summer.

In Lavaca Bay, zooplankton is most abundant during the spring and at their lowest levels in the fall. The zooplankton community is dominated by the copepod and barnacle. Zooplanktons form the basis of the food chain for larval and juvenile fish. It is expected that plankton assemblages in Matagorda Bay would be similar to those of Lavaca Bay.

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. These species are found throughout the Texas coast. Seasonal differences occur in abundance and biomass depending on the timing of Gulf-ward migrations.

Matagorda Bay has one of the lowest percentages of the total finfish harvest of all the Texas bay systems, contributing less than 5% of the coast wide 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 5% 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 macro-invertebrates within the bay is influenced by both bathymetry and sediment type. Benthic macro-invertebrates 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. The dominant polychaetes are *Mediomastus californiensis* and *Spiophanes bombyx*. The dominant crustaceans are *Pseudohaustorius* spp. and *Ampelisca abdita*. See Appendix B for species lists.

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. Oysters play an important role as an indicator species of pollutants and contamination. Because they are sessile they tend to bioaccumulate whatever pollutant is present in the water column.

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 has classified shellfish-harvesting areas in Matagorda Bay approved or conditionally approved.

2.3.1.3 Wildlife Resources

The project area is located within the Texas Biotic Province (TBP). This province represents a transitional area between the forested Austroriparian Biotic Province to the east and grassland provinces to the west. At least 49 species of mammals are known to have occurred in the TBP in recent times, in addition to 39 snake species, 16 lizards, 2 land turtles, 18 anurans (frogs and toads), and 5 urodeles (salamanders and newts). There are no endemic vertebrate species in this region. See Appendix B for species lists.

Matagorda Bay is located along the Central Flyway for waterfowl and is one of the most significant water bird wintering regions in North America. The Matagorda Island National Wildlife Refuge and State Natural Area are home to numerous species of resident and migrant birds including raptors, songbirds, and migratory waterfowl.

2.3.1.4 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). (See Appendix B for species lists.) 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 (*Charadrius melodus*) and the Whooping crane (*Grus americana*).

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.

2.3.1.5 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.

2.3.1.6 Air Quality

The Matagorda region is in the Corpus Christi – Victoria Air Quality Control Region (AQCR). 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.

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 ships, 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.

2.3.1.7 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.

Noise-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 (ship traffic, barges, commercial and recreation vessels, and maintenance dredging of the channel). Measured ambient noise levels, at noise-sensitive receptors in communities with a similar degree of activity, range between 60.9 and 65.1 Day-Night Sound Level (L_{dn}).

2.3.2 Climate

The mid-Gulf region climate 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 8 to 12 mph. For the rest of the year, the region is dominated by northerly winds ranging from 10 to 11 mph. The average annual wind speed is approximately 10 miles per hour (NCDC, 2016b).

Sea breezes from the Gulf help to ease the effect of the high temperatures. 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.

The 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. Average annual rainfall is 42.4" per year.

Humidity is typically above 50%, with an average annual humidity fluctuating between 66% in the afternoon and 90% in the morning. The highest percentages of sunlight occur in the summer months, with an overall average of sunlight present for 59% of all possible daylight hours.

2.3.3 Land Use and Classification

2.3.3.1 Prime and Other Important Unique Farmland

The US Department of Agriculture National Resource Conservation Service 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.

2.3.3.2 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.

2.3.4 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.

2.4 Cultural Resources

Human habitation along the central coast has only been identified in the region as early as 7,500 BP. 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.

Previous marine cultural resources investigations in the project area have included archeological surveys of the Matagorda Ship Channel for the El Paso LNG Terminal Company (McCormick et al. 1978), the USACE (Pearson and Hudson 1990), and the Calhoun County Navigation District (Borgens et al. 2012). An archeological survey was also conducted along alternative routes of the Gulf Intracoastal Waterway for the USACE (Enright et al. 2002). A magnetic anomaly (anomaly M39 in Enright et al. 2002:E-7) was identified as a result of this survey just north of Sundown Island, outside of the project area, which was recommended for additional investigation. Numerous terrestrial cultural resources investigations have been conducted in the study area for the Texas Department of Transportation, Texas Parks & Wildlife Department, Texas General Land Office, EPA, and USACE.

The primary considerations concerning cultural resources are threats to submerged resources from dredging, erosion of shoreline sites, and from construction of new dredged material placement areas in both upland and marine environments. A portion of the study area, especially within Port Lavaca and Point Comfort, has been altered for industrial and commercial use. The probability for intact prehistoric archeological sites to occur in these areas is low. However, there is a moderate to high potential for encountering historic age archeological sites, as well as historic age structures and buildings throughout the study area. Additionally, there is a moderate probability for encountering prehistoric archeological sites in upland areas that have not been previously developed. For the marine portions of the study area, the potential for encountering submerged cultural resources, such as shipwrecks, is moderate. Although much of the area has been dredged in years past, the very dynamic nature of the study area means that submerged resources may occur anywhere.

2.5 Environmental Engineering

2.5.1 Water and Sediment Quality

The TCEQ has designated water quality segments for the Matagorda Bay system. 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 E/O designation translates to a dissolved oxygen (DO) criterion for saltwater of an average of 5 milligram per liter (mg/L) and a minimum of 4 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).

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.

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. The study area has been experiencing shoreline erosion, primarily from wind waves, as described by McGowen and Brewton (1975). The authors suggested approximately 8,450 ac of land of bay and Gulf shorelines were lost to natural erosion between 1856 and 1957 compared to approximately 615 ac 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.

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.

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.

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 8-31 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 2 to 5 ppt in adjacent areas.

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 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.

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 (1 in Point Comfort and 22 in Port Lavaca).

2.6 Geology and the Structural Setting

All existing or available geotechnical information within the USACE or from others including 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 locations, elevation, and strata descriptions (Appendix A). Based on the stations, all locations of the above 80 borings can be distributed in the three reaches as follow:

- Lavaca Bay Reach – Station 115+502 to 75+000 (Boring Series: 3ST-43, 3ST-40, 3ST-37, 3ST-34, 3ST-31, 3ST-28, 3ST-25, 3ST-22, 3ST-19, 3ST-16, 3ST-13, 3ST-10, 3ST-7, 3ST-4, 3ST-1, 3ST-45, 3ST-48, 3ST-51, 3ST-54, 3ST-57, 3ST-60, 3ST-63, and 3ST-65)
- Matagorda Bay Reach – Station 75+000 to 6+000; and (Boring Series: 3ST-67, 3ST-70, 3ST-73, 3ST-76, 3ST-79, 3ST-82, 3ST-85, 3ST-88, 3ST-91, 3ST-94, 3ST-97, 3ST-100, 3ST-103, 3ST-106, 3ST-109, 3ST-112, 3ST-115, 3ST-118, 3ST-121, 3ST-124, 3ST-127, 3ST-130, 3ST-133, and 3ST-136)
- Offshore Reach – Station 6+000 to -23+000 (Boring Series: 6ST-161, 6ST-163, 6ST-165, 6ST-168, 6C-10, 6C-11, 6C-12, 6C-13 6C-14, 6C-15, 6C-16, 6C-17, 6C-18, 6C-19, 6C-1, 6C-2, 6C-3, 6C-4, 6C-5, 6C-6, 6C-7, 6C-8, 6C-9, 6C-20, 6C-21, 6C-22, 6C-23, 6C-24, 6C-25, 6C-26, 6C-27, 6C-28, and 6C-29)

This information can be used to confirm side slopes and estimate quantities for the improved channel.

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 B. The tests were performed at locations that indicated very soft material near the surface, with stiffer material at greater depth (Appendix B). 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.

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 approximately 20ft as shown in 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.

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 5 displays the test results for these sediment samples and the calculated dry densities.

Table 5 - 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 MSC dictate the type of dredge that would be utilized to perform the excavation for DMMP. 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.

2.7 Real Estate

2.7.1 Existing USACE Interests

- A perpetual easement and right-of-way for navigation purposes to construct, dredge, reconstruct, enlarge, replace, maintain, operate and repair a navigation channel and waterway and jetties and related facilities and spoil – disposal areas (Das) for the deposit of sand, silt and spoil 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
- 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

Existing PAs currently in use for maintenance dredge material placement that are to be excluded from this project are PA-5 to PA-12, PA-17 to PA-18, and PA-116-B (Figure 10).

Existing PAs currently in use for maintenance dredged material placement that would be included in this project are (Figure 10):

- PA-14 to PA-16 totaling over 300 ac are open water unconfined PAs
- PA-19 is an unconfined, emergent PA encompassing approximately 90 ac. About 23 ac is emergent, with the remainder being wetland or open water
- Disposal Area (DA) 2 (Sundown Island) is a designated PA used for both MSC and GIWW maintenance material disposal, located near the MSC Entrance
- A perpetual easement to dispose of dredged material on tract DA-3 was acquired 9 August 1967 from the Matagorda County Navigation District No. 2
- PA-1 is an ODMDS

2.8 Socioeconomics

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

The State is ranked as the second largest state in terms of resident population as of the 2010 census, with 25.1 million residents. As of 2010, the population estimate for the MSC region was just under 159,000. Between 2000 and 2016, Texas' experienced 29% growth, while the MSC region experienced 5% growth. The state is expected to grow by 43% between 2016 and 2050, while the MSC region expects to grow by 24%. See Appendix A – Table 7-1 for Population Estimates and Projections (2000, 2016, and 2050).

2.8.2 Employment

The majority of the MSC region is employed in the Educational services, health care, and social assistance sector at 22%. The next largest group is employed by the Manufacturing sector (14%), the Retail trade sector (12%), and the Construction sector (9%).The remaining sectors each employ between 5% and 8% of the MSC region population. See Appendix A – Table 7-2 for Employment by Sector.

2.8.3 Income and Poverty

The median household incomes within the MSC region were comparable to the State in 2016. The only county within the MSC region whose median household income was substantially below the state's median was Matagorda County. In terms of per capita income, the MSC region's incomes were slightly below that of the state. Per capita incomes in the MSC region ranged from $22,939 in Matagorda County to $27,509 in Victoria County.

Two of the four counties in the MSC region, Calhoun and Matagorda, had a greater percentage of both families and people with incomes below the poverty level when compared to the State. See Appendix A – Table 7-3 for Median, Per Capita Income and Poverty Data (2016).

2.8.4 Unemployment Rates

The 2016 annual average unemployment rate in Texas was 4.6%. The unemployment rates in the counties surrounding the project area were slightly higher. The annual average unemployment rate was 5.6% in Calhoun County, 4.8% in Jackson County, 7.4% in Matagorda County, and 5.4% in Victoria County. See Appendix A – Table 7-4 for Labor Force, Employment and Unemployment Rates (2016 Annual Averages).

2.8.5 Race and Ethnicity

Within the MSC region, 47% of the population self-identifies as White, 6% as Black, 43% as Hispanic or Latino, 2% as Asian, and 1% as two or more races. By comparison, within the State, 43% of the population self-identifies as White, 12% as Black, 39% as Hispanic or Latino, 4% as Asian, and 2% as 2 or more races. See Appendix A – Table 7-5 for Racial Composition by Geographical Area (2016).

2.8.6 Age

The age distribution between the State and the MSC region is similar. The MSC region has a slightly larger population ages 65 and over when compared to the State. The MSC region's 65 or over population was 15% in 2016 compared to State's 11%. See Appendix A – Table 7-6 for Population by Age Group (2016).

2.8.7 Environmental Justice

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, in the 53rd percentile in the state in terms of linguistically isolated population, in the 60th percentile in terms of population with less than a high school education, 51st in population under the age of five, and 74th in population over age 64. 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 – 2074), 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

3.1.1 General Expectations Summary

Changes in wave climate and sea-level rise are much easier to predict than changes in currents or bathymetry. Waves should remain unchanged, and sea level should rise to some value between the Low and Intermediate Level Curves.

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 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.

3.1.2 Waves

Wave heights and periods in deep water are little affected by changes in currents or water levels (SLR), thus there is no reason to expect significant changes in the wave climate.

3.1.3 Currents

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

3.1.4 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.

3.1.5 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.)

3.1.6 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.

3.2 Economics

3.2.1 Port Expansions

At the onset of this study, in addition to the crude oil users that 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.

3.2.1.1 South Peninsula Development Project

This 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’ LOA and 140’ beam (Figure 19). The design depth for the liquid bulk docks would be 47’ MLLW 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.

Figure 19 - 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 and second time in 1998 for $900 million. The company's sales in 2015 totaled approximately $5.7 billion.

Since 2015, Formosa has been undergoing an additional expansion which should be complete in 2018 (Figure 20). This expansion adds 800 ac to their plant for a total 2,300 ac. The company, which employees approximately 2,000 full-time employees, and 922 contract staff, is projected to add 340 permanent jobs. The growth being experienced by Formosa supports the growth forecasted in the chemicals commodity category.

Figure 20 – 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 the 50-year period of analysis for the project (2024-2074). To estimate future tonnage levels, annual growth rates were applied to the baseline tonnage levels for chemicals and petroleum products respectively (Appendix A – Economics Section 2.4). Several sources of data were used to establish the commodity forecasts including historical data, the US Energy Information Administration's Annual Energy Outlook, and a 2015 IHS Global Insight forecast prepared for the Texas Gulf Coast (Houston Ship Channel).

3.2.2.1 Global Insight

IHS Global Insight (Global Insight) provides comprehensive economic, financial, and political coverage of countries, regions, and industries. It 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 21). This multi-stage forecasting uses a combination of bottom-up and top-down approaches.

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.

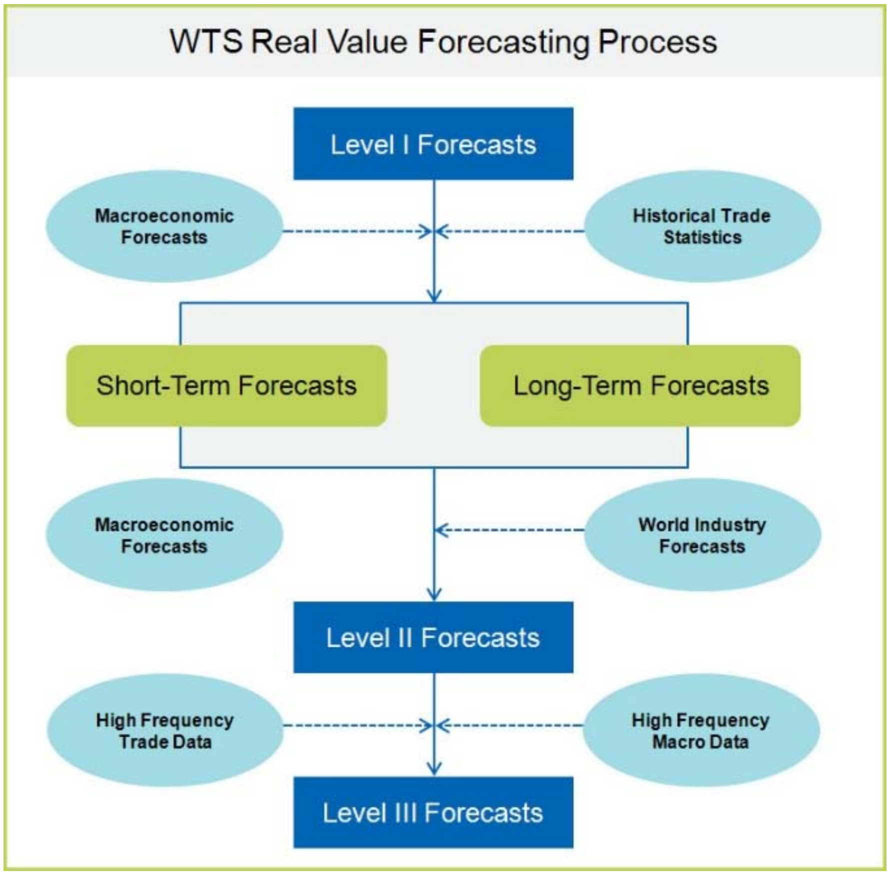

Figure 21 - World Trade Service Real Value Forecasting Process

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 US Department of Energy's Energy Information Administration (EIA). The AEO is developed using the National Energy Modeling System (NEMS), 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 US becomes a net energy exporter (in most cases) between 2017 and 2050.

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, since domestic, barge traffic would not benefit from the channel deepening and widening. 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 imports to the Port is 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 imports

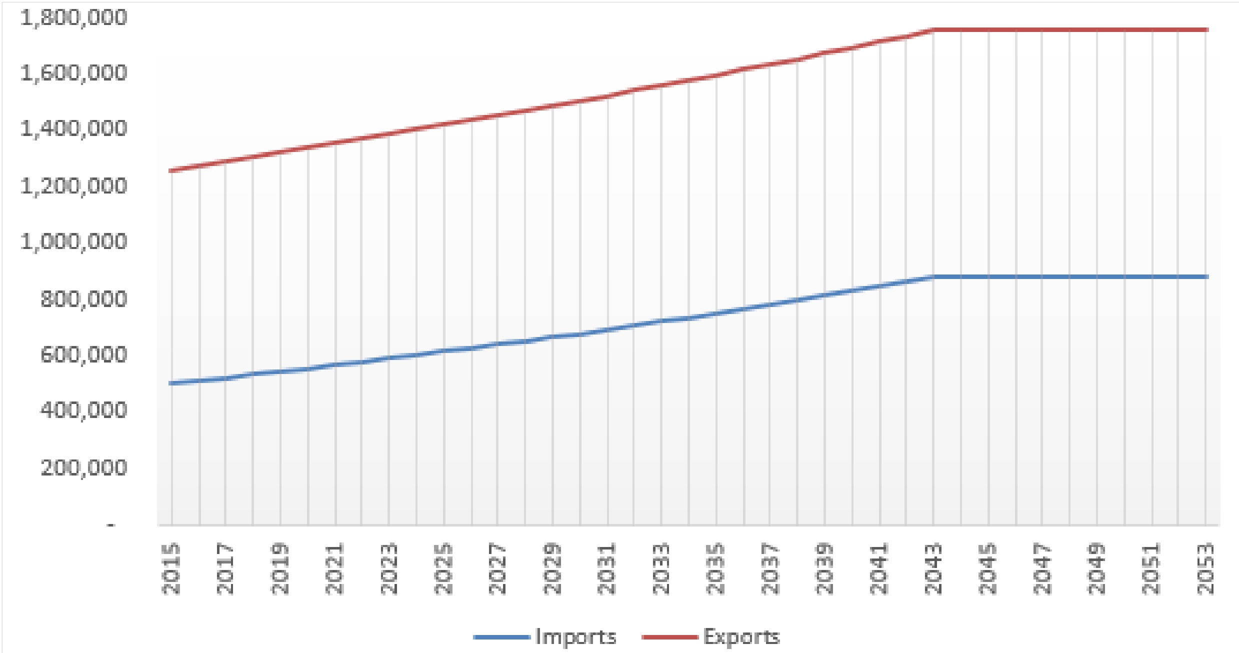

Figure 22 - MSC Chemical Tonnage Forecast (2015 - 2053)

3.2.2.4 Crude Oil and Condensate Exports

The export of petroleum products from the Port is a new type of commerce. The 2017 American Energy Outlook's (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 23).

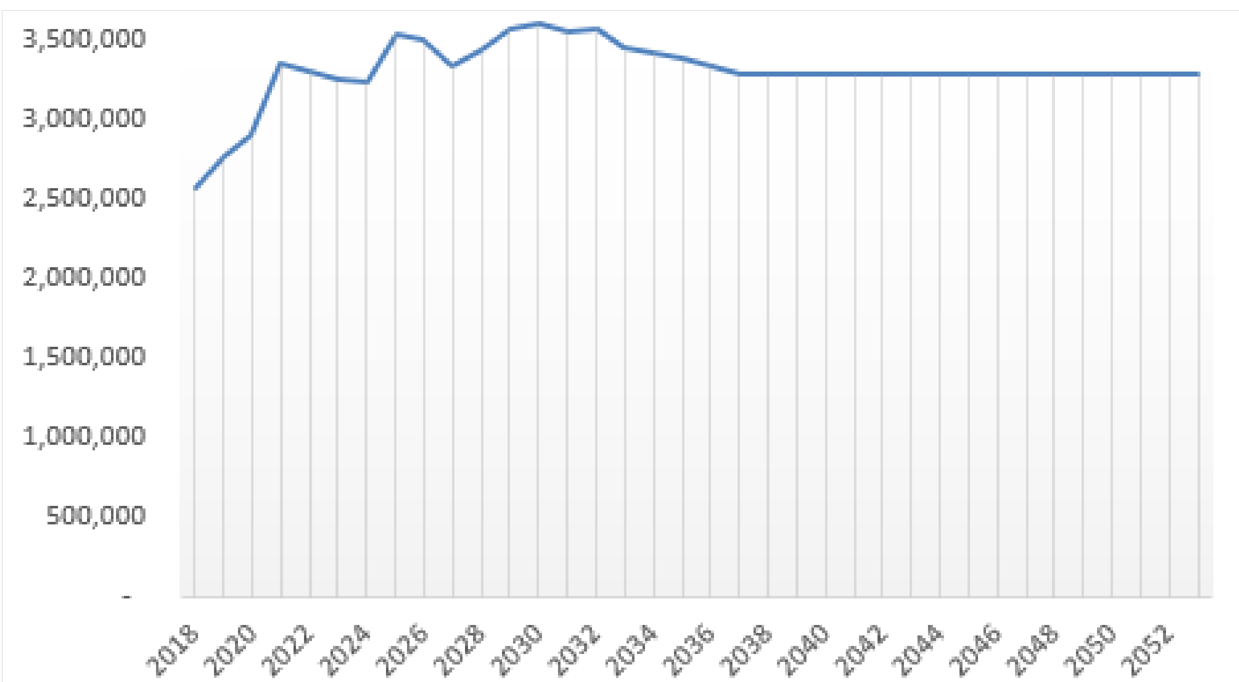

Figure 23 - MSC Crude Oil Tonnage Forecast (2015 – 2053)

For the period of analysis (2024 – 2074), 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. Growth rates were applied to the established baseline tonnage levels to obtain benefitting tonnage levels in three different decades, 2024, 2034, and 2044 (Figure 24). This commodity forecast is held constant in the FWOP and each of the FWP scenarios.

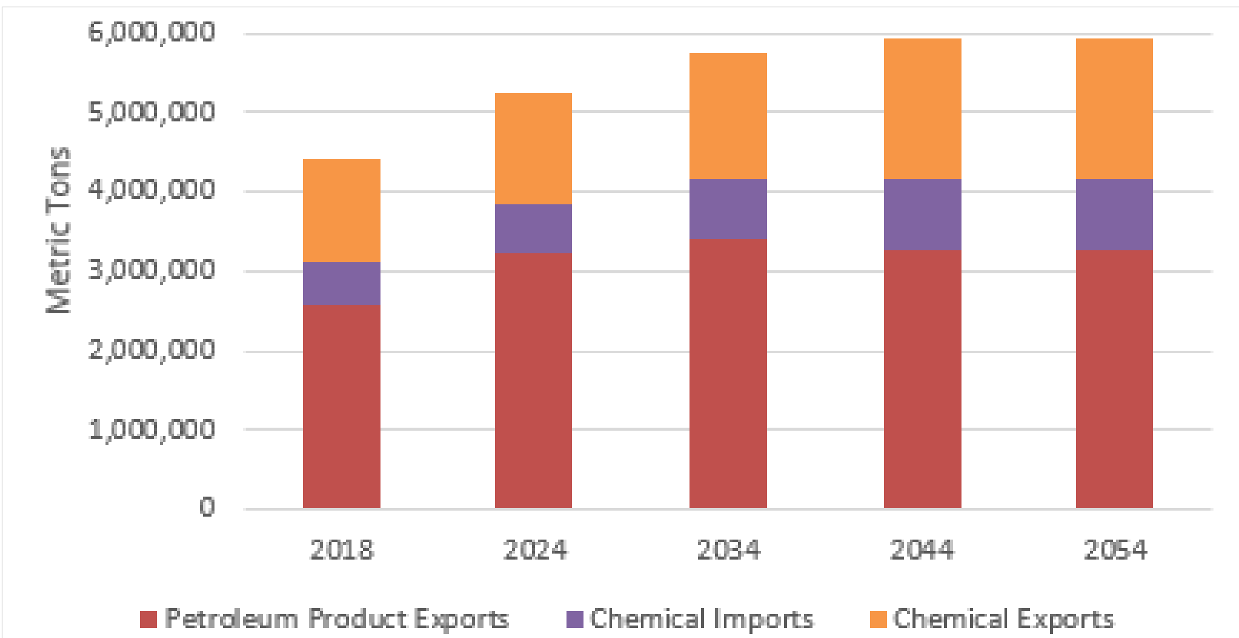

Figure 24 - MSC Benefitting Commodities Forecast by Decade

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. 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.

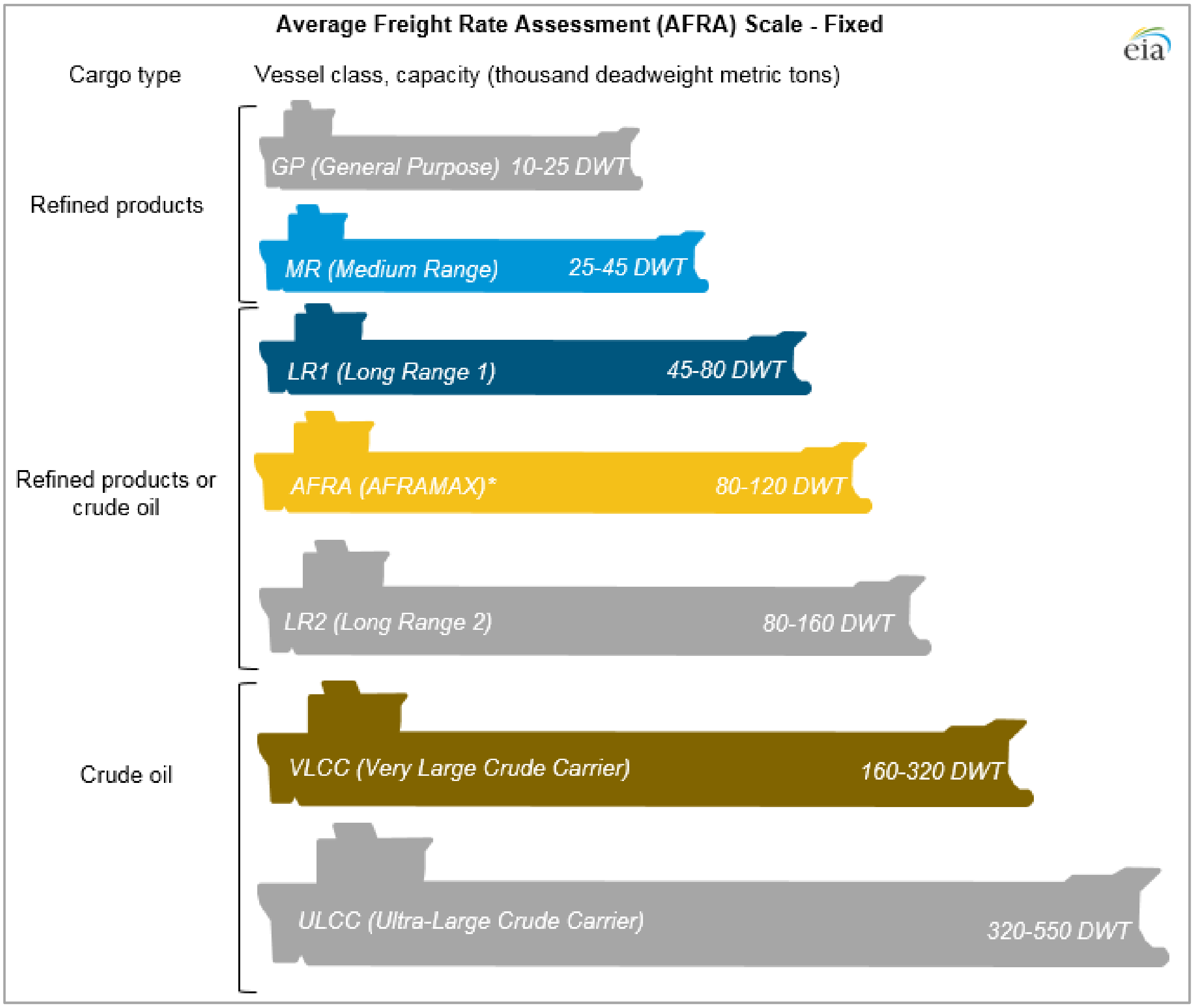

Figure 25 – Petroleum Tanker Average Freight Rate Assessment (AFRA) Scale

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

Aframax tankers refer to tankers between 80,000 and 120,000 DWTs. These vessels are used extensively in non-OPEC 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 ship size is popular with oil companies for logistical purposes, and therefore, many ships 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 6 shows, the Aframax (110,000 DWT) cost per ton is cheaper in each alternative depth when compared to the Panamax (70,000 DWT).

Table 6 - 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 7). The only vessel classes that showed an increase in new builds were the Aframax and the Suezmax (125,000 – 199,999 DWT) tankers.

Table 7 - 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 48’ MLLW design draft.

3.3 Environmental Resources

3.3.1 Affected Environment

3.3.1.1 Wetlands

The SAV community in the project area would be unaffected under the FWOP condition, 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 approximately 250 ac of SAV could be permanently lost.

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

Estuarine (saline and brackish) marshes may decline due to relative sea level rise under the FWOP condition. 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 condition. 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 condition.

3.3.1.2 Aquatic Resources

The FWOP condition would not affect recreational or commercial fisheries. However, the ongoing maintenance dredging and open-water placement may indirectly affect fishery species due to increased turbidity. No decrease in abundance is expected and any impacts would be temporary.

The FWOP condition would not affect open-bay bottom habitats. Ongoing maintenance dredging and open-water placement may indirectly affect 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.

The FWOP condition would not affect oyster reefs. However, the ongoing maintenance dredging and open-water placement may indirectly affect oyster reef beds due to increased turbidity.

3.3.1.3 Threatened and Endangered Species

The FWOP condition would not affect any T&E species or their critical habitat in or near the project area.

3.3.1.4 Essential Fish Habitat

The FWOP condition would not affect EFH. However, the ongoing maintenance dredging and open-water placement may indirectly EFH due to increased turbidity. Any indirect effects are expected to be temporary.

3.3.1.5 Air Quality

The FWOP condition 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 would continue to contribute to air emission contaminants through the fuel combustion/exhaust of marine vessels, as would 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.

3.3.1.6 Noise

In the FWOP, the existing maintenance dredging and operations of the channel would continue and permanent noise impacts are not expected. Dredging operations occur a significant distance from the shoreline and noise-sensitive receivers. The nearest receiver, at Magnolia Beach, is approximately 3,000' from the channel. This distance would 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 condition is not likely to result in short-term or permanent noise impacts.

3.3.2 Land Use and Classification

3.3.2.1 Soils

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 would continue under the FWOP condition, but is not expected to occur at an elevated rate, nor is it expected to 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 condition.

3.3.2.2 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.

3.4 Cultural Resources

There are an estimated 113 cultural resources located within and along the Matagorda Ship Channel 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 DO concentrations for the FWOP condition are not entirely clear. There are conflicting study results on whether or not the placement of maintenance materials affect DO. Turbidity from dredging activities would be similar to existing conditions. Changes to sediment quality are not expected.

3.5.1.1 Currents and Circulation

No changes to the ship channel depth or width would occur under the FWOP condition, and water movements would continue to follow historical trends

3.5.1.2 Salinity

No changes to the ship channel depth or width would occur under the FWOP condition, and changes in salinity would continue to follow historical trends.

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 ship 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.

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.

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, Chapter 7. 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 26 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 U.S. 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.

Table 8 - Population Projections through 2050

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**
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 (2020, 2030, 2040, 2050 Projections)						

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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' MLLW.
- 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 ships, 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 – 2074)
- Improve the operational safety of the deep-draft navigation system over the period of analysis (2024 – 2074)
- Manage environmental quality effects in the project area over the period of analysis (2024 – 2074)
- Establish environmentally suitable PAs & utilize beneficial use (BU) of dredged material for placement of the dredged material over the period of analysis (2024 – 2074)
    - o Identify the Least Cost Plan

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 Dredged Material Management Plan (DMMP) that includes environmentally suitable PAs
- Plans should include a Least Cost DMMP that includes the use the Beneficial Use of dredged material, if possible

4.1 Description of Preliminary Management Measures

After the problems, opportunities, objectives, and constraints were agreed upon by the USACE and the non-Federal sponsor, the USACE brainstormed management measures (measures). They came up with four non-structural and five structural measures (Table 9).

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 9 - 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 easing 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 vessels (not all) to transit the channel safely; however, it limits the vessel's full draft capability leading to more overall vessel calls.

4.1.2 Structural Measures

The Institute for Water Resources 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' MLLW in the Main Channel, and from the existing 43' MLLW in the Entrance Channel.

   NOTE: Per current dredging standards, the Entrance Channel would include an additional two 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 5' deeper, and the Main Channel would be dredged approximately four feet deeper. (Figure 26 and Figure 27)
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 new widths were determined by the USACE required safety factors for the Aframax tanker design vessel. These widths were determined as follows:

   In 2009, the non-Federal sponsor 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'. The EIS 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.

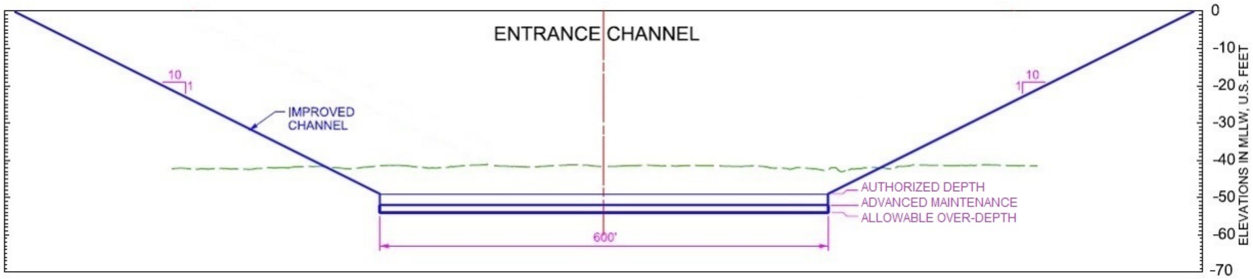

Figure 26 - Drawing of Entrance Channel Cross Section

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'.

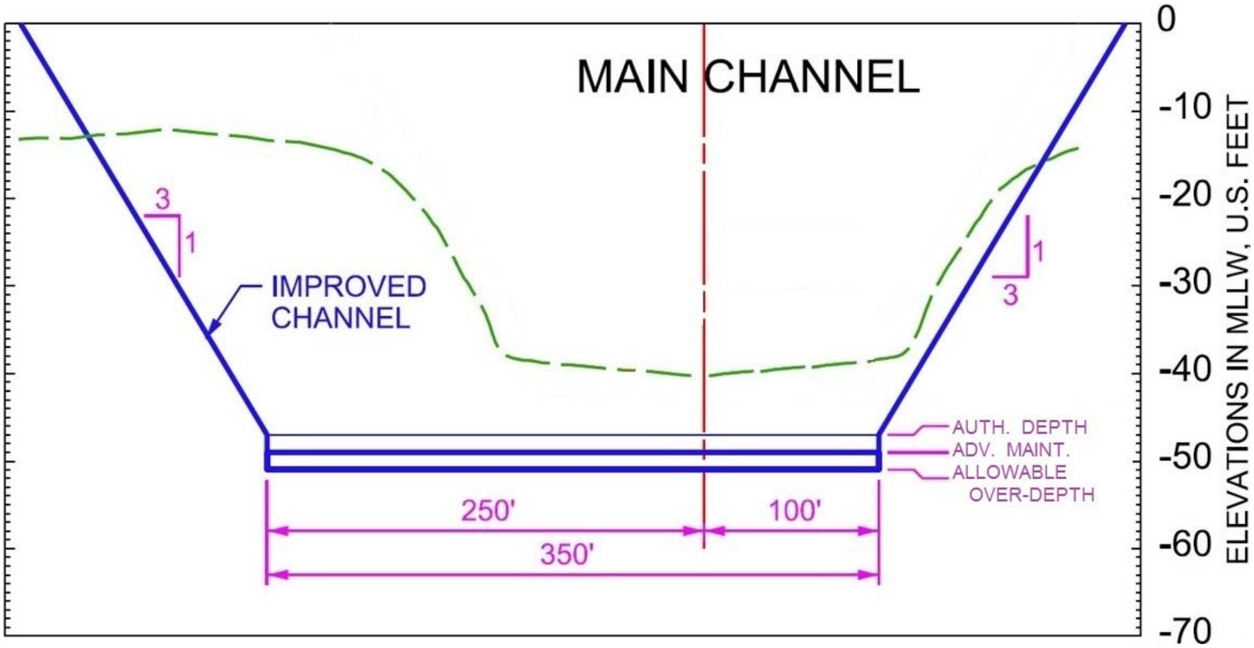

Figure 27 - Drawing of Main Channel Cross Section

However, because the MSC Entrance Channel is considered the most dangerous Entrance Channel in the US, for safety reasons, the USACE and the 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 26 & Figure 27)

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 ship returning to the Gulf to pass. The ship stopped in the vessel passing-lane would then continue on to the public port facilities (Figure 28).

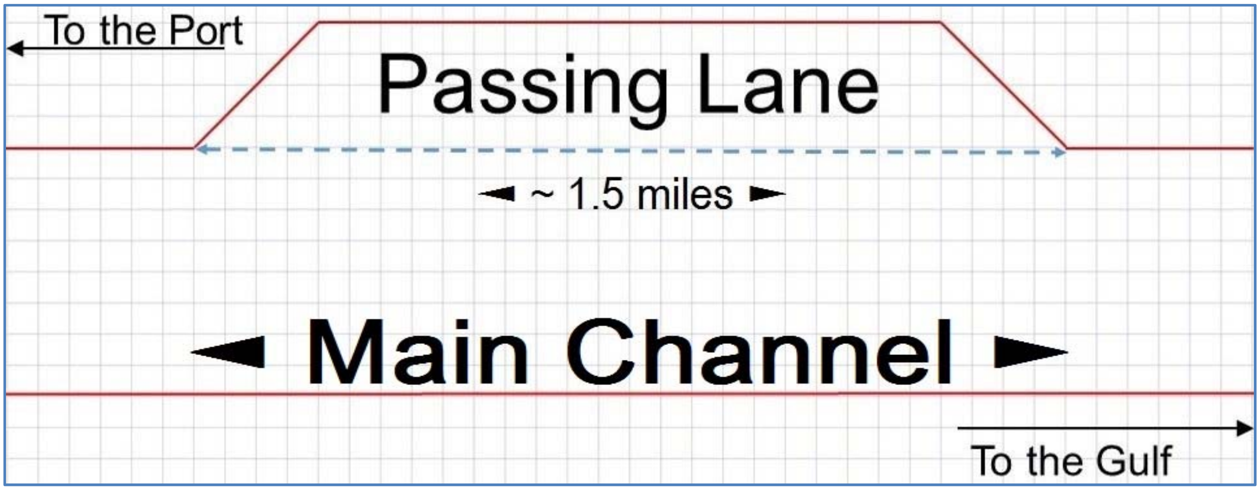

Figure 28 - Drawing of Vessel Passing-lane

4. **Modification of Existing Turning Basin** – This structural measure consists of physically expanding the existing 1,000' by 1,000' by 47' MLLW deep turning basin at Port 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.

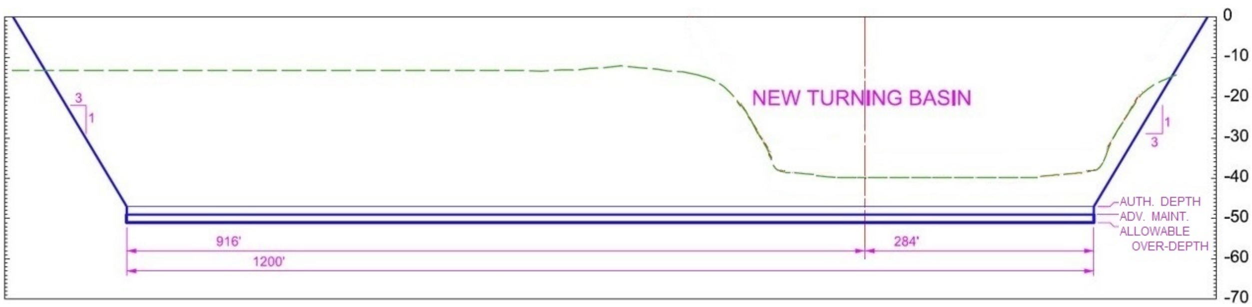

Figure 29 - Drawing of New Turning Basin Dimensions

The depth of the new turning basin would be the new economically justified depth for the design vessel (Figure 29). The new turning basin would be in lieu of modifying the existing turning basin.

NOTE: Per current dredging standards, 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 non-Federal sponsor, with the assistance of Captain David Adrian and Captain Steve Gibson of the Matagorda Bay Pilots Association, 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 10). Those measures that did not meet study objectives were removed from further consideration.

Table 10 – 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

Captain David Adrian indicated that the current Pilot's Rules have evolved over the years as commodities have changed, and ships 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 ships 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' MLLW would allow Aframax tankers to utilize Port Comfort so some extent. Deeper depths would allow Aframax tankers to increase their loads without the danger of grounding. The USACE judged 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' MLLW and a maximum depth of 51' MLLW 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 tanker 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 ships 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 beams of two ships is less than 324' (600' * .54), the Pilots are comfortable allowing two ships to meet and pass each other.

For the Main Channel, the Pilots would also use the 54% Rule to determine whether to allow to ships to meet and pass each other. For Main Channel, the combined ship's beams would need to be less than 189' (350' * .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 Gulf Intercoastal Waterway and the turn near Station 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 approximately 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.

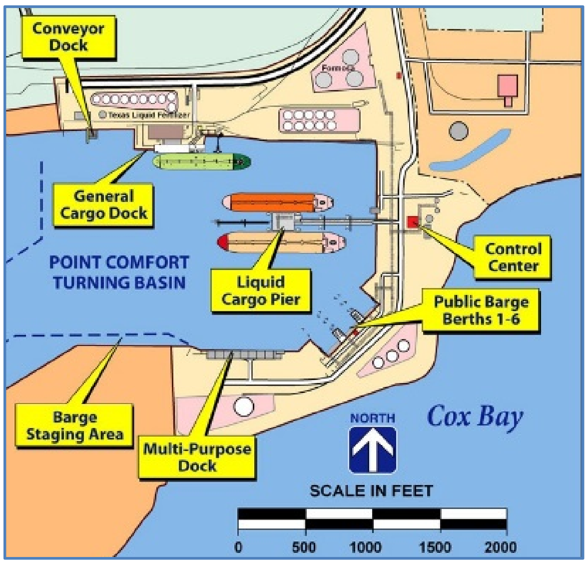

Figure 30 - Existing Turning Basin (Drawing)

Figure 31 - 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 29 & Figure 32). This turning basin would be located at the turn from the Main Channel into the Port, at Station 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 ships now use.

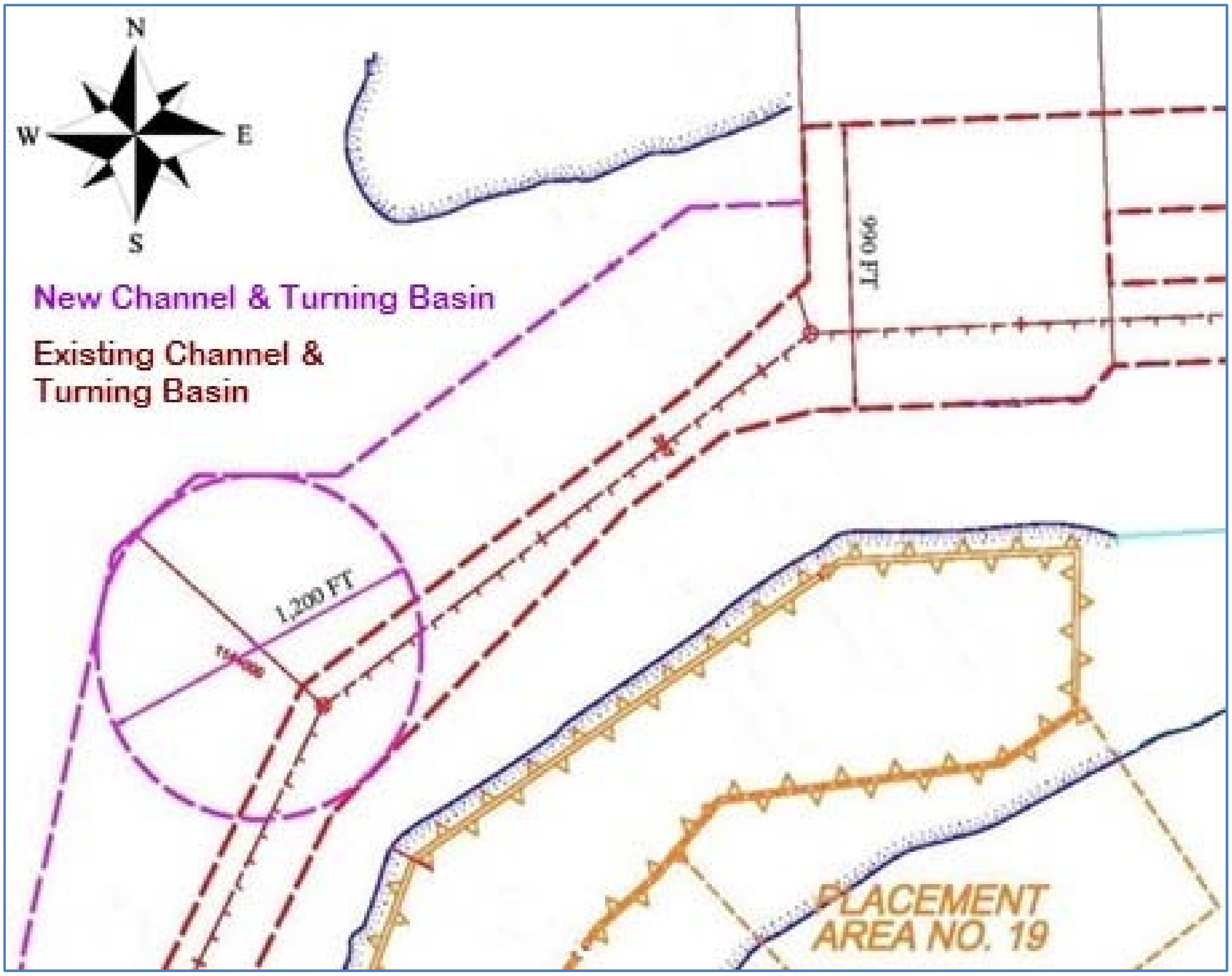

Figure 32 - New Turning Basin Site

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.

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 11 - 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

The USACE and non-Federal sponsor 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’ MLLW (Main Channel) and increased to a depth of 51’, in two-foot increments (Table 12). 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’ MLLW’ is a 41’ MLLW deep Main Channel with a 43’ MLLW deep Entrance Channel. This is clearly shown in Figure 6, but is shortened for the remainder of the report for simplicity.

Table 12 – 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 the National Environmental Policy Act of 1969 (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 (See 1.7.2 Description of the Currently Authorized Project). FWOP conditions are expected. The current Pilot’s Rules would remain in force.

4.5.2 Alternative Plan A

Table 13 - 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 14 - 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 non-Federal sponsor, with the assistance of Captain Adrian and Captain Gibson of the Matagorda Bay Pilots Association, 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’ MLLW 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’ MLLW) 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.

At this subsequent meeting, the Pilots expressed their opinion that dredging a vessel passing-lane would not increase efficiencies in ship movements into, or out of the Port. While ships of various sizes occasionally anchor in the gulf waiting for another ship to exit the MSC, it is a very rare event for two large ships to be at the Port at the same time. The Pilots do not expect this to change. The USACE and non-Federal sponsor 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 Plan – 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’ MLLW 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 2015 (Table 15). 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, and was revised in July 2015. Since the total project cost is over 40 million dollars, a formal risk analysis (Crystal Ball) would be required.

Table 15 - 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 FIRST COST	**$355,161,000**	**$464,548,100**	**$571,172,775**
E&D – Engineering and Design, S&A - Supervision and Administration			

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

It was understood that public port facilities are designed for a water depth of 47’ MLLW, 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.

4.8.1.1 Transportation Cost Savings Benefit Analysis

This section describes the economic analysis completed to calculate the national economic development (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 Institute for Water Resources (IWR). The HMST reflects the USACE guidance on transportation cost savings analysis.

HarborSym Model

IWR developed HarborSym as a planning level, general-purpose model to analyze the transportation costs of various waterway modifications within a harbor. 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 is an event driven model. Vessel calls are processed individually and the interactions with other vessels are taken into account. For each iteration, the vessel calls for an iteration that falls within the simulation period are accumulated and placed in a queue based on arrival time. When a vessel arrives at the Port, the route to all of the docks in the vessel call is determined. This route is comprised of discrete legs (contiguous sets of reaches, from the entry to the dock, from a dock to another dock, and from the final dock to the exit). The vessel attempts to move along the initial leg of the route. Potential conflicts with other vessels that have previously entered the system are evaluated according to the user-defined set of rules for each reach within the current leg, based on information maintained by the simulation as to the current and projected future state of each reach. If a rule activation occurs, such as no passing allowed in a given reach, the arriving vessel must either delay entry or proceed as far as possible to an available anchorage, waiting there until it can attempt to continue the journey. Vessels move from reach to reach, eventually arriving at the dock that is the terminus of the leg.

After the cargo exchange calculations are completed, and the time the vessel spends at the dock has been determined, the vessel attempts to exit the dock, starting a new leg of the vessel call. Rules for moving to the next destination (another dock or an exit of the harbor) are checked in a similar manner to the rule checking on arrival, before it is determined that the vessel can proceed on the next leg. As with the entry into the system, the vessel may need to delay departure and re-try at a later time to avoid rule violations and, similarly, the waiting time at the dock is recorded.

Table 16 shows the vessel fleet forecast (The number of vessels of each class expected to call at Port Comfort in that year.) for the FWOP and for the various scales of Alternative Plan A.

Table 16 - Vessel Fleet Forecast by New Channel Depth

		Vessel Class	FWOP	Alt A 41'	Alt A 43'	Alt A 45'	Alt A 47'	Alt A 49'
2024	Chemicals	SPX1	110	110	110	110	110	110
		SPX2	58	51	42	29	21	21
		PX1	82	73	73	73	73	73
	Petroleum	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	Chemicals	SPX1	127	127	127	127	127	127
		SPX2	69	63	45	33	26	26
		PX1	95	84	84	84	84	84
	Petroleum	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	Chemicals	SPX1	146	146	146	146	146	146
		SPX2	71	70	54	35	24	24
		PX1	110	97	97	97	97	97
	Petroleum	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**

NOTE: SPX – Sub-Panamax, PX – Panamax, Afra – Aframax, and PT – Petroleum Tanker

Each vessel call has a known (calculated) associated cost, based on time spent in the harbor and ocean voyage and cost per hour. Also for each vessel call, the total quantity of commodity transferred to the Port (both import and export) is known, in terms of commodity category, quantity, tonnage, and value.

When a vessel leaves the system, the total tonnage, export tonnage, and import tonnage transferred by the call are available, as is the total cost of the call. The cost per ton can be calculated at the call level (divide total cost by respective total of tonnage). Once these values are available, it is possible to cycle through all of the commodity transfers for the vessel call. Each commodity transfer for a call is associated with a single vessel class and unit of measure. Multiplying the tons or value in the transfer by the appropriate per ton cost, the cost totals by class and unit for the iteration can be incremented. In this fashion, the total cost of each vessel call is allocated proportionately to the units of measure that are carried by the call, both on a tonnage and on a value basis. After the cargo exchange calculations are completed, and the time the vessel spends at the dock has been determined, the vessel attempts to exit the dock, starting a new leg of the vessel call. Rules for moving to the next destination (another dock or an exit of the harbor) are checked in a similar manner to the rule checking on arrival, before it is determined that the vessel can proceed on the next leg. As with the entry into the system, the vessel may need to delay departure and re-try at a later time to avoid rule violations and, similarly, the waiting time at the dock is recorded.

Table 16 shows the vessel fleet forecast (The number of vessels of each class expected to call at Port Comfort in that year.) for the FWOP and for the various scales of Alternative Plan A.

Table 16

4.8.1.2 Transportation Cost Savings Benefit Analysis by Depth

Transportation cost benefits were estimated using the HarborSym Economic Reporter, a tool that summarizes and annualizes 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. It then produces an Average Annual Equivalent (AAEQ). Results were verified using IWR Planning Suite and spreadsheet models also.

Transportation costs were estimated for a 50-year period of analysis (2024 – 2074). 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 17 - Origin - Destination Annual Transportation Costs for Alternative Plan A by Scale ($1,000s)

Total At-Sea and In-Port Transportation Cost Allocated to Port						
Year	FWOP	Alt A - 41’	Alt A - 43’	Alt A - 45’	Alt A - 47’	Alt A - 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 - 2074	$151,522	$136,837	$130,002	$125,116	$118,185	$118,063
At-Sea Transportation Cost Allocated to Port						
Year	FWOP	Alt A - 41’	Alt A - 43’	Alt A - 45’	Alt A - 47’	Alt A - 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 - 2074	$145,914	$131,533	$124,853	$120,103	$113,288	$113,170
In-Port Transportation Costs						
Year	FWOP	Alt A - 41’	Alt A - 43’	Alt A - 45’	Alt A - 47’	Alt A - 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 - 2074	$5,608	$5,303	$5,149	$5,013	$4,897	$4,893
Price levels are October 2017 and the discount rate is 2.75%.						

Table 18 - Annual Transportation Cost Savings for Alternative Plan A by Scale ($1,000)

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 - 2074	$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 - 2074	$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 - 2074	$304	$459	$595	$711	$714
Price levels are October 2017 and the discount rate is 2.75%.					

Table 19 - AAEQ Transportation Cost Reduction Benefits for Alternative Plan A by Scaled Depths (MLLW)

Alt A	AAEQ Transportation Cost	AAEQ Transportation Cost Reduction Benefit
FWOPC	$147,380,000	-
41’	$133,220,000	$14,160,000
43’	$126,577,000	$20,802,000
45’	$121,902,000	$25,478,000
47’	$116,789,000	$30,590,000
49’	$116,428,000	$30,952,000
Price levels are October 2017 and the discount rate is 2.75%.		

4.8.2 Transportation Cost Savings Benefit Analysis

The cost summaries are presented in Table 15. These costs include the associated costs, which would be paid by the non-Federal sponsor, that are necessary to realize project benefits. Between the depths of 41’ and 47’, berth deepening would be required. After 47’ MLLW, dock modifications are required in order to deepen berths. These costs are included in the project costs. 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. The benefits and costs were estimated at the current FY 2017 Federal Discount rate of 2.75%.

4.8.2.1 Total Net Benefits

The best project may be defined as the plan that returns the greatest excess of benefits over costs, i.e., it is not possible to improve upon a plan producing maximum net benefits (total benefits minus total costs). Benefits for deep draft navigation (DDN) projects are monetary.

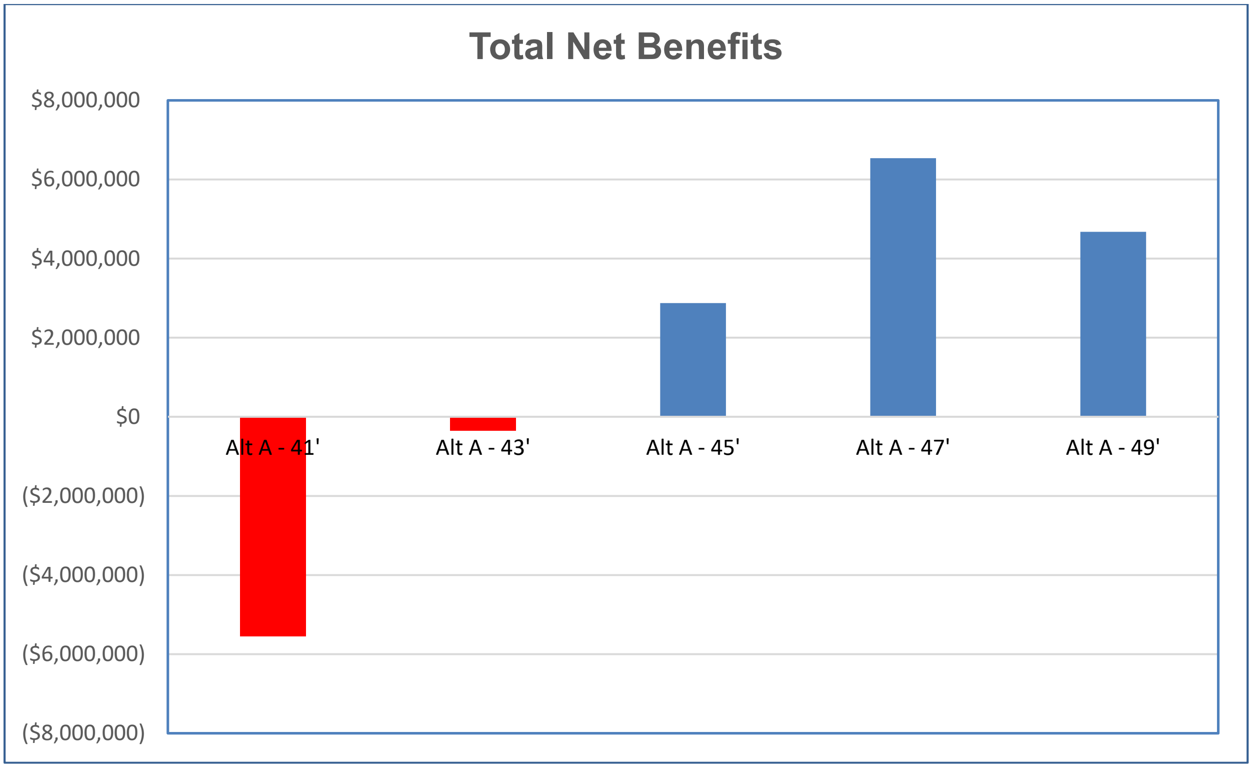

Figure 33 - Total Net Benefits for Alternative Plan A by Scale (Price levels are October 2017 and the discount rate is 2.75 %.)

Figure 33 shows that Alternative Plan A does not have positive total net benefits for any project smaller than Alternative Plan A at 45’ MLLW, with Alternative Plan A at 47’ MLLW showing the largest total net benefits. Alternative Plan A at 49’ MLLW then drops in total net benefits.

Because Alternative Plan A at 49’ MLLW demonstrated a drop in total net benefits, Alternative Plan A at 51’ MLLW was removed from further evaluation and comparison.

4.8.2.2 Incremental Costs Analysis

Incremental analysis is a process used in plan formulation to help identify plans that deserve further consideration in an efficient manner. The analysis consists of examining increments of plans to determine their incremental costs and incremental benefits. Increments of plans continue to be added and evaluated as long as the incremental benefits exceed the incremental costs. When the incremental costs exceed the incremental benefits no further increments are added.

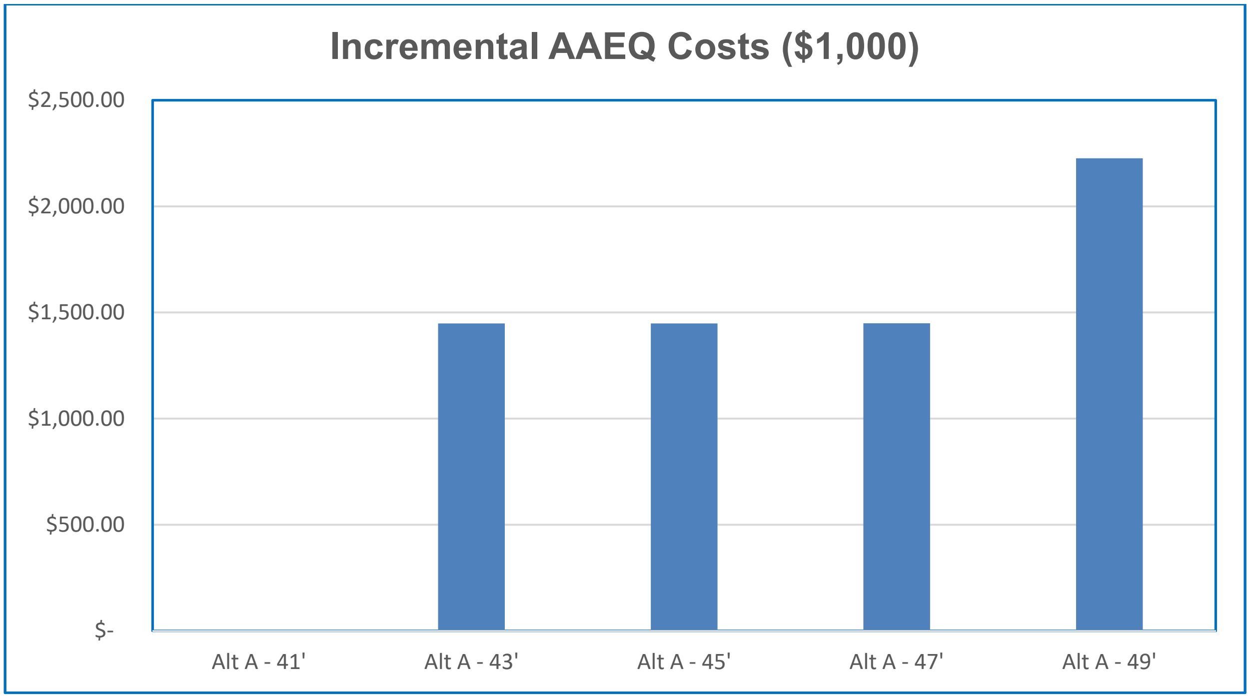

Figure 34 - Incremental AAEQ Costs for Alternative Plan A by Scale (Price levels are October 2017 and the discount rate is 2.75 %.)

Figure 34 shows a definite jump in AAEQ costs between Alternative Plan A at 47' MLLW and Alternative Plan A at 49' MLLW.

4.8.2.3 Summary of Costs and NED Benefits

The vessel calls list obtained via the Bulk Loading Tool (BLT) were input in to HarborSym and a simulation was run for each of the three out years (2024, 2034, and 2044) at each of the alternative depths. The transportation costs at each alternative depth were compared to the transportation costs in the absence of a deepening/widening project, and the results of the costs of the project as well as the benefits provided by the project are annualized and displayed below (Table 20). As shown in the table, the plan with the highest net benefits is the 47' MLLW alternative, which provides $6,539,000 in annual net benefits with a benefit-to-cost ratio (BCR) of 1.3.

Table 20 - Summary of AAEQ Costs & Benefits for Alternative Plan A at Scaled Depths (MLLW)

Alt A	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	Benefit / Cost Ratio
41'	$19,706,000	$14,160,000	($5,546,000)	-	0.7
43'	$21,154,000	$20,802,000	($352,000)	$5,194,000	1.0
45'	$22,602,000	$25,478,000	$2,876,000	$3,228,000	1.1
47'	$24,051,000	$30,590,000	**$6,539,000**	$3,664,000	**1.3**
49'	$26,277,000	$30,952,000	$4,675,000	($1,865,000)	1.2
Price levels are October 2017 and the discount rate is 2.75%.					

The summary of project costs for each alternative depth, including Interest during Construction (IDC) and an estimate of OMRR&R, are displayed below (Table 21).

Table 21 - Summary of Costs at 2.75% Interest ($1,000s) for Alternative Plan A at Scaled Depths (MLLW)

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%.							

4.9 Selection of the Tentatively Selected Plan – Step 6

Economic analyses indicate that Alternative Plan A at 47’ MLLW is the NED Plan. It is the plan that reasonably maximizes net economic benefits consistent with protecting the Nation’s environment. The non-Federal sponsor, CPA, is in agreement with this selection, 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’**

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 Engineering Regulation (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 22 - Principles and Guidelines 4 Criteria Evaluation

	Complete?	Effective?	Efficient?	Acceptable?
Alternative A at 47’	YES	YES	YES	YES

1. **Completeness** – Alternative Plan A at 47’ MLLW 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 ships of the sizes currently visiting Port Comfort. This plan provides increased efficiency in the transportation of commodities into and out of the Port by allowing larger ships 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 (See Appendix F).
2. **Effectiveness** – Alternative Plan A at 47’ MLLW contributes to the achievement of the planning objectives and avoids all constraints.
3. **Efficiency** – Alternative Plan A at 47’ MLLW 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’ MLLW 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’ MLLW.

4.10 Description of the Tentatively Selected Plan

Economic analyses indicate that Alternative Plan A at 47’ MLLW is the NED Plan. It is the plan that reasonably maximizes net economic benefits consistent with protecting the Nation’s environment.

The information provided in this section was taken directly from Appendix G – Engineering Appendix. References to chapters, sections, sub-sections, page numbers, figures, tables, plans, drawings, and stationing can be found in Appendix G – Engineering Appendix.

4.10.1 General Description

The proposed MSC is shown on the Location Plan, Drawing G-2. Table 6-4, MSC TSP Dimensions show the new A47-foot 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

The proposed extension to the Matagorda entrance channel will be constructed from Sta -33+000 to Sta -20+000. Refer to Drawing C-11. The extension of the entrance channel is needed to account for the proposed deeper channel depth. The authorized depths for the new Matagorda entrance extension channel will be 49' MLLW. The advanced maintenance will be two 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 ships and vessels room to maneuver away from strong winds and currents.

4.10.3 Entrance Channel

The Matagorda Entrance Channel begins at Sta -20+000 and ends at Sta -6+000. The authorized depths for the entrance channel were increased from 40' to 49' MLLW. The advanced maintenance is two 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 ships and vessels room to maneuver away from strong winds and currents.

4.10.4 Jetty Channel

The Matagorda Jetty Channel begins at Sta -6+000 and ends at Sta 0+000. The authorized depths for the jetty channel were increased from 40' to 49' MLLW. The advanced maintenance is two 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 186' making the total width in this area, 536'. This additional width is needed to give ships and vessels room to maneuver away from strong winds and currents.

4.10.5 Channel through Matagorda Bay

The proposed channel through Matagorda Bay begins at Sta 0+000 and ends at Sta 75+000. The authorized depths for the Lavaca Bay Channel were increased from 38' to 47' MLLW. 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 186' making the total width in this area, 536'. This additional width is needed to give ships and vessels room to maneuver away from strong winds and currents.

4.10.6 Channel through Lavaca Bay

This section of the MSC The proposed Lavaca Bay channel begins at Sta 75+000 and ends at Sta 116+223. The authorized depths for the Lavaca Bay Channel were increased from 38' to 47' MLLW. 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 beam of the proposed design vessel, a 1,200’ wide 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 ship where prevailing currents are 0.5 knots or less. Recent ERDC/WES 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 48’. The 1.5 knots * 800’ LOA = 1,200’ diameter.

4.10.8 Point Comfort Turning Basin

The Point Comfort turning basin begins at Sta 116+223 and ends at Sta 117+223. The authorized depths for the Point Comfort Turning Basin were increased from 38’ to 47’ MLLW. 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 ships 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

The Point Comfort north and south basins begin at Sta 117+223 and end at Sta 118+502. The authorized depths were increased from 38’ to 47’ MLLW. 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 selected plan is 30.22 MCY. The new work material volumes are shown by reaches in Table 6-5, the MSC New Work Dredging Quantities for A-47’ MLLW Plan. 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 two 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 impacts to the oysters and marshes, therefore mitigation will be required. Mitigation will be addressed before detail design of this project.

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 U.S. 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

Preliminary shoaling rates are discussed and shown in the Geotechnical Section 4.3.2. Before detailed design is started, Hydrology, Hydraulics, and Coastal Branch will use the historical survey data and the Corps Shoaling Analysis Tool (CSAT) system to produce updated estimates of shoaling.

4.10.16 Real Estate

All placement areas are owned or will be acquired by the CPA. Navigational servitude takes precedence for the extension of the Matagorda Entrance Channel. Refer to the Real Estate Appendix for more details.

4.10.17 Placement Areas

The proposed MSC Project will utilize the existing Sundown (Chester) Island placement area (PA) for the storage of the new work dredging material. New upland placement areas will also be constructed such as the ER3/D (In Bay Upland/Enhanced Recovery Area) and P1 (Terrestrial Upland) for the placement of new dredging material. New Unconfined open water placement areas will also be constructed west of the existing Matagorda and Lavaca Bay channel such as NP3, NP2 and an Ocean Dredge Material Disposal Site (ODMDS) O5 to contain the new work material. New work material will be placed according to Table 6-7. Details concerning all of the proposed placement areas can be found in the Geotechnical Section of this Engineering Appendix.

4.10.18 Relocations

During the Planning Phase, 22 pipelines were identified in the Lavaca and Matagorda Bays and Entrance Channel including an abandoned 8.63-inch pipeline in the Lavaca Bay. Only 13 of the 22 pipelines were located and shown on the drawings. Additional research will be done to verify the permits and the location of the remaining pipelines. Refer to the Real Estate Appendix for additional details on the pipelines. It is assumed that some berthing/dock areas will need to be upgraded due to deepening of the channel. The Calhoun Port Authority will undertake the responsibility of modifying existing berthing/dock facilities that will need upgrading to receive and accommodate vessel traffic at the new channel depths.

4.10.19 Hazardous and Toxic Materials

PA ER3/D (In-Bay Confined Upland Placement Area) is located along the western shoreline of Dredge Island. Sediments on the northern edge of Dredge Island are impacted by mercury with concentrations above the Lavaca Bay Superfund Record of Decision (ROD) sediment remedial action objective (RAO). Dredged sediments will be placed over the area to cover impacted sediment. To reduce the potential disturbance of mercury-impacted sediment, a rigid barrier may be placed along the outside of ER3 prior to any material placement.

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 G, Section 4.3.2 Maintenance Dredging.

4.10.22 Cost Estimate

Table 23 - Summary of Costs at 2.75% Interest ($1,000s) for Alternative Plan A at Scaled Depths (MLLW)

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
Price levels are October 2017 and the discount rate is 2.75%.							

5 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 – 2074).

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 heights and periods in deep water are little affected by changes in currents or water levels (SLR), thus there is no reason to expect significant changes in the wave climate.

5.1.2 Currents

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

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.

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.)

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.

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 advance maintenance dredging at a bar offshore of the jetties. Both computer modeling and direct measurement of sediment transport are notoriously 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.

5.2 Economics

5.2.1 Regional Economic Analysis

The regional economic development (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.

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 The 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.

Once final costs are received for this project, RECONS would be used to perform the regional analysis for the MSC deepening and widening, and results would be displayed in this section.

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 at any of the alternative depths. Absent of channel improvements, a greater number of vessels would be required to transport the forecasted increase in cargo volumes. However, with implementation of any of the deepening (and widening) alternatives, the total number of vessels could decrease and transportation costs could be reduced compared to future without-project 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

5.3.1 Affected Environment and Environmental Consequences

5.3.1.1 Wetlands

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. High flow conditions show greater differences in salinities for the TSP, but the absolute values would be relatively low, and so would not stress the estuaries SAV beds.

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 TSP greater than would be expected under the FWOP condition. Since the TSP 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 TSP, so no direct impacts associated with construction are anticipated. The DMMP would result in a net increase of five ac of marsh by creating 26 ac of estuarine marsh.

Changes in salinity 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 Partial Salinity Unit difference in average annual salinities between the TSP and the FWOP condition, 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 TSP 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 ac of farmed wetlands at PA-1. SWG determined these ac were jurisdictional based on their adjacency to Lavaca Bay.

5.3.1.2 Aquatic Resources

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.

Repeated dredging and placement operations for channel maintenance may temporarily reduce the quality of recreational and commercial fisheries near construction and dredging operations. This may result from decreased water quality and increased turbidity during dredging as well as from a loss of attractiveness to game fish resulting from loss of benthic prey. This condition is not permanent, and the quality of fishing near the channel and PAs should steadily improve after dredging is completed and would likely be similar to existing maintenance dredging, as described for the No-Action Alternative. Maintenance dredging operations would only cause temporary effects to the immediate area during the proposed dredging process.

During construction dredging, game fish would leave prime recreational fishing areas for more favorable, less turbid locations; however, once construction is completed, conditions would improve and game fish would return to the area. Placement of new work and maintenance material in an existing ODMDS (PA-1) and a new ODMDS (PA O5) may result in a localized effect on recreational and commercial fishing in the area. However, construction activity should not significantly affect overall fishing in the project area. The TSP should enhance habitat for recreational and commercial fishing throughout the Matagorda Bay system and offshore through the creation of marsh habitat and oyster reefs.

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 TSP. Therefore, impacts to recreational and commercial fish populations are not expected 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.

5.3.1.3 Wildlife Resources

Dredged material would be deposited in one confined upland PA, 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 TSP on wildlife would result from the placement of dredged material over the 50-year period of analysis.

Construction of the PAs and associated levees would likely have additional indirect effects on wildlife by affecting aquatic organisms (Appendix B - Section 4.12) that serve as a food source for terrestrial species by potentially reducing the availability of their local food supply.

Construction of PA-P1 would directly affect approximately 246.5 ac of agricultural land (i.e., rice fields) and 1.5 ac of jurisdictional wetlands. The conversion of a rice field to a PA is not expected to have a significant impact on local wildlife resources. This tract provides 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.

Construction activities in the project area might result in the direct destruction of those organisms not mobile enough to avoid construction equipment. Resource availability determines the carrying capacity for any given area. It is assumed that habitats are at their carrying capacity for each species in the particular 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.

Bird species can be expected to benefit from increased upland habitat, including wooded areas, for the purposes of cover, foraging, and nesting. Other species would directly benefit from upland herbaceous cover and woodland-edge habitats. In addition, some species would directly benefit from increased upland territorial range. See Appendix B for species lists.

More species can be expected to benefit from the increased marsh habitat for cover and foraging.

5.3.1.4 Threatened and Endangered Species

Effect determinations for federally listed species are listed in Appendix B - Table 4.5.

The West Indian manatee is extremely rare in Texas and to date has not been seen in the project area. 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 and tidal amplitude as a result of the TSP are expected to have no impact on the piping plover or red knot. No placement of dredged material would occur within areas of designated critical habitat or in areas that include primary constituent elements 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.

There are no known records of the Gulf jaguarondi in the project vicinity and therefore the TSP would not likely adversely affect this species.

It has been well documented that hopper-dredging activities occasionally result in the sea turtle entrainment and death, even with seasonal dredging windows, V-shaped turtle-deflector dragheads, and concurrent relocation 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.

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 the 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", while the conclusion for the leatherback sea turtle is "may affect, but it not likely to adversely affect."

5.3.1.5 Essential Fish Habitat

The TSP would have negative impacts, both directly and indirectly, to EFH in the project area. However, it also has the potential to enhance EFH throughout the Matagorda Bay system and offshore by the creation of marsh habitat and oyster reef. The TSP 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 would indirectly benefit certain federally managed species and their prey given that the mercury-impacted area would 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 would be located in a non-impact area.

5.3.1.6 Air Quality

Temporary increases in air pollution would result from the equipment associated with construction of the TSP. 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. 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.

5.3.1.7 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. Appendix B - Table 4.3 provides a summary of dredging-related noise levels by equipment type.

No permanent noise sources would be installed as part of the project. Short-term noise levels could be elevated at the noise-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. Noise levels from the project would be similar to those from ongoing maintenance dredging operations within the channel.

Noise may temporarily affect wildlife in areas adjacent to the machinery. Impacts are expected to be minor.

5.3.2 Land Use and Classification

5.3.2.1 Soils

Under the TSP 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.

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 in the project area would minimize the potential for this type of impact.

5.3.2.2 Energy and Mineral Resources

Locations identified for dredged material placement do not appear to affect known areas of mineral production.

The DMMP was designed to minimize impacts to oil and gas wells and pipelines. Appendix B - Table 4.5.1 summarizes the energy resources identified within the proposed PAs. One permitted well location is within the proposed in-bay unconfined PA locations. No active wells are located within the proposed PA sites.

A total of 15 active pipelines are mapped within the 2,000' wide buffer along the proposed ship channel. Fourteen are listed as natural gas lines and the remaining pipelines transport ammonia. Although well sites and pipelines are mapped within the buffer, no impacts are likely with the TSP. Well and pipeline locations reported by the Texas Railroad Commission are approximate. No mitigation is expected for well sites, plugged wells, or dry holes. As a result of the project, pipelines would need to removed and relocated to meet the USACE's policy of a minimum of 20' below the channel and a distance of 50' on each side of the channel. Pipeline relocation would be assessed by the owners.

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.

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 TSP. 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). Ten projects were considered.

5.4.1.1 Evaluation Criteria

Criteria include ecological, physical, chemical, socioeconomic, and cultural attributes, listed in Table 24. 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 TSP.

Table 24 - 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 25 and are compared to the TSP presented in this EIS

Table 25 - Past, Present, and Reasonably Foreseeable Actions within the Study Area

Past or Present Projects / Activities	Reasonably Foreseeable Projects / Activities
Gulf Intracoastal Waterway	Jetty Stabilization Project
Mouth of the Colorado River	Gulf Intracoastal Waterway Reroute
Formosa Plastics Corporation	Port of Calhoun Expansion
E.S. Joslin Power Station	
Alcoa	
Palmetto Bend Project	
LCRA-SAWS Water Project	

5.4.2 Reasonably Foreseeable Future Actions

5.4.2.1 Jetty Stabilization 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 4 miles long from the Gulf through the jetties to the inner channel.

The Galveston and New Orleans Districts have completed a draft jetty stabilization project initial appraisal 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 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.

5.4.2.2 GIWW Re-route

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. Based on barge simulation analysis and modeling, the channel will have a bottom width of 125' from Station 0+00 until it approaches the bend at Station 550+00. From that point to Station 585+00, the channel width widens to 847' and then narrows to 300' to Station 670+00. This will allow for both two-way traffic and safe navigational passage of vessels across strong currents at the MSC. The alignment uses the existing GIWW route on the eastward end for approximately 3.9 miles, and then turns westward for 13 miles. Approximately 2.5 mcy of new work material would be dredged during construction, and maintenance dredging quantities are estimated to be 77,500 cy per year (3,875,000 cy for the 50-year life of the project) (USACE, 2002).

A DMMP was designed for each reach of the new channel based on sediment type and quantity. Based on the DMMP, dredged material for Reach 1 will be used to create a test marsh along the shoreline near Palacios Point or will be placed in the surf zone of Matagorda Peninsula. Material from Reach 2 will be placed in the surf zone of Matagorda Peninsula to supply sediment for littoral transport. Material dredged from Reach 3A will be used to create marsh in the bay to the northwest of Port O'Connor and/or pumped in the surf zone along Matagorda Peninsula, depending on the success of a test marsh. The large amount of sand present in new work material and expected from maintenance material in Reach 3B provides the opportunity for beach nourishment. Thus, material from the reach that is not used in marsh creation associated with Reach 3A will be used to nourish Port O'Connor Beach and Sundown

Island. Material not suitable for these uses will be placed in the surf zone along Matagorda Peninsula for beach nourishment and littoral transport (USACE, 2002).

The GIWW reroute will affect approximately 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. Placement areas 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).

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 ship traffic expected with the MSC.

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.

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 (Wilber and Bass, 1998). 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) (PBS&J, 2005b); 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.

5.4.3.3 Formosa Plastics Corporation

Formosa currently operates eight plants and a variety of support facilities at an 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 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.

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.

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 has been producing alumina since at least 1948 and continues today. 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 contaminated 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.

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 (U.S. Bureau of Reclamation, 2008).

An EIS was conducted by the U.S. 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 (U.S. Bureau of Reclamation, 1974).

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.

5.4.4 Results

The following sections provide discussion regarding potential cumulative impacts resulting from the TSP combined with past, present, and reasonably foreseeable actions affecting the study area.

5.4.4.1 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 TSP 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.

5.4.4.2 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 ship 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.

5.4.4.3 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. The beneficial use of construction material to cap contaminated sediments should reduce the probability of future exposure potential. Precaution will be taken to minimize displacement of impacted sediments.

5.4.4.4 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. The beneficial use of construction material to cap high-mercury-content sediments should reduce the probability that these sediments will impact water quality by being suspended in the water column.

5.4.4.5 Sediment Quality

As noted in subsection 3.9.4, 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. However, 698 ac of these sediments will be capped by the beneficial use of construction material, reducing the chance of contact with these sediments by epibenthic organisms and the chance of resuspension from disturbances such as wave action or boating.

5.4.4.6 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 approximately 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 TSP 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, approximately 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.

5.4.4.7 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 are 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.

5.4.4.8 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.

5.4.4.9 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.

5.4.4.10 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

TSP for both construction and maintenance could result in the take of protected sea turtles. However, many of the mitigation measures proposed for the TSP 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.

5.4.5 Conclusions

Cumulative impacts due to past, existing, and reasonably foreseeable future projects, along with the TSP, 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.

5.5 Any Irreversible or Irretrievable Commitments of Resources Involved in the Implementation of the TSP

The labor, capital, and material resources expended in the planning and construction of the TSP 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 TSP, 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.

5.6 Cultural Resources

The proposed action includes deepening and widening of the existing channel, and the construction of new placement areas, and the expansion of existing placement areas, 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 Environmental Engineering

5.7.1 Water and Sediment Quality

Under the TSP, 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 (jetty deficiency correction), which is part of FWP condition. Increased water velocity would contribute to improved mixing and oxygen transport. The increase in salinity along the axis of the MSC would slightly reduce the DO saturation concentration and thus the absolute value by a similar amount. The magnitude of change is not likely to have a significant effect on the system.

Open-bay placement of maintenance material would continue in Matagorda Bay, so turbidity impacts there should be roughly equivalent to the FWOP condition. Offshore placement of construction material would cause a one-time increase in turbidity at the construction material ODMDS, and offshore placement of future maintenance material would periodically create turbidity, as it does now.

Although there would be more maintenance material placed in Matagorda Bay under the TSP, the source of the material would not change, and the method of placement would not change. 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. Additionally, the USACE routinely tests the elutriates prepared from maintenance material according to the Inland Testing Manual (ITM, EPA/USACE, 1998) and the Regional Implementation Agreement (RIA) (EPA/USACE, 2003) protocols before dredging to ensure that there are no causes for concern. The ITM and RIA provide guidance for testing sediments for in bay and offshore placement, respectively. Tier I (use of readily available information), Tier II (sediment and water chemistry information, including comparison of elutriates to Texas Surface Water Quality Standards and Water Quality Discrete Criteria, and Tier III (bioassays and bioaccumulation testing) testing of elutriates with chemical analyses and water column bioassays indicated no cause for concern. Additionally, significant detrimental environmental effects have not been noted in past maintenance dredging operations are not expected with the TSP.

5.7.1.1 Currents and Circulation

The TSP would not have any effect on freshwater inflows, but may modify the tidal exchange of water with the Gulf, to an insignificant extent. There would also be modifications to the tidal movement of water produced by the PA features. With tidal exchange, the main constriction points for water entering and leaving the bay are the inlet at the MSC entrance and at Pass Cavallo. The TSP would have little effect on the tides and waves within Matagorda Bay

5.7.1.2 Salinity

One effect of the TSP may be to allow the density current to transport a large volume of higher salinity Gulf water up the bay under certain conditions. The biggest effects are expected to occur following large freshwater inflow events when there is a strong salinity gradient from the upper to the lower bay. In this case, the deeper channel can be expected to reduce the time required for the density current to move higher salinity Gulf water to Lavaca Bay. This can be expected to increase the average salinity in the upper Matagorda and Lavaca Bays. During dry periods when salinity levels are relatively high throughout the bay, density differences would be small and the deeper channel would have relatively little effect.

Modeling predicts salinity increases along the channel. The amount of the salinity increase would be greater during times of higher inflow. The largest changes in salinity are predicted to occur fairly rarely – less than 10% of the time for most months. About a quarter of the time, low flows would be low enough that there is little change in salinity. The median salinity changes should correspond to the flow that is exceeded 50% of the time.

5.7.2 Sediment Quality

The TSP could result in the disturbance of bay sediments and subsequently affect 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 TSP that may potentially disturb bay sediments include dredging, placement of dredged material to build dikes or levees, placement of dredged material within PAs, 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) is currently undergoing natural recovery from mercury, by sedimentation. However, the sedimentation rate in the area is lower than rates in the rest of the bay (Alcoa, 1997). Under the TSP, the natural recovery would be enhanced by placement of dredged material over the impacted sediments. No change in surficial sediment quality is expected under the TSP.

5.7.3 HTRW Concerns

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 an NPL (Superfund) site. This area has been defined as having been impacted by contaminant releases from the Alcoa facility. Data provided by the National Oceanic and Atmospheric Administration (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 milligrams per kilogram.

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.

5.8 Real Estate

The CPA owns approximately 505 acres of submerged land located in Matagorda Bay, 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., P.L. 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.

Utilizing the Texas Railroad Commission website, approximately twenty-two (22) pipelines were identified within the channel that may require removal or relocation. More detailed information can be found in Appendix D – Real Estate.

Any conclusion or categorization contained in the real estate plan, or elsewhere in this project report, that an item is a utility or facility relocation to be performed by the non-federal sponsor as part of its LERRD responsibility is preliminary only. The government will make a final determination of the relocations necessary for the construction, operation, or maintenance of the project after further analysis, completion, and approval of the final attorney's opinions of compensability for each of the impacted utilities and facilities.

5.9 Socioeconomics

Detailed socioeconomic and demographic information characterizing industry, income, unemployment, age, and race in the study area can be located in Appendix A, Chapter

7. The deepening and widening of the channel is not anticipated to affect the distribution of these socioeconomic and demographic metrics within the study area.

5.9.1 Population Projections

Table 26 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 U.S. 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.

Table 26 - Population Projections through 2050

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**
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 (2020, 2030, 2040, 2050 Projections)						

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6 Plan Implementation

6.1 Placement of Dredged Materials on Beaches

The DMMP developed for the MSC, Texas, study is the Least Cost plan (Appendix F). Placement of dredged material (beach quality sand) on local beaches is not the least costly acceptable means for disposal. Such material placement is not considered integral to the project. It would not be cost shared. The USACE would not participate in the additional placement costs under the authority of Section 145 of the WRDA of 1976, as amended, because:

- This has not been requested by the State,
- The Secretary of the Army has given no indication that this is in the public interest,
- The added cost of disposal is not justified by hurricane and storm damage reduction benefits, nor is
- The shoreline on which the material is placed is open to public use.

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 addresses the dredging needs, disposal capabilities, capacities of DAs, 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 DAs 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 of 1972, as amended.

For the DMMP, see Appendix F.

6.3 Categorical Exemption to the NED Plan

Neither the USACE nor the non-Federal sponsor requested a categorical exemption from the NED. Even though dredging deeper than 47’ MLLW would have required modifications to the Port’s facilities, depths down to 51’ MLLW were evaluated and compared.

6.4 Mitigation

Based on findings of the Habitat Suitability Index (HSI) models, 133 ac of oyster reef would be required as mitigation for direct impacts to oyster reefs, and 26 ac of marsh would be required as mitigation for direct impacts to both low and high marshes, and to farmed wetlands.

The HSI was used to quantify the loss of functional value of oyster reef habitats impacted by the proposed project. The HSI addresses losses due to channel the same 50-year period of analysis. The analysis was also used to ensure that the proposed mitigation would restore all lost functional value. The HSI for oyster reef was calculated using the model of American Oyster (Swannack et al., 2014) using a spreadsheet certified for one-time use by the USACE Ecosystem Restoration - Planning Center of Expertise (PCX).

A second HSI was used to quantify the loss of functional value to the low and high marshes, and farmed wetlands. The HSI addressed losses due to placement of new work and maintenance material over the same planning period. The analysis was also used to ensure that proposed mitigation would restore all lost functional value. The HSI for marsh and farmed wetland was calculated using the model for clapper rail (Lewis and Garrison, 1983) using a spreadsheet certified for one-time use by the USACE Ecosystem-PCX.

Selection of potential mitigation sites and modeling of benefits would be conducted in coordination with resource agencies. The location of the marsh mitigation sites would be, to the extent practicable, within the areas surrounding Matagorda Bay. Oyster-reef mitigation sites would be within the Matagorda Bay. After confirmation of the TSP and public review, fully realized mitigation plans would be developed in consultation with the resource agencies and presented in the final integrated feasibility report and EIS. Impacts of the TSP would be fully compensated in accordance with specific impacts and benefits quantified by the HSI modeling. Marsh creation / mitigation would be conducted in compliance with ER 1165-2-27 (Establishment of Wetland Areas in Connection with Dredging).

6.5 Design and Construction Considerations

- Should mercury be found during new or maintenance dredging, a containment barrier would be constructed around PA-ER3/D.

6.6 LERRD Considerations

The MSC is an existing Federal project. The non-Federal sponsor (NFS) is required to furnish all Lands, Easements, Rights-of-way, Relocations, and Disposal areas (LERRDs) for the proposed cost-shared project. Appendix D is the Real Estate Plan.

"ANY CONCLUSION OR CATEGORIZATION CONTAINED IN THE REAL ESTATE PLAN, OR ELSEWHERE IN THIS PROJECT REPORT, THAT AN ITEM IS A UTILITY OR FACILITY RELOCATION TO BE PREFORMED BY THE NON-FEDERAL SPONSOR AS PART OF ITS LERRD RESPONSIBILITY IS PRELIMINARY ONLY. THE GOVERNMENT WOULD MAKE A FINAL DETERMINATION OF THE RELOCATIONS NECESSARY FOR THE CONSTRUCTION, OPERATION, OR MAINTENANCE OF THE PROJECT AFTER FURTHER ANALYSIS AND COMPLETION AND APPROVAL OF FINAL ATTORNEY'S OPINIONS OF COMPENSABILITY FOR EACH OF THE IMPACTED UTILITIES AND FACILITIES."

6.7 Operations and Maintenance Considerations

- Deeper dredging, both new and maintenance, at the offshore bar is being considered, since the bar is limiting the draft of ships.

6.8 Institutional Requirements

6.8.1 Charter Fishing Craft, Head Boats, and Similar Recreation-Oriented Commercial Activities

Temporary and minor adverse effect to recreational and charter fishing 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 charter fishing industry 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 TSP. Therefore, impacts to fish populations targeted by recreational and charter fishing are not expected to be significant.

6.8.2 Subsistence Fishing

No current records of subsistence fishing in the Matagorda Bay system were found while researching for this project. Therefore, no impacts to subsistence fishing are expected from the TSP.

6.8.3 Permit Coordination

Coordination with federal and state agencies to receive necessary permits and compliance certificates is ongoing. A Section 404(b) (1) short form can be found in Appendix B. The ODMDS has been permitted by the EPA for placement of new work and maintenance material (See Appendix B, Enclosure 2). Further coordination is underway with Texas GLO, and TCEQ to demonstrate compliance with required regulations.

6.8.4 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 ships to smaller vessels and vice versa), anchorage and channels.

6.8.5 Local Service Facilities

These are the responsibility of non-Federal entities and are required as part of the cooperation agreements if they are necessary for project benefits to accrue. However, changes to the existing local service facilities are not required for the TSP.

6.8.6 The USACE Campaign Plan

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 TSP 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
- 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

6.8.6.1 Environmental Operating Principles

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 TSP 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

6.9 Views of Non-Federal Sponsor

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 Tentative Selected Plan.

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7 Summary of Coordination, Public Views, and Comments

7.1 Compliance with Environmental Requirements

This section retained as a placeholder for the final report.

7.1.1 USFWS Coordination Act

This section retained as a placeholder for the final report.

7.1.2 ESA Consultation and Compliance

This section retained as a placeholder for the final report.

7.1.3 Section 106 of the National Historic Preservation Act

Compliance with the National Historic Preservation Act of 1966, as amended (54 U.S.C. § 306108), requires the consideration of effects of the undertaking on all historic properties in the project area and development of mitigation measures for those adversely affected properties in coordination with the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation. 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 will execute a Programmatic Agreement among the USACE, the Texas SHPO, and any non-federal sponsors 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. A draft of the Programmatic Agreement is provided in Appendix C.

7.2 Cooperating Agencies

This section retained as a placeholder for the final report.

7.3 Public Involvement

This section retained as a placeholder for the final report.

7.4 Non-Federal Views and Preferences

This section retained as a placeholder for the final report.

7.5 Summary

This section retained as a placeholder for the final report.

7.6 List of Preparers

Name	Technical Specialty
Franchelle Craft	Project Management
Kathy Skalbeck	Plan Formulation
Michael Kauffman	Hydrology and Hydraulic Engineering
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Aron Edwards	Operations
Dale Williams	Cost Engineering
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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, DRAFT Integrated Feasibility Report and Environmental Impact Statement

I recommend implementation of the National Economic Development plan, identified as Alternative Plan A at 47' MLLW in the Matagorda Ship Channel, Texas, DRAFT Integrated Feasibility Report and Environmental Impact Statement, in the Vicinity of the City of Point Comfort, Texas, May 2018, with such modifications thereof as in the discretion of the Commander, Headquarters, US Army Corps of Engineers (HQUSACE), may be advisable.

Implementation of the alternative plan would __________

The total project first cost is estimated to be $__________ at Month Year prices, with a Federal share of $__________ (by the US Army Corps of Engineers (USACE) and the local sponsor share of $__________. Annual operation, maintenance, repair, rehabilitation, and replacement costs are estimated to be $__________ at Month Year prices, a Federal discount rate of _____ percent, and a period of analysis of 50-years.

The non-Federal sponsor would be the Calhoun Port Authority.

I make this recommendation with the provision that prior to implementation the local sponsor 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 local sponsor 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 _____ percent of the total cost of construction of the general navigation features (GNFs) attributable to dredging to a depth not in excess of _____ feet, plus _____ percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of _____ feet but not in excess of _____ feet, as further specified below:

    i. Provide _____ percent 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 _____ percent of the total cost of construction of the GNFs attributable to dredging to a depth not in excess of _____ feet, plus _____ percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of _____feet but not in excess of _____ feet.

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 _____ years following completion of the period of construction of the GNFs, an additional amount equal to _____ percent 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 _____ percent 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 _____ percent 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 United States 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 United States 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 _____ 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 P.L. 91-611, Flood Control Act of 1970, as amended, (42 USC. 1962d-5b) and Section 101(e) of the WRDA 86, Public Law 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, P.L. 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, P.L. 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 months to complete. 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.

Lars N. Zetterstrom Colonel, US Army Corps of Engineers District Commander	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.

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11 Acronyms and Abbreviations

‘	Foot or Feet
“	Inch or Inches
%	Percent
AAEQ	Average Annual Equivalent
ac	Acre
Alcoa	Alcoa Corporation
ASA-(CW)	Office of the Assistant Secretary of the Army For Civil Works
ATR	Agency Technical Review
BA	Biological Assessment
BCR	Benefit Cost Ratio
BO	Biological Opinion
Bpd	Barrels per Day
BU	Beneficial Use
CAGR	Compound Annual Growth Rate
CCSC	Corpus Christi Ship Channel
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfu/dL	Colony Forming Units per Deciliter, Or 100 Ml
CPA	Calhoun Port Authority of Calhoun County, Texas
DA	Disposal Area
dBA	A-Weighted Sound Level
DDN	Deep Draft Navigation
DMMP	Dredged Material Management Plan
DO	Dissolved Oxygen
DQC	District Quality Control
DWT	Dead Weight Ton
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EOPs	Environmental Operating Principles

EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FCSA	Feasibility Cost Share Agreement
Formosa	Formosa Plastics Corporation
ft	Foot or Feet
FWOP	Future Without-Project
FWP	Future With-Project
GDM	General Design Memorandum
GIWW	Gulf Intracoastal Waterway
GNF	General Navigation Feature
Gulf	Gulf of Mexico
HTRW	Hazardous, Toxic, and Radioactive Waste
ITM	Inland Testing Manual
LCRA	Lower Colorado River Authority
Ldn	Day-Night Sound Level
LNG	Liquefied Natural Gas
LNGC	LNG Carrier
LOA	Length Overall
mg/L	Milligrams per Liter
mi	Mile
MLT	Mean Low Tide
MLLW	Mean Lower Low Water
MSC	Matagorda Ship Channel
MSCIP	Matagorda Ship Channel Improvement Project
NAAQS	National Ambient Air Quality Standards
NCDC	National Climatic Data Center
NED	National Economic Development
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOx	Nitrogen Oxide

NPL	National Priority List
NRHP	National Register of Historic Places
ODMDS	Ocean Dredged Material Disposal Site
OSE	Other Social Effects
PA	Placement Area (For Dredged Material)
PCC	Port of Corpus Christi
PCX	Planning Center of Expertise
PED	Pre-construction, Engineering and Design Phase
P&G	Principles and Guidelines
Port	Port of Port Lavaca–Point Comfort
ppt	Parts per Thousand
RCRA	Resource Conservation and Recovery Act
RED	Regional Economic Development
RHA	Rivers and Harbor Act
RIA	Regional Implementation Agreement
ROD	Record of Decision
SAV	Submerged Aquatic Vegetation
SHPO	State Historic Preservation officer
SO_2	Sulfur Dioxide
State	State of Texas
SWG	Galveston District
TBP	Texas Biotic Province
TCEQ	Texas Commission On Environmental Quality
TCMP	Texas Coastal Management Program
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
US	United States
USACE	US Army Corps of Engineers

USFWS	US Fish and Wildlife Service
WCSC	Waterborne Commerce Statistics Center
WMA	Wildlife Management Area
WRDA	Water Resources Development Act

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 approximately 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 Port 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)

MLLW = MLT + 1.69'. 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.

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," 10 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)