U.S. Army Corps of Engineers

Galveston District
Southwestern Division

Freeport Harbor Channel Improvement Project, Brazoria County, Texas

Draft Integrated General Reevaluation Report Environmental Assessment

March 2017

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Draft Finding of No Significant Impact

FREEPORT HARBOR CHANNEL IMPROVEMENT PROJECT,
BRAZORIA COUNTY, TEXAS
DRAFT INTEGRATED GENERAL REEVALUATION REPORT AND ENVIRONMENTAL ASSESSMENT

XXXXX 2017

The U.S. Army Corps of Engineers, Galveston District (Corps), has conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. The Corps assessed the effects of the following actions in the Final Integrated General Reevaluation Report, dated XXXXX 2017, for the Freeport Harbor Channel Improvement Project, which is incorporated herein by reference:

- Channel Widening to 400 feet from approximately Station (Sta.) 142+00 to Sta. 185+00 would deepen about 9.9 acres of submerged bottom to 46 feet mean lower low water (MLLW) with a hydraulic cutterhead dredge. The widening would require removal of the underwater berm around the perimeter of the Dow Thumb. Removal of the underwater berm could reduce the stability of a portion of the existing Freeport Hurricane Flood Protection Project (HFPP). To stabilize to recommended levels, a stability wall would be inserted into the terrestrial portion of the Dow Thumb at the waterside toe of the HFPP levee to provide foundation reinforcement;

- Bend Easing would be constructed at the west end of the HFPP North Wave Barrier from Sta. 147+00 to Sta. 160+00, require excavation that would affect approximately 16.4 acres of emergent land and dredging that would affect approximately 7.5 acres of submerged lands. Construction would be conducted with a hydraulic cutterhead dredge and mechanical excavator. Prior to constructing the bend easing, a portion of the existing HFPP wave barrier would be relocated through a re-designation of a segment of the Old Quintana Road to serve as the wave barrier. At this time, it is believed that no modifications to the existing roadway would be required. Old Quintana Road currently serves as the wave barrier for the east side of the North Wave Barrier. This would be required prior to construction of the bend easing;

- Turning Notch would be constructed at the Upper Turning Basin (Sta. 175+00 to 182+00) by a hydraulic cutterhead dredge. Construction of the turning notch would require dredging that would affect about 8.3 acres of submerged bottom.

- Construction of the Tentatively Selected Plan (TSP) would generate approximately 1.7 million cubic yards (MCY) of new work material, which would be placed in existing Placement Area 1. Maintenance material would be placed in the Maintenance Ocean Dredged Material Disposal Site 1A (ODMDS).

In addition to the "no action" alternative, two channel widening alternatives of 400-foot and 425-foot widths were evaluated in the final screening. The bend easing and turning notch features were included in and identical in both Alternatives. The 400-foot width alternative was determined to be the TSP, as it was the plan with the greatest net excess benefits and the most complete, efficient, and effective plan. [Waiting on info whether it is the National Economic Development (NED) plan] The TSP is the environmentally preferable alternative. All practicable means to avoid and minimize adverse environmental effects have been incorporated into the TSP. No significant impacts have been identified and no compensatory mitigation is required. The TSP would have no effect on existing salinity, long-term water quality, threatened or endangered species, essential fish habitat (EFH), wetlands, submerged aquatic vegetation, or prime farmlands, and historic properties, and there would be no negative socio-economic effects. Temporary and minor impacts to water quality, turbidity, benthic organisms, and noise would occur during dredging and placement activities in the project area. A General Conformity Determination for nitrogen oxide (NOx) emissions would be required as these emissions are estimated to exceed the current applicability threshold. Emissions are well within emissions budgets in the most recent State Implementation Plan

Technical and economic criteria used in the formulation of alternative plans were those specified in the Water Resource Council's 1983 Economic and Environmental Principles for Water and Related Land Resources Implementation Studies. All applicable laws, executive orders, regulations, and local government plans were considered in the evaluation of the alternatives. It is my determination that the recommended plan does not constitute a major federal action that would significantly affect the human environment; therefore, preparation of an Environmental Impact Statement is not required.

_____ _____

Date

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

EXECUTIVE SUMMARY* (NEPA required)

REPORT

This *Draft* Integrated General Reevaluation Report and Environmental Assessment (DIGRR-EA), evaluates modifications to the recommended plan from the *Freeport Harbor Channel Improvement Project Final Feasibility Report (*2012 Feasibility Report*) and Environmental Impact Statement* (2012 FEIS), dated September 2012 (2012 Feasibility Report/FEIS). The plan was authorized for construction in Section 7002 of the Water Resources Reform and Development Act of 2014 (WRRDA 2014). The 2012 FEIS provided National Environmental Policy Act (NEPA) compliance for the 2012 Feasibility Report.

Currently, the study has identified and screened alternatives and identified the tentatively selected plan (TSP). The TSP Milestone Meeting held on February 21, 2017, resulted in approval to release the DIGRR-EA for concurrent public and agency review, policy review, and Agency Technical Review (ATR). Subsequent to the concurrent reviews, the U.S. Army Corps of Engineers (USACE) Project Delivery Team (PDT), inclusive of the non-Federal sponsor, will address all review comments, present a recommended plan and develop the *Final* Integrated General Reevaluation Report and Environmental Assessment (FIGRR-EA).

STUDY INFORMATION

Authority. This report is an interim response to the study authority, Section 216 of the Flood Control Act (FCA) of 1970 (Public Law [P.L.] 91-611), as amended.

Purpose and Scope. The study purpose of the DIGRR-EA is to determine what modifications to the 2012 Feasibility Report are necessary to facilitate the safe and efficient navigation of the Panama design vessel around the Dow Thumb and to and from the Velasco Container Terminal and whether those modifications are economically justified as a separable element. Additionally, an economic update of the overall project authorized in WRRDA 2014 will be performed to determine whether the project is still in the Federal Interest.

Location. The DIGRR-EA study area is located on the middle Texas coast, bounded generally by the Brazos River on the west, Oyster Creek on the north and east, and the Gulf of Mexico on the south. The study area for the Freeport GRR will mirror the study area identified for the 2012 Feasibility Report/FEIS (**Figure ES-1**).

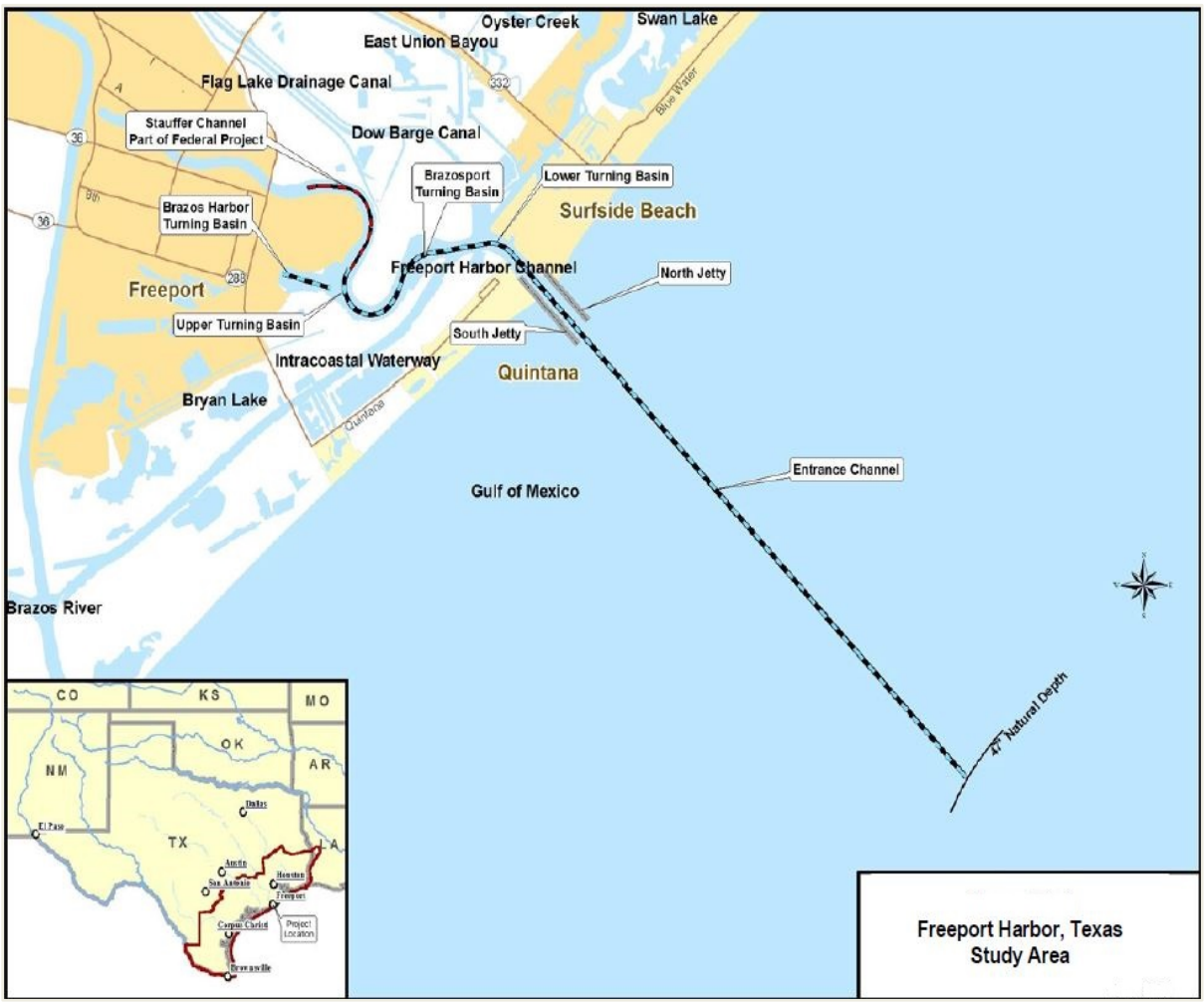

Figure ES-1 – GRR Study Area

The EA for the Freeport DIGRR-EA will cover the impact areas of the TSP, which are outside the footprint of the 2012 Feasibility Report/FEIS and within the first segment of construction project area. The 2012 Feasibility Report was divided into four separable reaches (Reach 1 through Reach 4, as shown in **Figure ES-2)**.

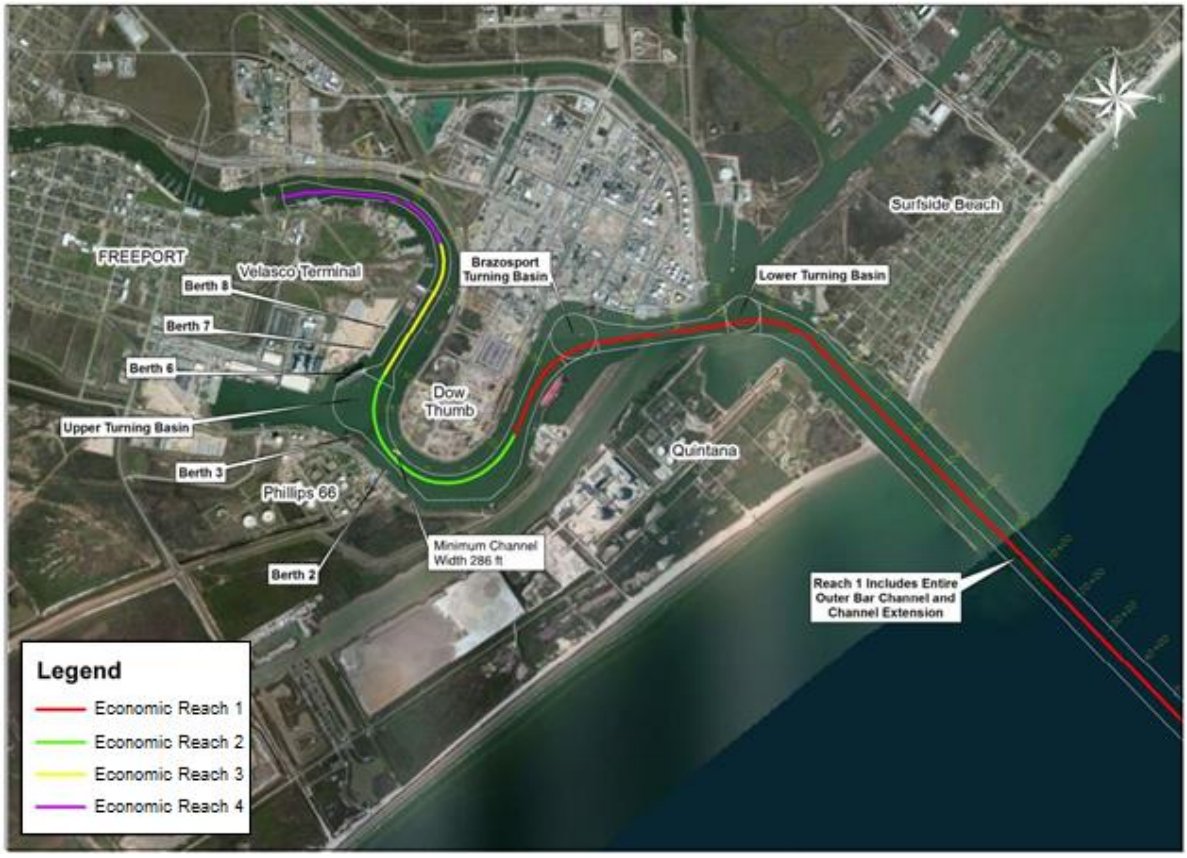

Figure ES-2 –Project Area (GRR Reach 2 and Reach 3)

Study Sponsor. The non-Federal Sponsor (NFS) is Port Freeport. Port Freeport is providing the environmental analyses and most engineering products as Work-In-Kind (WIK) products.

AUTHORIZED PROJECT

The plan authorized under WRRDA 2014 was the locally preferred plan (LPP) from the 2012 Feasibility Report. The LPP plan was comprised of the following improvements referenced in mean lower low water (MLLW) datum with the associated Reach identified in parenthesis:

- Deepen the Outer Bar Channel into the Gulf of Mexico to 58 feet **[Reach 1]**;
- Deepen from the end of the Jetties in the Gulf of Mexico to the Lower Turning Basin to 56 feet **[Reach 1]**;
- Deepen from the Lower Turning Basin to Station 132+66 near the Brazosport Turning Basin to 56 feet **[Reach 1]**;
- Enlarge the Brazosport Turning Basin from 1,000 foot diameter to 1,200 foot diameter **[Reach 1];**

- Deepen from Station 132+66, above the Brazosport Turning Basin, through the Upper Turning Basin to 51 feet **[Reach 2]**;
- Deepen and widen the lower 3,700 feet of the Stauffer Channel to 51 feet and 300 feet wide **[Reach 3]**;
- Dredge the remainder of the Stauffer Channel to 26 feet (previously authorized to 30 feet) **[Reach 4]**;

A dredged material management plan (DMMP) was developed during the study. Mitigation was required to compensate for impacts from the future construction of two new placement areas, PA 8 and PA 9.

GENERAL REEVALUATION TRIGGER

Panamax Concerns - Shortly after the feasibility was concluded, Port Freeport and the Brazos Pilots expressed concerns regarding the ability of the Panamax design vessel to reach the Velasco Container Terminal in Reach 3. The channel narrows around the Dow Thumb in Reach 2 (**Figure ES-3**) and the Panamax design vessel cannot safely transit around the Dow Thumb to allow travel to and from the Velasco Container Terminal in Reach 3.

Figure ES-3 - Channel Constriction

Previous Ship Simulations. In 2005 and 2007, ship simulations conducted for the feasibility study showed that Post Panamax vessels could not navigate the channel. An assumption was made that both Panamax and Sub Panamax sized vessels could safely navigate the channel. The assumption, however, was not verified through an additional ship simulation during that feasibility study.

Decision to Reevaluate. The decision was made to proceed with a general reevaluation report (GRR) to examine ship passage under different scenarios around the Dow Thumb. In addition, the GRR would determine any needed modifications to allow the Panamax design vessel to safely and efficiently transit around the Dow Thumb to and from the Velasco Container Terminal in Reach 3. The sponsor requested the modifications be investigated to a depth of 46 feet MLLW as a first segment of construction, with intent to eventually construct the project authorized under WRRDA 2014, to its full dimensions. Additionally, an economic update of the 2012 Feasibility Report inclusive of the GRR modifications must be conducted to determine whether the project is still in the Federal interest.

PRIOR REPORTS AND EXISTING WATER PROJECTS

The **Flood Control Act (FCA) of 1962** authorized the Freeport Hurricane Flood Protection Project (HFPP). Many existing features were adopted into the HFPP as is. Two of those features are located within the GRR project area (circled in **Figure ES-4**). They are the Old River North Levee located around the Dow Thumb (purple line) and the North Wave Barrier (pink line).

Figure ES-4 – GRR Study Area

The RHA of 1970 authorized the Freeport Harbor Project commonly referred to as the *45-Foot Project* (at mean low tide or MLT). Construction completed in 1993, generally deepened, and widened the previously authorized project from the 1950s. During the construction process the channel in the area of the Dow Thumb (Reach 2), was shifted, reducing the 1958 project width of 400 feet to "generally 350-375" with the current day narrowest constriction of 279 feet. This was the result of a series of shifts of the channel for the express purpose of protecting the underwater berm at the base of the Old River North Levee for stabilization.

The project authorized under WRRDA 2014, has not yet been constructed; therefore, the existing condition nearly matches the dimensions of the 45-Foot Project authorized to 45-feet MLT (46-feet MLLW). The difference between the 45-Foot Project and the existing condition is widening of the channels (Outer Bar Channel and Jetty Channel) conducted by Port Freeport under Department of the Army Regulatory Permit SWG-2004-02311. The authorized depths and widths for both projects are included in **Table ES-1**. For orientation purposes, the channel segments involved in this GRR evaluation for modifications are highlighted in the table.

Table ES-1 - Authorized Depths / Widths: 45 Foot (RHA 1970) & 2012 Feasiblity Report

Channel Segment	45 Foot Project		WRRDA 2014	
	Depth (MLLW)[1]	Width (Feet)	Depth (MLLW)[1]	Width (Feet)
Outer Bar Channel				
(New) Future Channel Extension[2]	N/A	N/A	58	600
Outer Bar Channel	48	400	58	600[3]
Jetty Channel	46	400	56	600[3]
Lower Turning Basin	46	750	56	Existing (750)
Main Channel				
Channel to Brazosport Turning Basin	46	400	56	Existing (400)
Brazosport Turning Basin	46	1,000	56	1,200
Channel to Upper Turning Basin	46	Generally 350-375[4]	51	Generally 350-375[4]
Upper Turning Basin	46	1,200	51	Existing (1,200)
Brazos Harbor				
Channel to Brazos Harbor	37	200	N/A	N/A
Brazos Harbor Turning Basin	37	750	N/A	N/A
Stauffer Channel				
Channel to Stauffer Turning Basin	Deauthorized		51	300
Stauffer Turning Basin	Deauthorized		26	200

[1] Does not include advance maintenance or allowable overdepth.
[2] Not surveyed or constructed. Extension authorized from end of Outer Bar Channel to the -58 MLLW Contour.
[3] Widened from 400 to 600 feet per DA Regulatory Permit (SWG-2004-02311) by Port Freeport (not deepened).
[4] Channel is constructed to a width of approximately 279-feet at the waist of the Dow Thumb.

Sabine Pass to Galveston Bay Study (S2G) is developing recommendations to reduce the risk of coastal storm surge impacts in this study area. The S2G is proposing to modify the Old River North Levee located in Reaches 2 and 3 of the GRR project area. The Chief's Report is currently scheduled for completion in August 2017.

WORK-IN-KIND APPROVED UNDER MEMORANUM OF UNDERSTANDING

On October 8, 2015, the Assistant Secretary of the Army (Civil Works) or ASA (CW) approved execution of a memorandum of understanding (MOU) with Port Freeport to construct a portion of the Lower Stauffer Channel concurrent with this study. The work would be accomplished by Port Freeport for Section 221 credit to be applied upon a finding that the work is integral to the Channel Improvement project and the execution of the Project Partnership Agreement. The work to be conducted under the MOU involves dredging a portion of the Lower Stauffer Channel to 46 feet MLLW to serve Berths 7 and 8; this work is necessary for the first segment of construction to be able to yield benefits. Note the Lower Stauffer Channel is authorized to 51 feet MLLW under WRRDA 2014. The dredge quantities for the WIK effort are included with the TSP placement plan.

ALTERNATIVE PLANS AND SCREENING

Formulation for the Freeport DIGRR-EA was limited to determining what modifications to the 2012 Feasibility Report would allow the Panamax vessel to safely transit around the Dow Thumb (Reach 2) to and from the Velasco Container Terminal (Reach 3) and accrue the benefits intended by Congress. During the formulation process, it was determined using previous ship simulation information, and based on meetings with the Brazos Pilots, that in addition to channel widening around the Dow Thumb, bend easing and a turning notch in the Upper Turning Basin would be critical components to the alternative. The alternatives considered for the first segment of construction to 46 feet MLLW are listed in **Table ES-2.**

Table ES-2 - Alternatives to 46 feet MLLW

Alternative	Description
No Action Alternative	No Action or Future Without-Project Condition
Alternative 1	Widening at Dow Thumb (375 feet) + Bend Easing + Notch at Upper Turning Basin (required for incremental justification)
Alternative 2	Widening at Dow Thumb (400 feet) + Bend Easing + Notch at Upper Turning Basin
Alternative 3	Widening at Dow Thumb (425 feet) + Bend Easing + Notch at Upper Turning Basin (required for incremental justification and if the ship simulation does not pass the design vessel with 400-foot at Dow Thumb)
Alternative 4[1]	Widening at Dow Thumb (TSP width) + Bend Easing + Notch at Upper Turning Basin + optimization of the channel depth

[1] Alternative 4 is for purposes of the incremental justification to determine whether the 46-foot depth is the National Economic Development Plan.

Final Array Screening Based on 2016 Ship Simulation

A limited ship simulation study was performed at the STAR Center based in Dania Beach, Florida. The Engineer Research and Development Center (ERDC) provided technical oversight. The simulation used the hydrodynamic model of a Panamax sized container vessel, the *CMA CGM Virginia* for the study (964.6 feet LOA, 105.6 feet Beam, and 42.6 feet draft). The ship simulation examined the 375 foot and 400 foot alternatives. The simulation failed for the 375 foot width and was successful with the 400 foot width. The recommendations of the 2016 Ship Simulation concluded that safe inbound and outbound transits with the Panamax sized vessel are possible with the 400-foot channel width, and three assist tugboats for both inbound and outbound transits. The Brazos Pilots confirmed, by letter dated September 8, 2016 that the 400 foot width would provide for the safe transit of the Panamax design vessel around the Dow Thumb, to the upper Turning Basin.

The ship simulation results were used for screening those alternatives from the Final Array that would not provide for the transit of the Panamax vessel around the Dow Thumb. The remaining

alternatives carried forward for final screening process are Alternative 2 (Widening at Dow Thumb (400 feet) + Bend Easing + Notch) and Alternative 3 (Widening at Dow Thumb (425 feet) + Bend Easing + Notch).

Final Comparison of Alternative Plans

Criteria used to evaluate the remaining two alternatives included an evaluation of costs and benefits of the proposed modification as a separable element (**Table ES-3**). Benefits were calculated utilizing the HarborSym model. The Project First Cost includes the HFPP Mitigation Feature (stability wall) needed prior to removal of the underwater berm and widening of the channel, relocating the wave barrier to allow for construction of the bend easing, and dredging of a turning notch, all to 46 feet MLLW. Neither of the alternatives would result in environmental impacts requiring mitigation. Therefore, no environmental mitigation or monitoring costs are included in the estimated Project First Cost.

Table ES-3 – NED Benefit[2] Analysis for GRR Alternatives ($000)

Screening Criteria		**Alternative 2** Widening at Dow Thumb (400 feet) + Bend Easing + Notch	**Alternative 3** Widening at Dow Thumb (425 feet) + Bend Easing + Notch
		Oct 2016 Price Levels and 2.875% Interest Rate	
Total Costs	Project First Cost	$**57,006**	Greater than $**57,006**
	O&M Cost	$100,646	$100,646 or Greater
	Environmental Mitigation / Monitoring	$0	$0
	HFPP Mitigation Feature	$15,342	$15,342
Average Annual	Average Annual Costs[1]	$4,374	Greater than $4,374
	Average Annual Benefits	$6,452	$6,452
	BCR	1.47	Less than 1.47
	Net Excess Benefits	$2,078	Less than $2,078

[1] First cost of construction, O&M, and stability mitigation included in this cost; reassignment of wave barrier will be added for final report.
[2] The table shows costs and benefits at 46 feet.

A comparison against the four criteria in the Water Resource Council's 1983 Economic and Environmental Principles for Water and Related Land Resources Implementation Studies (Principles and Guidelines or P&G): completeness, effectiveness, efficiency, and acceptability, was also made for the remaining two alternatives. The two remaining alternatives in the final array are considered acceptable. While both alternatives would allow the transit of the Panamax design vessel around the Dow Thumb while avoiding and minimizing environmental impacts to the greatest extent possible during the 50-year period of analysis, the plan with the greatest net

excess benefits is considered the most complete, efficient, and effective plan. Therefore, Alternative 2 (Widening at Dow Thumb (400 feet) + Bend Easing + Notch) is the plan which best meets the four P&G criteria.

TENTATIVELY SELECTED PLAN

Alternative 2 is the most cost effective alternative of the final array of alternatives for the first segment of construction to 46-feet deep. This plan involves widening the channel at the Dow Thumb to 400 feet, and constructing the bend easing and turning notch, all to 46 feet MLLW as the first segment of construction (**Figure ES-5**). The pilots concurred that the TSP would allow for the efficient, safe transit of the Panamax around the Dow Thumb and to and from the Velasco Container Terminal. No environmental mitigation would be required for Alternative 2.

TSP COMPONENTS

The TSP consists of the following features to 46 feet MLLW:

Channel Widening to 400 feet from approximately Sta. 142+00 to Sta. 185+00 would require dredging approximately 9.9 acres of submerged bottom. The widening would require removal of the underwater berm around the perimeter of the Dow Thumb. Removal of the underwater berm would reduce the HFPP Old River North Levee global stability factor of strength (FOS) in this area to about 1.0. USACE guidance recommends a FOS value of 1.3. To bring the FOS up to recommended levels, a stability wall would be inserted into the terrestrial portion of the Dow Thumb at the waterside toe of the HFPP levee to provide foundation reinforcement. Preliminary slope stability analysis demonstrates a possibility of increasing the factor of safety to 1.698 by constructing the stability wall to 55 feet below zero feet, North American Vertical Datum of 1988 (NAVD).

Bend Easing would be constructed at the west end of the HFPP North Wave Barrier from Sta. 147+00 to Sta. 160+00 and require excavation that would affect approximately 16.4 acres of emergent land and dredging that would affect approximately 7.5 acres of submerged lands. Prior to constructing the bend easing, the wave barrier would be relocated through a re-designation of a segment of the Old Quintana Road, which is of higher elevation, to serve as the wave barrier. At this time, it is believed that no modifications to the existing roadway would be required. Old Quintana Road currently serves as the wave barrier for the east side of the North Wave Barrier. This would be required prior to construction of the bend easing.

Turning Notch would be constructed at the Upper Turning Basin (Sta. 175+00 to 182+00) and situated adjacent to the Brazos Port Harbor. Construction of the turning notch would require dredging that would affect about 8.3 acres of submerged bottom.

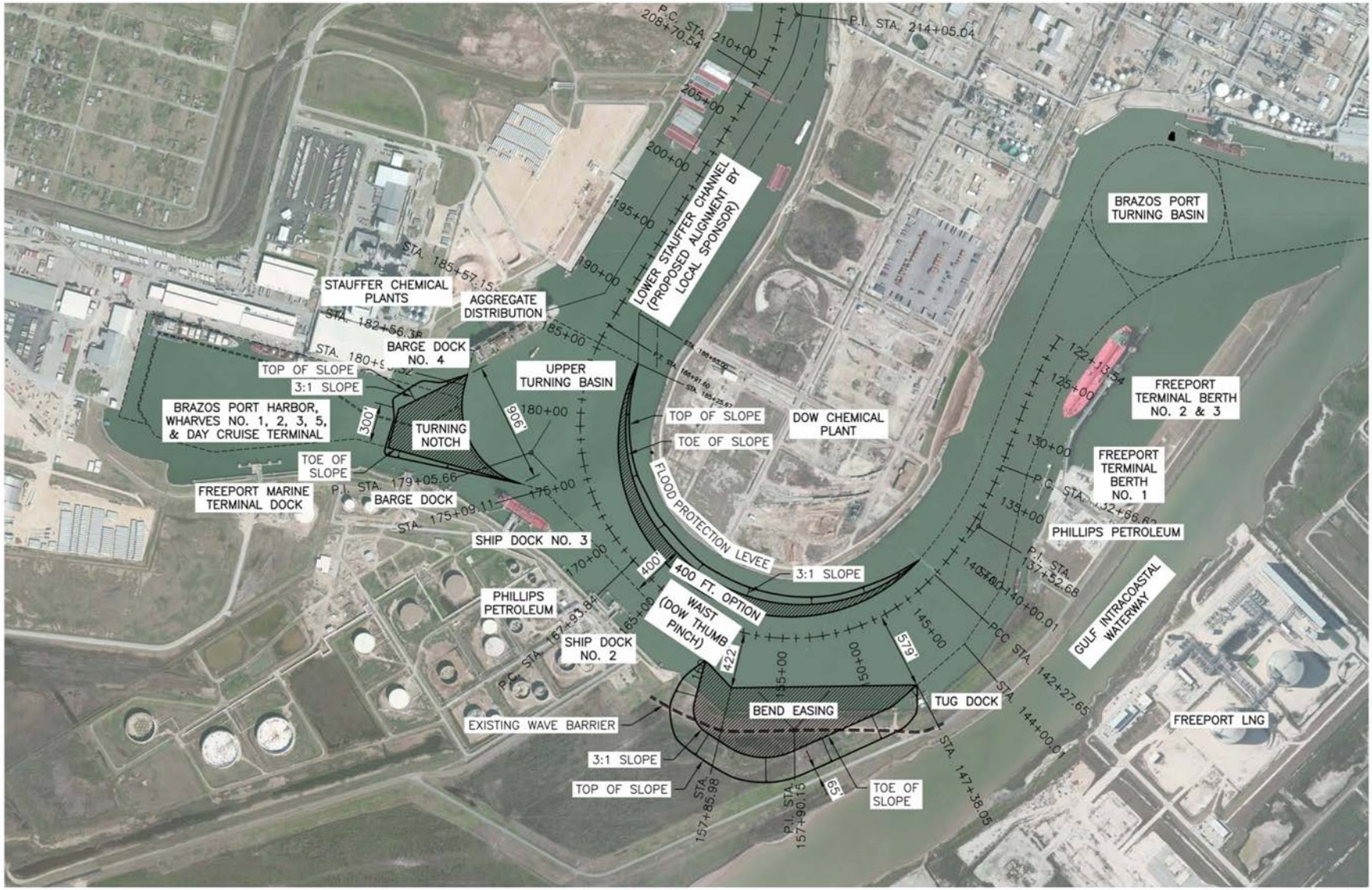

Figure ES-5 – Tentatively Selected Plan

Construction of the TSP would generate approximately 1.7 MCY of new work material. An additional 270,000 cubic yards (CY) of material would be generated by the sponsors WIK effort on the Lower Stauffer Channel, bringing the total to approximately 2 MCY of material. Placement options were evaluated to determine the best placement alternative for all material from the TSP, both new work and O&M. These alternatives considered possible beneficial use (BU) of dredged material, as well as traditional PAs. The least cost placement plan for the TSP provides for the new work going to PA 1 and approximately 2.7 MCY of maintenance over the 50-year period of analysis (TSP and sponsor WIK) going offshore to the Ocean Dredged Material Disposal Area designated for maintenance (ODMDS 1A).

ENVIRONMENTAL IMPACTS AND COMPLIANCE

The TSP would result in no significant environmental or historic property impacts and therefore no mitigation is required. The impact analysis determined there would be no effects to existing salinity, long-term water quality, threatened or endangered species, essential fish habitat (EFH), wetlands, submerged aquatic vegetation, or prime farmlands, and historic properties, and that there would be no negative socio-economic effects. Temporary and minor impacts to water quality, turbidity, benthic organisms, and noise would occur during dredging and placement activities in the project area. Construction of the TSP would not be expected to violate National Ambient Air Quality Standards. Analysis of air emissions associated with the TSP, and construction of the stability wall needed in conjunction with construction of the channel widening, has determined that a General Conformity Determination for nitrogen oxide (NOx) emissions would be required as emissions of NOx are estimated to exceed the current applicability threshold. However, the emissions are well within emissions budgets in the most recent State Implementation Plan as documented in Appendix J.

The U.S. Fish and Wildlife Service (USFWS) prepared a Fish and Wildlife Coordination Act Report (CAR; Appendix I). The CAR recognizes that the TSP avoids significant impacts to fish and wildlife resources, including federal threatened and endangered species. USACE has agreed to fully adopt four CAR recommendations, and partially adopt two recommendations. USACE has agreed to utilize specific Best Management Practices (BMPs) to avoid wildlife impacts, coordinate with the National Marine Fisheries Service (NMFS), and reevaluate mitigation and endangered species impacts if the TSP changes. USACE also agreed to properly dispose of contaminated sediments should they be identified and encourage Port Freeport to work with tenants and operators to beneficially use dredged material where feasible. Two recommendations cannot be adopted due to USACE policy. Adoption of a standard policy regarding the beneficial use (BU) of new work and maintenance material is beyond the purview of this study. A review of potential BU options determined that the least-cost disposal plan is use of existing PA 1. The USFWS recommendation that USACE construct a bird island with

dredged material was not adopted because no wildlife mitigation is required and ecosystem restoration is not an authorized study purpose. Recommendations and all partial or non-adopts are fully explained in Section 7.7 of the DIGRR-EA.

A draft Biological Assessment (BA) was prepared that concluded the TSP would have no effect on federally listed threatened and endangered species. The draft BA was submitted to USFWS and NMFS. Neither agency provides concurrence when a "no effect" call is made by the action agency. State water-quality coordination, general conformity coordination for air emissions impacts, consistency with the Texas Coastal Management Plan, and EFH consultation will be completed concurrently with public and agency review.

BENEFITS AND COST OF THE TSP

A Class 4 parametric cost, using historical and unit costs, was applied to develop the estimated cost estimate for screening the final array (**Table ES-4**). A cost estimate using Microcomputer Aided Cost Estimating System (MCACES) will be developed for the final plan carried forward for feasibility-level design following the concurrent public and agency review, policy review, and ATR. The Civil Works Cost Engineering and Agency Technical Review Mandatory Center of Expertise will provide a mandatory ATR of the final cost estimate prior to certification.

Table ES-4 - Estimated Project First Cost for TSP ($000)

Cost Account and Feature	GRR First Cost *(Oct 2016 Price level)*
01 Lands & Damages (100% Non-Federal)	3,989
11 Levees & Floodwalls	20,767
12 Navigation, Ports & Harbors	25,695
16 Bank Stabilization	1,163
30 Preconstruction Engineering & Design (PED)	3,725
31 Construction Management (E&D, S&A)	1,667
Total Project First Cost	**57,006**

In reference to the costs shown in the table for the 12 Account, these costs include the initial Lower Stauffer dredging (270,000 CY) being done as WIK under the WRRDA 2014 authorization, and the dredging for the TSP channel widening, bend easing and turning basin. The Cost Account 11 is the cost for the construction of the HFPP Old River North Levee stability feature and the PA 1 dike containment rise to elevation 31.5 feet NAVD. The costs in the 01 Account are for the land to be excavated/dredged for the bend easing. The cost for the re-designation of the west end of the North Wave Barrier to the elevated Old Quintana Road is not included in the cost estimate.

TOTAL PROJECT FIRST COST COMPARISON

Table ES-5 provides the Project First Cost for 1) the WRRDA 2014 authorized cost at October 2013 price levels, 2) the WRRDA 2014 authorized cost updated to current price levels, and 3) the Project First Cost for the WRRDA 2014 updated costs at current prices levels with the TSP costs included.

Table ES-5 - Project First Cost Comparison Summary of 2012 Feasiblilty Report ($000)

Cost Account and Feature	WRRDA 2014 Authorized Project First Cost *(Oct 2013 Price level)*	WRRDA 2014 Authorized Project First Cost *(Oct 2016 Price level)*	Project First Cost (WRRDA 2014 Updated Costs plus GRR TSP) *(Oct 2016 Price level)*
01 Lands & Damages (100% Non-Federal)	1,702	1,653	5,832
06 Fish & Wildlife Facilities	166	246	137
11 Levees & Floodwalls (GRR only)	-	-	20,767
12 Navigation, Ports & Harbors[1]	209,432	182,299	218,730
16 Bank Stabilization (GRR only)	-	-	1,163
30 Preconstruction Engineering & Design (PED)	18,449	18,578	24,012
31 Construction Management (E&D, S&A)	9,567	8,551	10,577
SubTotal Project First Cost	**239,316**	**211,327[1]**	**281,218**
12 Associated Costs (Berthing Areas)[2]	58,878	59,601	59,601
Other Federal Costs (Aids to Navigation) –USCG	1,392	1,352	1,352
Total Project First Cost	**299,586**	**272,280**	**342,171**

[1] Cost decreased due to changes in labor rates, fuel costs, and interest rates.
[2] Associated costs that are not part of the recommended Federal project but are a necessary non-Federal responsibility.

COST SHARING

The estimated Cost Apportionment for the cost of the TSP at October 2016 price levels is presented in **Table ES-6**. For the TSP a Class 4 cost estimate was developed. For the FIGRR-EA, a Class 3 cost estimate will be developed and certified.

Table ES-6 – Cost Apportionment (WRRDA 2014 costs plus TSP costs)

Project Feature		Project First Cost October 2016 Price Levels		
		Federal	Non-Federal	Total
General Navigation Features[1]				
1	Land & Damages (100% NF)	-	5,832	5,832
6	PA Mitigation-Contract 8 (90/10)	1	0	1
6	PA Mitigation-Contract 8 (75/25)	32	11	42
6	PA Mitigation-Contract 8 (50/50)	116	116	232
11	Levees and Floodwalls (90/10)	10,358	1,151	11,509
11	Levees and Floodwalls (75/25)	7,255	2,418	9,673
11	Levees and Floodwalls (50/50)	956	956	1,912
12[2]	Navigation Ports & Harbors (90/10)	845	94	939
12[2]	Navigation Ports & Harbors (75/25)	24,784	8,261	33,045
12[2]	Navigation Ports & Harbors (50/50)	93,628	93,628	187,256
12[2]	GRR-Navigation Ports & Harbors (90/10)	9,524	1,058	10,852
12[2]	GRR-Navigation Ports & Harbors (75/25)	11,104	3,701	14,806
12[2]	GRR-Navigation Ports & Harbors (50/50)	1,575	1,575	3,150
16	Bank Stabilization (90/10)	522	58	580
16	Bank Stabilization (75/25)	428	143	571
16	Bank Stabilization (50/50)	73	73	145
	Spent Costs	471	471	942
	Sub-Total Project First Cost[3]	**161,671**	**119,546**	**281,218**
	Associated Costs	-	59,601	59,601
	Navigation Aids (USCG)	1,352	-	1,352
	Total Project First Cost[3]	**163,023**	**179,147**	**342,171**

[1] Costs included PED and Construction Management totals.
[2] The Water Infrastructure Improvements for the Nation Act (WIIN Act) dated January 4, 2017, under Section 1111, modifies the cost share percentages for the new work originally stated in WRDA 1986. Once USACE provides Implementation Guidance, cost share percentages will be updated per said guidance.
[3] The total project costs and respective cost share allocations are approximate and contain rounding errors.

PUBLIC COORDINATION

The public will have an opportunity to comment on the TSP during the 30-day public review of the DIGRR-EA. Any comments submitted during that process will be considered and addressed.

NON-FEDERAL SPONSOR SUPPORT

Port Freeport, the non-Federal sponsor for the existing project has actively participated in the entire planning process, including development of the Engineering Appendix and NEPA products. Their primary concern has been to provide modifications to allow for transit of the Panamax vessel to and from the Velasco Container Terminal and realize the benefits intended by Congress.

AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

The DIGRR-EA is very limited in scope and non-controversial. There is an open issue with respect to USACE authority to implement portions of the TSP. At the TSP milestone meeting, the vertical team concluded that neither the 2014 WRRDA authorization nor the Chief's discretionary authority appeared sufficient to allow USACE modifications to the existing wave barrier or hurricane protection system. An implementation strategy will be developed prior to the final report.

MAJOR FINDINGS AND CONCLUSIONS

The proposed actions of this report are in the national interest and provide a modification that would allow the authorized project to accrue the benefits for which Congress intended. The recommendations contained herein reflect the information available at this time. To ensure that all applicable laws and policies are addressed for the TSP, this DIGRR-EA will undergo public, policy, and ATR. The study team will address any outstanding issues raised during the review and confirm the analysis in this DIGRR-EA and recommendations to move forward with development of the feasibility-level design and completion of a FIGRR-EA.

This TSP is in support of two of the four goals for USACE contained in the latest (as of 1 May 2015) USACE Campaign Plan. Specifically, the TSP supports Goal 2 (Transform Civil Works) and Goal 4 (Prepare for Tomorrow). This plan is available on the internet at the following address: *http://www.usace.army.mil/about/campaignplan.aspx*.

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DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
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GALVESTON, TEXAS 77553-1229

Freeport Harbor Channel Improvement Project, Brazoria County, Texas

Draft Integrated General Reevaluation Report – Environmental Assessment

March 2017

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List of Acronyms

ADM	Agency Decision Milestone
AM	Advance Maintenance
APE	Area of Potential Effects
AO	Allowable Overdepth
ASA(CW)	Assistant Secretary of the Army (Civil Works)
ATON	Aids to Navigation
ATR	Agency Technical Review
BA	Biological Assessment
BCR	Benefit-to-Cost Ratio
BMP	Best Management Practice
BRPA	Brazos River Pilots Association
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWA	Clean Water Act
cy	Cubic Yards
DA	Department of the Army
dB	Decibel
DIGRR-EA	Draft Integrated General Reevaluation Report and Environmental Assessment
DMMP	Dredged Material Management Plan
DWT	Dead Weight Tons
EA	Environmental Assessment
EC	Engineer Circular
EFH	Essential fish habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EM	Engineer Manual
EO	Executive Order
EOP	Environmental Operating Principles
EPA	U.S. Environmental Protection Agency
EQ	Environmental Quality
ER	Engineer Regulation
ERDC	Engineer Research and Design Center
ESA	Endangered Species Act
ETL	Engineer Technical Letter
FCA	Flood Control Act

FCSA	Feasibility Cost Sharing Agreement
FHC	Freeport Harbor Channel
FIGRR-EA	Final Integrated General Reevaluation Report - Environmental Assessment
FM	Farm-to-Market Road
FPPA	Farmland Protection Policy Act
FWOP	Future Without-Project
FY	Fiscal Year
GDM	General Design Memorandum
GIWW	Gulf Intracoastal Waterway
GLO	Texas General Land Office
GNF	General Navigation Feature
GRR	General Reevaluation Report
H&H	Hydrology and Hydraulics
HFPP	Hurricane Flood Protection Project
HGB	Houston-Galveston-Brazoria
HTRW	Hazardous, Toxic and Radioactive Waste
IDC	Interest During Construction
IEPR	Independent External Peer Review
LERRD	Lands, Easements, Rights-of-Way, Relocations, and Disposal
LNG	Liquefied Natural Gas
LOA	Length Overall
LPG	Liquid Petroleum Gas
LPP	Locally Preferred Plan
MBTA	Migratory Bird Treaty Act
MCACES	Micro Computer Aided Cost Engineering System
MCY	Million Cubic Yards
MLLW	Mean Lower Low Water
MLT	Mean Low Tide
MOU	Memorandum of Understanding
MPRSA	Marine Protection, Research, and Sanctuaries Act
NAAQS	National Ambient Air Quality Standards
NAD 27 (or 83)	North American Datum of 1927 (or 1983)
NAVD 88	North American Vertical Datum of 1988
NED	National Economic Development
NEPA	National Environmental Policy Act
NFS	Non-Federal Sponsor or Sponsor
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

NO_x	Nitrogen Oxide
O&M	Operations and Maintenance
ODMDS	Ocean Dredged Material Disposal Site
OSE	Other Social Effects
OSV	Offshore Supply Vessels
P&G	Principles and Guidelines
PA	Placement Area
PDT	Project Delivery Team
PED	Preconstruction Engineering and Design
PF	Port Freeport
P.L.	Public Law
PPA	Project Partnership Agreement
RED	Regional Economic Development
RHA	Rivers and Harbors Act
ROD	Record of Decision
RPM	Reasonable and Prudent Measures
RSLC	Relative Sea Level Change
RSLR	Relative Sea Level Rise
S2G	Sabine to Galveston
SAV	Submerged Aquatic Vegetation
SH	State Highway
SHPO	State Historic Preservation Officer
SMMP	Site Monitoring and Management Plan
TCEQ	Texas Commission on Environmental Quality
TCMP	Texas Coastal Management Program
TPWD	Texas Parks and Wildlife Department
TPY	Tons Per Year
TSP	Tentatively Selected Plan
TWDB	Texas Water Development Board
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Compounds
WIK	Work-In-Kind
WRDA	Water Resources Development Act
WRRDA	Water Resources Reform and Development Act

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1 STUDY INFORMATION

1.1 INTRODUCTION

This *Draft* Integrated General Reevaluation Report and Environmental Assessment (DIGRR-EA), examines channel improvements for the Freeport Harbor Channel (FHC), Texas deep-draft navigation channel. Report sections required for compliance with the National Environmental Policy Act (NEPA) are indicated with an asterisk following the section heading. The Feasibility Cost Sharing Agreement (FCSA) for this study was signed on June 10, 2015, with the non-Federal sponsor (NFS or sponsor), Port Freeport. The study alternatives have been screened, resulting in identification of the Tentatively Selected Plan (TSP). This DIGRR-EA will undergo concurrent public and agency review, policy review, and Agency Technical Review (ATR). Subsequent to the concurrent reviews, the U.S. Army Corps of Engineers (USACE) Project Delivery Team (PDT) will address review comments, present a recommended plan, and develop the *Final* Integrated General Reevaluation Report and Environmental Assessment (FIGRR-EA).

1.2 STUDY AUTHORITY

This DIGRR-EA is being performed under the authority of Section 216 of the Flood Control Act (FCA) of 1970 (Public Law [P.L.] 91-611), as amended:

> *The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects 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.*

The *Freeport Harbor Channel Improvement Project Final Feasibility Report* (2012 Feasibility Report) *and Final Environmental Impact Statement* (2012 FEIS) dated September 2012 (2012 Feasibility Report/FEIS), was authorized for construction in Section 7002 of the Water Resources Reform and Development Act of 2014 (WRRDA 2014). **Table 1-1** provides dates and descriptions of authorized features for the Freeport Harbor, Texas Project.

Table 1-1 – Authorization Documents under Freeport Harbor, Texas Authorization

Date Authorizing Act	Project and Work Authorized for Freeport Harbor, Texas	Documents
Jun 14, 1880	Provided for construction of jetties for controlling and improving the channel over the bar at the mouth of the Brazos River	Rivers and Harbors Act (RHA) of 1880
Mar 03, 1899	Dredging and other work necessary in judgment of Secretary of War for improving harbor; for taking over jetties and privately built works at mouth of river	(RHA of 1899, 55th Congress, Ch. 425
Mar 02, 1907	Examination authorized. Work later confined to maintenance of jetties	H. Doc. 1087, 60th Cong., 2nd Sess.
Feb 27, 1911	Repairs to jetties and dredging	RHA of 1911, P.L. 61-425
Mar 04, 1913	Construct seagoing hopper dredge	RHA of 1913, P.L. 62-429
Aug 08, 1917	Purchase of one 15-inch pipeline dredge and equipment, its operation of 3 years, operation of seagoing dredge one-half time for 3 years, and repairs to jetties	RHA of 1917, P.L. 65-37
Mar 03, 1925[1]	Diversion dam, diversion channel, and necessary auxiliary works	Rivers and Harbors Committee Doc. 10, 68th Cong., 2nd Sess.
Jul 03, 1930	Maintenance of diversion channel at expense of local interest	Rivers and Harbors Committee Doc. 18, 70th Cong., 1st Sess.
Aug 30, 1935	Deepening channels and basins	Rivers and Harbors Committee Doc. 15, 72nd Cong., 1st Sess.
May 17, 1950	Deepen outer bar channel to 38 feet from gulf to a point within jetties, thence 36 feet in authorized channels to and including upper turning basin	H. Doc. 195, 81st Cong., 1st Sess.
Aug 30, 1935	Maintenance of present project dimensions of channels and basins at Federal expense	Rivers and Harbors Committee Docs. 15, 72nd Cong., 1st Sess., and 29, 73rd Cong., 2nd Sess.
Jul 03, 1958	Relocate outer bar channel on straight alignment with jetty channel and maintain Brazos Harbor entrance channel and turning basin (constructed by local interests)	RHA of 1958 (House Doc. 433, 84th Cong., 2nd Sess.)
Oct 05, 1961	Modification of HD 1469 revoking certain provisions of local cooperation	PL 394, 87th Cong.
Dec 31, 1970[2]	Relocation of entrance channel and deepen to 47 feet; enlargement to a depth of 45 feet and relocation of jetty channel and inside main channel; deepening to 45 feet of channel to Brazosport; enlargement of the widened area of Quintana Point to provide a depth of 45 feet with a 750-foot diameter turning area; Brazosport turning basin to 45 feet deep with a 1,000 foot turning area; a new turning basin with a 1,200 foot diameter turning area and 45 feet deep; deepening Brazosport channel to 36 by 750 feet diameter; flared approaches from Brazos Harbor Channel; relocation of north jetty and rehabilitation of south jetty	RHA of 1970, PL 91-611; 84 Stat.1818.3[3]
Nov 17, 1986	Modified local cooperation requirements for the 1970 Act	Sec. 101, PL 99-662
Nov 08, 2007	Amends Sec 101 of RHA of 1970 to make all costs for removal of the sunken vessel COMSTOCK a Federal responsibility	Sec. 3148, PL 110-114

[1] *Construction of lock in diversion dam at local expense considered inactive.*
[2] *It was during the construction of the project that the channel in Reach 2 was shifted away from the underwater berm, resulting in the 279-foot constrained waist at the Dow Thumb.*
[3] *Extension of north jetty 1,950 feet and south jetty 1,265 feet considered inactive (1975 Deauthorization list).*

1.3 STUDY PURPOSE AND SCOPE*

This report is an interim response to the study authority. The study purpose of the Freeport DIGRR-EA is to determine what modifications to the authorized project are necessary to facilitate the safe and efficient navigation of Panamax vessels around the Dow Thumb and to and from the Velasco Container Terminal and whether those modifications are economically justified as a separable element. Additionally, an economic update of the 2012 Feasibility Report inclusive of the GRR modifications will be performed to determine whether the overall project as authorized is still in the Federal Interest.

1.4 NON-FEDERAL SPONSOR

The NFS is Port Freeport. Port Freeport is providing the environmental and most of the engineering products as Work-In-Kind (WIK) products.

1.5 STUDY AREA

The Freeport GRR study area is located on the middle Texas coast, bounded generally by the Brazos River on the west, Oyster Creek on the north and east, and the Gulf of Mexico on the south. The study area for the Freeport GRR will mirror the study area identified for the 2012 Feasibility Report (**Figure 1-1**), which was divided into four separable reaches (as shown in **Figure 1-2)** The 2012 FEIS provided NEPA compliance for the authorized project.

1.6 PROJECT AREA

The project area for this DIGRR-EA is a subset of the authorized project study area. It is located immediately south of the City of Freeport, in Brazoria County, Texas. This DIGRR-EA focuses on the area affected by the first segment of construction modifications proposed within Reaches 2 and 3. The Environmental Assessment (EA) for the Freeport DIGRR-EA will cover the impact areas of the TSP, which are outside the footprint of the 2012 Feasibility Report/FEIS and within the first segment of construction project area.

The following congressional representatives serve the project area: Senators John Cornyn and Ted Cruz, and Representative Randy Weber (District 14).

Figure 1-1 - Freeport GRR Study Area

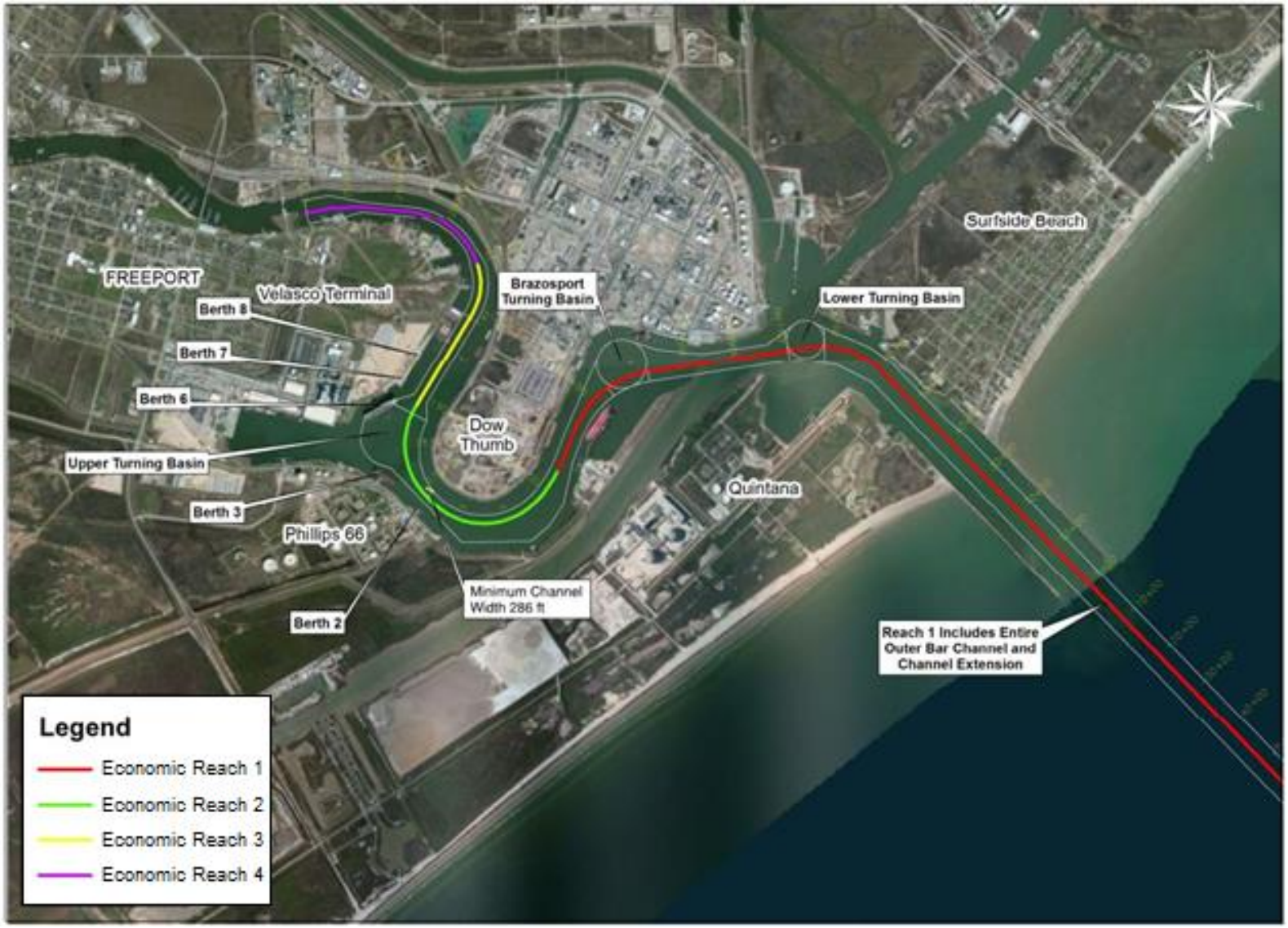

Figure 1-2 - Project Area (GRR Reach 2 and Reach 3)

1.7 VERTICAL DATUM INFORMATION

As per Engineering Technical Letter (ETL) 1110-2-349 *Requirements and Procedures for Referencing Coastal Navigation Project to Mean Lower Low Water Datum*, dated April 1, 1993, and Engineering Manual (EM) 1110-2-1003 *Hydrographic Surveying*, dated April 1, 2002, all elevations referred to in this report, unless specifically noted otherwise, are based on mean lower low water (MLLW) tidal datum. Previous publications on this project were released utilizing Galveston District's mean low tide (MLT) datum. A conversion of zero MLLW = 1 foot MLT (rounded to the nearest whole foot) has been applied (**Engineer Appendix Section 3.2**).

1.8 FUNDING SINCE AUTHORIZATION

Table 1-2 shows the funding history through September 30, 2016, for the Freeport Harbor, by fiscal year (FY) and category.

Table 1-2 – Funding Since Authorization *(through September 30, 2016)*

Fiscal Year	Investigations – RECON		Investigations – Feasibility		Investigations – GRR		Investigations – PED		Total Funding	
	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal
FY 2002	$46,000		$130,000	$					$176,000	$ -
FY 2003	$79,000		$406,900	$570,000					$485,900	$570,000
FY 2004			$418,000	$397,000					$418,000	$397,000
FY 2005			$495,000	$500,000					$495,000	$500,000
FY 2006			$500,000	$482,900					$500,000	$482,900
FY 2007			$709,000	$709,000					$709,000	$709,000
FY 2008			$382,000	$400,000					$382,000	$400,000
FY 2009			$574,000	$556,000					$574,000	$556,000
FY 2010			$248,000	$199,549					$248,549	$199,549
FY 2011			$248,549	$49,000					$412,000	$49,000
FY 2012			$412,000	$ -					$48,000	$ -
FY 2013			$48,000	$ -			$1,000	$ -	$1,000	$ -
FY 2014							$1,452,400	$ -	$1,452,400	$ -
FY 2015					$1,211,000		$(11,000)	$ -	$1,200,000	$ -
FY 2016									$ -	$ -
TOTAL	$125,000	$ -	$4,323,499	$3,863,449	$1,211,000	$ -	$1,442,400	$ -	$7,101,849	$3,863,449
	$125,000		**8,186,898**		**$1,211,000**		**$1,442,400**		**$10,965,298**	

1.9 HISTORY OF THE INVESTIGATION

1.9.1 2012 Feasibility Report

The 2012 Feasibility Report evaluated navigation and environmental problems and opportunities for a 70-square mile study area. The study area included the cities of Freeport, Surfside Beach and Quintana, the FHC, the Brazos River Diversion Channel, a portion of the Gulf Intracoastal

Waterway (GIWW), the Gulf of Mexico shoreline on both sides of the FHC, the offshore channel, and placement areas (PAs) 10 miles into the Gulf of Mexico. The entire study area was located within Brazoria County, Texas and adjacent state waters in the Gulf of Mexico.

The recommended navigation plan was not the National Economic Development (NED) plan. The recommended plan was a Locally Preferred Plan (LPP), which was shallower and less cost than the NED plan. The recommended plan met the requirements for a categorical exemption in accordance with Engineer Regulation (ER) 1105-2-100, Section 3-2.b.10. The LPP authorization recommended the following improvements referenced in MLLW datum:

- Deepen the Outer Bar Channel into the Gulf of Mexico to 58 feet;
- Deepen from the end of the Jetties in the Gulf of Mexico to the Lower Turning Basin to 56 feet;
- Deepen from the Lower Turning Basin to Station 132+66 near the Brazosport Turning Basin to 56 feet;
- Enlarge the Brazosport Turning Basin from 1,000 to 1,200 foot diameter;
- Deepen from Station 132+66, above the Brazosport Turning Basin, through the Upper Turning Basin to 51 feet;
- Deepen and widen the lower 3,700 feet of the Stauffer Channel to 51 feet and 300 feet wide;
- Dredge the remainder of the Stauffer Channel to 26 feet (previously authorized to 30 feet);

The dredged material management plan (DMMP) placement was developed during the feasibility study and documented in the 2012 Feasibility Report. Material from the Channel Extension, Outer Bar Channel and Jetty Channel was designated for offshore placement in the existing New Work and Maintenance Material Ocean Dredged Material Disposal Sites (ODMDS 1 and ODMDS 1A, respectively). Material from the inland FHC and basins would be placed in one existing confined upland PA (PA 1) and two new PAs (PA 8 and PA 9) to be constructed.

The following mitigation features were required as compensation for the impacts to fish and wildlife habitat from the future construction of the two new PAs:

- Preservation of approximately 131 acres of riparian forest under a permanent conservation easement and the improvement of its habitat value by establishing 11 acres of riparian forest in place of 11 acres of invasive tree species;
- The creation of three acres of wetlands and an associated one acre of riparian forest; and
- Required monitoring of mitigation performance and impacts to wetlands and riparian forest for corrective action, if needed.

1.9.2 Chief's Report and WRRDA 2014 Authorization – Project Costs

A Chief of Engineers Report was signed on January 7, 2013. A Record of Decision (ROD) was signed by the Assistant Secretary of the Army (Civil Works) or ASA (CW) on May 31, 2014. The Chief of Engineers Report recommended modification of the existing FHC that provides for a deep-draft waterway from the Gulf of Mexico to the City of Freeport through the original mouth of the Brazos River. A diversion dam about 7.5 miles above the original river mouth, and a diversion channel rerouting the Brazos River from the dam to an outlet into the Gulf about 6.5 miles southwest of the original mouth, now separate the FHC from the river system and make the harbor and channels a tidal system.

The 2012 Feasibility Report provides for a LPP (currently unconstructed) to modify the existing FHC. The Project First Cost breakdown based on the October 2012 price level is shown in **Table 1-3**.

Table 1-3 – Project First Cost from 2013 Chief's Report

Project Feature	Cost Share Percentages (Fed/NF)	Authorized Project First Cost per Jan 2013 Chief's Report *(Oct 2012 Price Level)*		
		Federal Share	Non-Federal Share	Total Project First Cost
Upper Stauffer - Shallow Draft	90/10 (18-20 feet) 75/25 (20-26 feet)	$2,782,000	$825,000	$3,607,000
Lower Stauffer – Shallow / Deep Draft	90/10 (18-20 feet) 75/25 (20-45 feet) 50/50 (over 45 feet)	$7,693,000	$3,176,000	$10,869,000
Freeport Harbor Channel	50/50 (over 45 feet)	$110,520,000	$110,520,000	$221,040,000
Mitigation	51.4/48.6 Prorated	$137,000	$130,000	$267,000
Lands & Damages	100% Non-Federal	$0	$1,691,000	$1,691,000
TOTALS		**$121,132,000**	**$116,342,000**	**$237,474,000**

Note: Does not include $58,881,000 in Associated Costs ($18,803,000 in NF berthing areas, $39,695,000 in NF bulkhead modifications, or $1,383,000 Aids to Navigation costs (USCG Federal cost)

The costs displayed in the Section 7002 of WRRDA 2014 authorized the Project for a total project first cost total cost of $239,300,000 at October 2013 price levels. The estimated Federal and non-Federal shares of the project first cost are $121,000,000 and $118,300,000, respectively, as apportioned in accordance with the cost sharing provisions of Section 101 (a) of the Water Resources Development Act (WRDA) of 1986, as amended (33 U.S.C. 2211(a)).

1.9.3 General Reevaluation Trigger

Shortly after the study was concluded, the Port and the pilots expressed concerns regarding the ability of the Panamax design vessel to reach the Velasco Container Terminal in Reach 3. The channel narrows around the Dow Thumb in Reach 2 (Figure 1-3) and the Panamax design vessel has issues safely transiting around the Dow Thumb to allow travel to and from the Velasco Container Terminal.

Figure 1-3 – Channel Constriction

In late 2014, Port Freeport approached the Corps and requested a reevaluation of the previous study to determine the appropriate modifications to achieve the intent and purpose of the congressionally authorized project. The sponsor specifically requested evaluation of the modifications to Reach 2, required to allow the Panamax design vessel to reach the Velasco Container Terminal in Reach 3, and the work required to a depth of 46 feet. The sponsor's intention is to construct the necessary modifications as a "first segment of construction" with the ultimate goal of constructing the authorized project depths.

Subsequent coordination with the Headquarters USACE (HQUSACE) resulted in a decision to proceed with a general reevaluation study to examine ship passage under different scenarios around Dow Thumb, and formulate and evaluate alternative plans to determine a modification to the 2012 Feasibility Report that would allow the Panamax design vessel to transit safely to and from the Velasco Container Terminal. Modifications were to be examined to evaluate impacts to the existing channel and to the existing HFPP, which includes features located adjacent to the channel. As necessary, the study would include an updated environmental review and hydrodynamic modeling and sediment sampling. A cost-benefit analysis of the recommended channel modifications would be conducted to determine whether the modifications are in the Federal Interest.

Additionally, an economic update must also be conducted on the project as a whole (2012 Feasibility Report and GRR modifications) to determine whether the project authorized under WRRDA 2014 is still in the Federal interest.

1.9.4 USACE Ship Simulations for 2012 Feasibility Study

Per the 2012 Feasibility Report Engineer Appendix, multiple ship simulations were conducted for the study. **Table 1-4** provides the ships that were modeled in the ship simulations.

Table 1-4 – Vessels Used in USACE Ship Simulations[1] for 2012 Feasibility Study

Name	Type	Beam	LOA	Draft	Simulation (Year)
		(feet)			
Susan Maersk[2]	Containership	140	1140	47	2005
165k LNG Tanker	LNG Tanker	156	990	58	2005
VLCC	Crude Tanker	195	1120	58	2005
NA[3]	Containership	106	915	46	2007
VLCC	Crude Tanker	195	1087	44	2010
Tanker	Crude Tanker	164	922	48	2010

[1]This table was constructed from available records; however, not all records were available.

[2] Post Panamax Vessel Class

[3] Vessel dimensions provided by ERDC/CHL

LOA=Length Overall, LNG=Liquefied Natural Gas, VLCC=Very Large Crude Carrier

Five channel alignments were initially evaluated in 2005, and then a revised plan was evaluated with a smaller container ship in 2007. In 2010, final runs to evaluate the Brazos Turning Basin were completed. The simulations in 2005 and 2007 showed the Post Panamax vessels could not navigate the channel but an assumption was made that Panamax and Sub Panamax could safely navigate the channel. The assumption; however, was not verified through a ship simulation during that feasibility study.

1.9.5 Implications of Widening Around the Dow Thumb

It was realized early in the study that widening at the Thumb would likely have an impact on portions of two HFPP features located in the study area. Additionally, another study, the Sabine to Galveston study (S2G), has been involved in evaluating alternatives in the study area and is approaching finalization. The PDTs for both studies have coordinated throughout this study.

1.9.5.1 Existing Hurricane Flood Protection Project Infrastructure

One of the requirements of the GRR study is to examine any impacts the modifications to the authorized project may have on the HFPP. **Figure 1-4** provides an overview of the aerial extent of the HFPP features. The circle within the bottom right quadrant shows the location of the Dow Thumb and study area for this DIGRR-EA. Note the circle does not include the full 2012 Feasibility Report/FEIS project area.

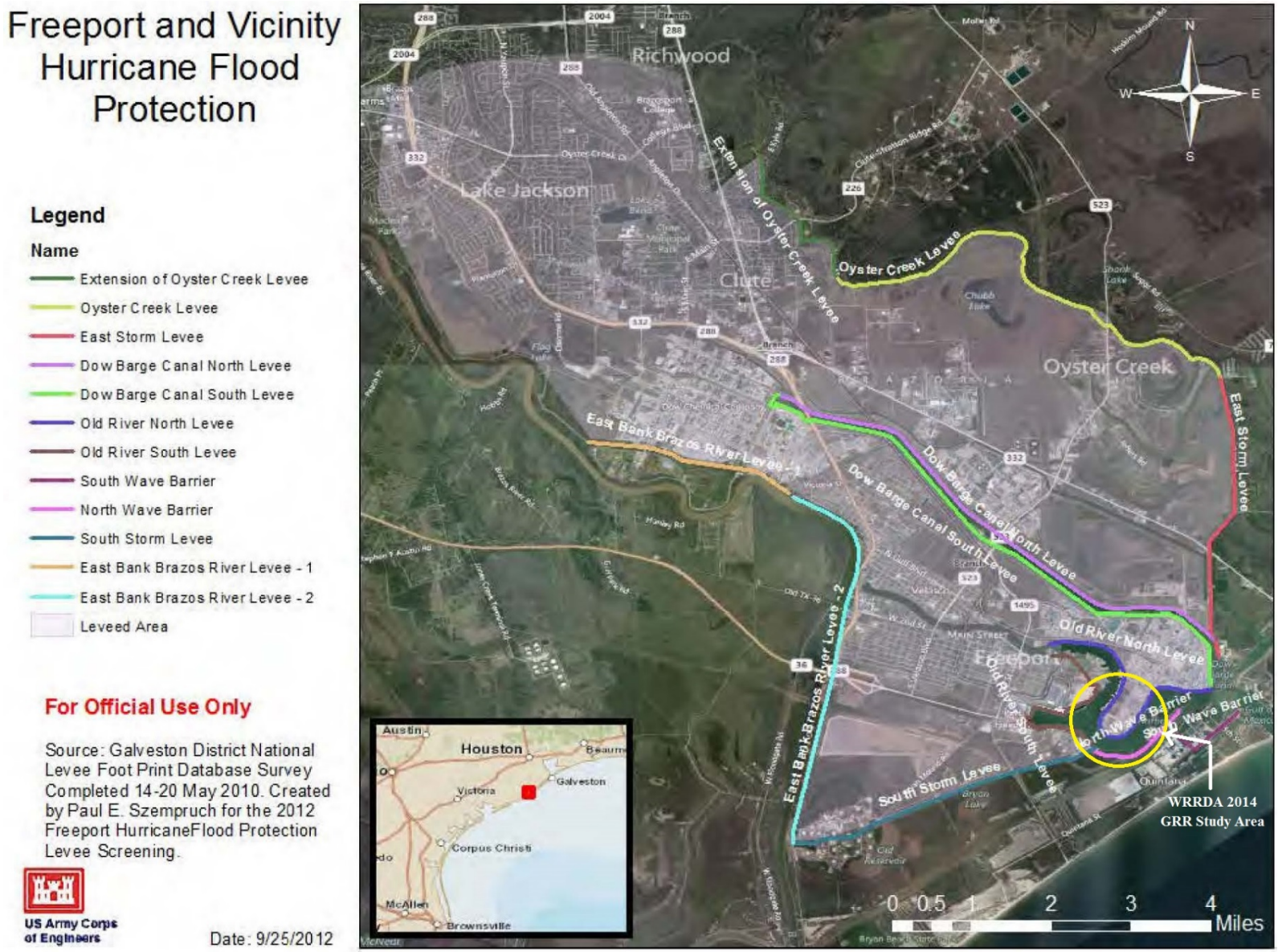

Figure 1-4 - HFPP Features within the GRR Study Area

1.10 PRIOR STUDIES, REPORTS, AND EXISTING WATER PROJECTS

See **Table 1-1**, presented earlier in this document for a complete list of Freeport Harbor, Texas work and authorizations.

Rivers and Harbors Act (RHA) of 1880 authorized the original project to construct jetties for controlling and improving the channel over the bar at the mouth of the Brazos River. Work was conducted from 1881-1886, then operations were suspended for lack of funds.

RHA of 1888 authorized the Brazos River Channel and Dock Company to provide a navigation channel at the mouth of Brazos River and thence inland between the banks of river. The company was unable to finance completion of the work.

RHA of 1899 transferred works, rights, and privileges for the project to the United States (U.S.). This constituted the initial authorization for the existing Freeport Harbor. Numerous authorizations have since been enacted but the majority of the changes have occurred since the 1950s.

RHA of 1925 (R&H Committee Doc. 10, 68th Cong., 2nd Session) authorized the construction of a diversion dam approximately 7.5 miles above the original river mouth and a diversion channel rerouting the Brazos River from the dam to an outlet in the Gulf about 6.5 miles southwest of the original mouth. Since this reroute, Freeport Harbor no longer receives freshwater input from the Brazos River, resulting in a tidal FHC.

RHA of 1950 (H. Doc. 195 81st Cong., 1st Session) deepened the outer bar channel to 38 feet, and 36 feet in the authorized channels to and including the Upper Turning Basin.

RHA of 1958 (H. Doc. 433, 84th Cong., 2nd Session) relocated the outer bar channel on a straight alignment with the jetty channel, and maintained the Brazos Harbor entrance channel and turning basin (constructed by local interests).

The FCA of 1962 (H. Doc. 495, 8th Cong.) authorized the Freeport Hurricane Flood Protection Project (Freeport HFPP) for Freeport and Vicinity, Texas, under P.L. 87-874. The HFPP (shown previously in Figure 1-4) provided for construction of improvements at Freeport and Vicinity, Texas for risk management against storm tides caused by tropical cyclones/hurricanes along the Gulf Coast of magnitudes up to and including the standard project hurricane. The HFPP consists of approximately 43 miles of levees and wave barriers and related pump stations, gates, and culverts. Many of the existing features that were determined to have an effect on the FHC

system were adopted into the HFPP Federal project as is. Portions of two of those HFPP features are located within the GRR project area (Figure 1-5).

The Old River North Levee is the first of those features and is shown in the figure with a purple line. The levee follows along the perimeter of the channel; however, within Reach 2 of the project area, the north slope of the channel is the toe and underwater berm of the Old River North Levee. This underwater berm provides slope stability to the levee in the area of the Dow Thumb. The second feature, in the GRR project area, shown with a pink line, is the North Wave Barrier located across the channel from the Dow Thumb.

Figure 1-5 – HFPP & GRR Study Area

RHA of 1970 (P.L. 91-611; 84 Stat.1818) authorized the Freeport Harbor Project commonly referred to as the "45-Foot Project" (at mean low tide or MLT). The project, which generally deepened and widened the 1950's project, was completed in 1993. The *Freeport Harbor, Texas (45-foot Project), Final Environmental Statement*, was prepared by the USACE in 1978. Text in the Report of the Board of Engineers described the channel in Reach 2 of the GRR study area as "generally 350-375" feet wide. The channel in Reach 2 was reduced from the 1958 RHA authorization due to an approximately 75-foot shift of the channel away from the underwater berm of the HFPP. This shift was conducted to protect the underwater berm at the base of the Old River North Levee for stabilization. The area around the Dow Thumb where the channel was shifted away from the underwater berm is shown as "deauthorized" in a diagram from the House Document used in the 1970 RHA **(Figure 1-6)**.

Two General Design Memorandums (GDM) were prepared for the existing 45-Foot Project, titled *Freeport Harbor, Texas General Design Memorandums No. 1, Phase I and Phase II*, dated 1978, and 1979, respectively. These GDMs provided the basis for preparation of all the dredging and construction plans and specifications for the authorized project. The GDM for Phase II presented additional concerns based on geotechnical data that was collected. The USACE determined the channel needed to be shifted yet further away (i.e. 90 feet) from the underwater berm. This provided stability to the existing HFPP levee foundation around the Dow Thumb and helped provide an appropriate factor of safety (FOS) resulting in a channel in the Dow Thumb area measuring 285 feet wide. Plans and Specs were prepared for the 45-Foot Project in 1991 showing the channel in its current constructed condition of 285 feet and 279 feet widths in the constricted area of the channel at Dow Thumb. A cutout of the section from the 1991 Plans and Specs is provided in **Figure 1-7**.

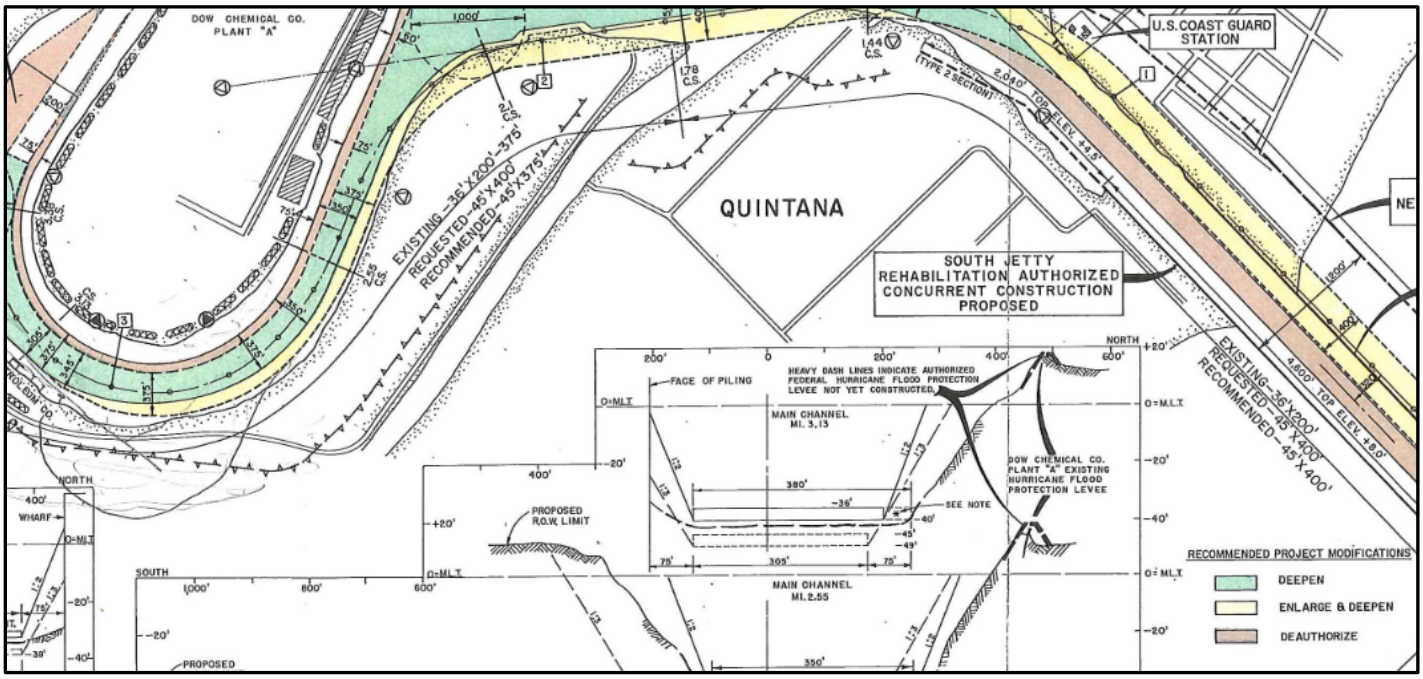

Figure 1-6 - RHA House Document Cutout - "Deauthorized" (Brown) Channel around HFPP Levee

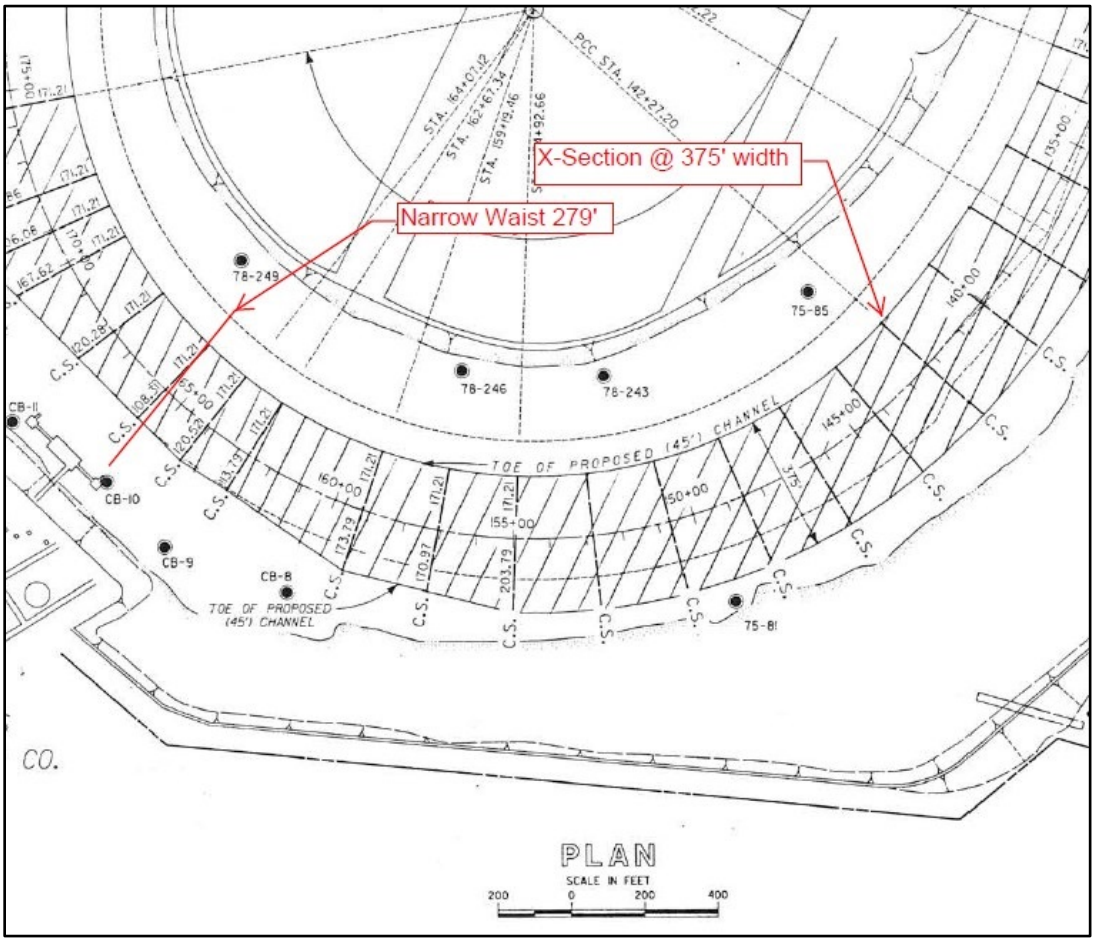

Figure 1-7 - Cutout of Channel from 1991 Plans & Specs for 45—Foot Project

Prior to the completion of the 45-Foot Project, the Brazos Pilots cited issues with negotiating the bends of the inner harbor. A ship simulation was conducted and the results demonstrated a need to widen the channel at three new locations to ensure safe navigation of vessels. Two of these widenings were located on each side of the channel in Reach 1, to ease the immediate approach to the Lower Turning Basin. The third location was within the GRR project area on the south side of Reach 2.

In 1997, the Galveston District issued a decision document determining the channel work, as recommended by the ship simulation, was "within the original authority for the construction of the project."

The *Freeport Harbor, Texas (45-Foot Project) Channel Widening to Correct Navigation Problems, Brazoria County, Texas, Environmental Assessment (*1997 EA*)* described the adjustment as:

> "*…dredging an average of about 200-foot wide strip on the south side of the main channel from Station 134+00 to Station 164+00. The dredged materials from the proposed channel work will be discharged in an existing upland confined placement area (PA) No. 1 located south of State Highway 288 and east of the Brazos River Diversion Channel. The proposed work will also require the relocation of about 2,000 feet of an existing upland earthen wave barrier."*

The wave barrier that was moved was the western end of the HFPP North Wave Barrier that is situated in the GRR Study Area.

The FHC is currently maintained at the 1970 authorized depths shown in **Table 1-5**. The channel in Reach 2 is generally 350-375 feet wide except for the constrained "waist" in the area of the Dow Thumb, which is currently 279 feet wide (caused by the shifting of the channel away from the HFPP underwater berm). The segment referred to as the Lower Stauffer Channel was never deepened or dredged for the 45-Foot Project. This segment was de-authorized in 1974 under Section 12 of WRDA 1974 (P.L. 93-251). Lower Stauffer Channel currently has a depth of approximately 19-feet MLLW.

Table 1-5 – 45 Foot Project Authorized Depths and Widths (RHA 1970)

Channel Segment	Depth (MLLW)[1]	Width (Feet)
Outer Bar Channel		
Outer Bar Channel	48	400
Jetty Channel	46	400
Lower Turning Basin	46	750
Main Channel		
Channel to Brazosport Turning Basin	46	400
Brazosport Turning Basin	46	1,000
Channel to Upper Turning Basin	46	Generally 350-375[2]
Upper Turning Basin	46	1,200
Brazos Harbor		
Channel to Brazos Harbor	37	200
Brazos Harbor Turning Basin	37	750
Stauffer Channel		
Channel to Stauffer Turning Basin	Deauthorized	
Stauffer Turning Basin	Deauthorized	

[1] *Does not include advance maintenance or allowable overdepth.*
[2] *Two GDMs subsequent to the 45-Foot project authorization (1970 RHA) resulted in shifting the channel in the area of the Dow Thumb to protect an underwater berm and thus the stability of the HFPP levee factor of safety. This resulted in a constriction of the channel measuring approximately 279 feet wide at the waist of the Dow Thumb.*

WRRDA 2014 authorized the recommended plan from the 2012 Feasibility Report. The recommended navigation plan was the LPP, which was shallower and less costly than the NED plan. A Chief of Engineers Report was signed on January 7, 2013, and the ROD was signed by the ASA (CW) on May 31, 2014. The depths and widths of the plan authorized by WRRDA 2014 are presented in **Table 1-6**. The proposed deepening and widening required a Dredged Material Management Plan (DMMP), which included two new PA sites (PA 8 and PA 9) as well as offshore sites. For orientation purposes, the channel segments involved in this GRR evaluation for modifications are highlighted in the table.

The project authorized under WRRDA 2014 has not yet been constructed. Except for the widening of the Outer Bar Channel and Jetty Channel conducted by Port Freeport under DA Regulatory Permit SWG-2004-02311, the existing condition matches the dimensions of the 45-Foot Project authorized to 45-feet MLT (46-feet MLLW).

Table 1-6 –2012 Feasibility Report Authorized Depths & Widths (Unconstructed)

Channel Segment	Depth (MLLW)	Width (Feet)
Outer Bar Channel		
(NEW) Future Channel Extension[1]	58	600
Outer Bar Channel	58	600[2]
Jetty Channel	56	600[2]
Lower Turning Basin	56	Existing (750)
Main Channel		
Channel to Brazosport Turning Basin	56	Existing (400)
(NEW) Brazosport Turning Basin	56	1,200
Channel to Upper Turning Basin	51	Existing (generally 350-375)[3]
Upper Turning Basin	51	Existing (1,200)
Brazos Harbor (No Proposed Change)		
Channel to Brazos Harbor	N/A	N/A
Brazos Harbor Turning Basin	N/A	N/A
Stauffer Channel (Modified)		
Channel to Stauffer Turning Basin	51	300
Stauffer Turning Basin	26	200

[1] Not surveyed or constructed. Extension authorized from end of Outer Bar Channel to the -58 MLLW Contour.
[2] Widened from 400 to 600 feet per DA Regulatory Permit (SWG-2004-02311) by Port Freeport (not deepened).
[3] Channel is constrained to a width of approximately 279-feet at the waist of the Dow Thumb.

Sabine Pass to Galveston Bay Study (S2G) is developing recommendations to reduce the risk of coastal storm surge impacts in this study area. The S2G is proposing to modify the Old River North Levee, which is located in the GRR project area. Proposed modifications to the HFPP levee would be configured to ensure there is no reduction in the existing FOS. The Final Feasibility Report is scheduled for completion in August 2017.

Phillips 66 Berth 2 improvements were authorized under Department of the Army (DA) Permit SWG-2014-00116, issued to the Phillips 66 Company on December 23, 2014, under purview of Section 10 of the RHA of 1899 (33 U.S.C 403) and Section 404 of the Clean Water Act (33 U.S.C 1344). The DA Permit authorized the modification of the Phillips 66 (Phillips) Berth 2 as part of overall construction efforts by Phillips in the general area of the "waist" near the Dow Thumb. The stated purpose of the work was to increase production of Export Grade Liquid Petroleum Gas (LPG) to worldwide markets. This included upgrades to the terminal and dock facilities.

2 EXISTING CONDITIONS*

2.1 GENERAL

The FHC provides for deep-water access from the Gulf of Mexico to Port Freeport. **Table 2-1** presents the existing dimensions of the channels. The project authorized under WRRDA 2014 has not yet been constructed. Except for widening of the Outer Bar Channel and Jetty Channel conducted by Port Freeport, the existing condition matches the dimensions of the 45-Foot Project authorized to 45-feet MLT (46-feet MLLW). As addressed previously in **Section 1.7**, the FHC MLLW datum value is plus one foot above MLT. The Galveston District recently converted the FHC to the MLLW datum, and all dredging contracts now use the MLLW datum.

Table 2-1 – Existing Condition (Depths and Widths) of Freeport Harbor Channel

Channel Segment	Beginning Seaward		Depth (MLLW) feet	Bottom Width (feet)	Advance Maintenance (feet)	Allowable Overdepth (feet)
	Station Start	Station End				
Outer Bar Channel						
Future Channel Extension	Natural Bay Bottom	-300+00	Not surveyed or constructed. Extension is authorized from end of Outer Bar Channel to the -58 MLLW Contour.			
Outer Bar Channel	-300+00	0+00	48	600[1]	2	2
Jetty Channel	0+00	71+52	48	600[1]	2	2
Lower Turning Basin	71+522[3]	78+52[2]	46	750	2	2
Main Channel						
Channel to Brazosport Turning Basin	78+52	107+50	46	400-600	2	1
Brazosport Turning Basin	107+50[2]	115+00[2]	46	1,000	2	1
Channel from Brazosport Turning Basin	115+00	132+66	46	Generally 350-375	2	1
Channel to Upper Turning Basin	132+66	174+00	46	Generally 350-375	2	1
Upper Turning Basin	174+00	184+20	46	1,200	2	1
Brazos Harbor						
Brazos Harbor Approach Channel	28+00	20+00	37	200	-	-
Brazos Harbor Turning Basin	20+00	0+00	37	750	-	-
Stauffer Channel[3]						
Stauffer Channel, Lower Reach	184+20	222+00	19	200	2	1
Stauffer Channel, Upper Reach	222+00	255+00	19	200	2	1
Stauffer Turning Basin	255+00	260+00	19	500	2	1

[1] Widened only, per Department of the Army Regulatory Permit (SWG-2004-02311) by Port Freeport.
[2] Stations on Turning Basin indicate where the channel enters and exits from Turning Basin; channel does not necessarily enter or exit at the center of the Turning Basin.
[3] Stauffer Channel was Deauthorized under the 45-Foot Project and Reauthorized and Modified under the WRRDA 2014.

The existing FHC dredged material PAs are shown in **Figure 2-1**. PA 1 was constructed in 1990 and modified in 1997. It is located approximately 0.5 mile south of State Highway (SH) 36, and approximately 1,000 feet east of the Brazos River Diversion Channel. PA 1 is approximately 320 acres with a perimeter of approximately 20,310 linear feet. The existing ground elevation is approximately 21 feet NAVD 88 (North American Vertical Datum of 1988) with a dike height of 25 feet NAVD 88. Currently, PA 1 has an existing capacity of approximately 0.8 million cubic yards (MCY).

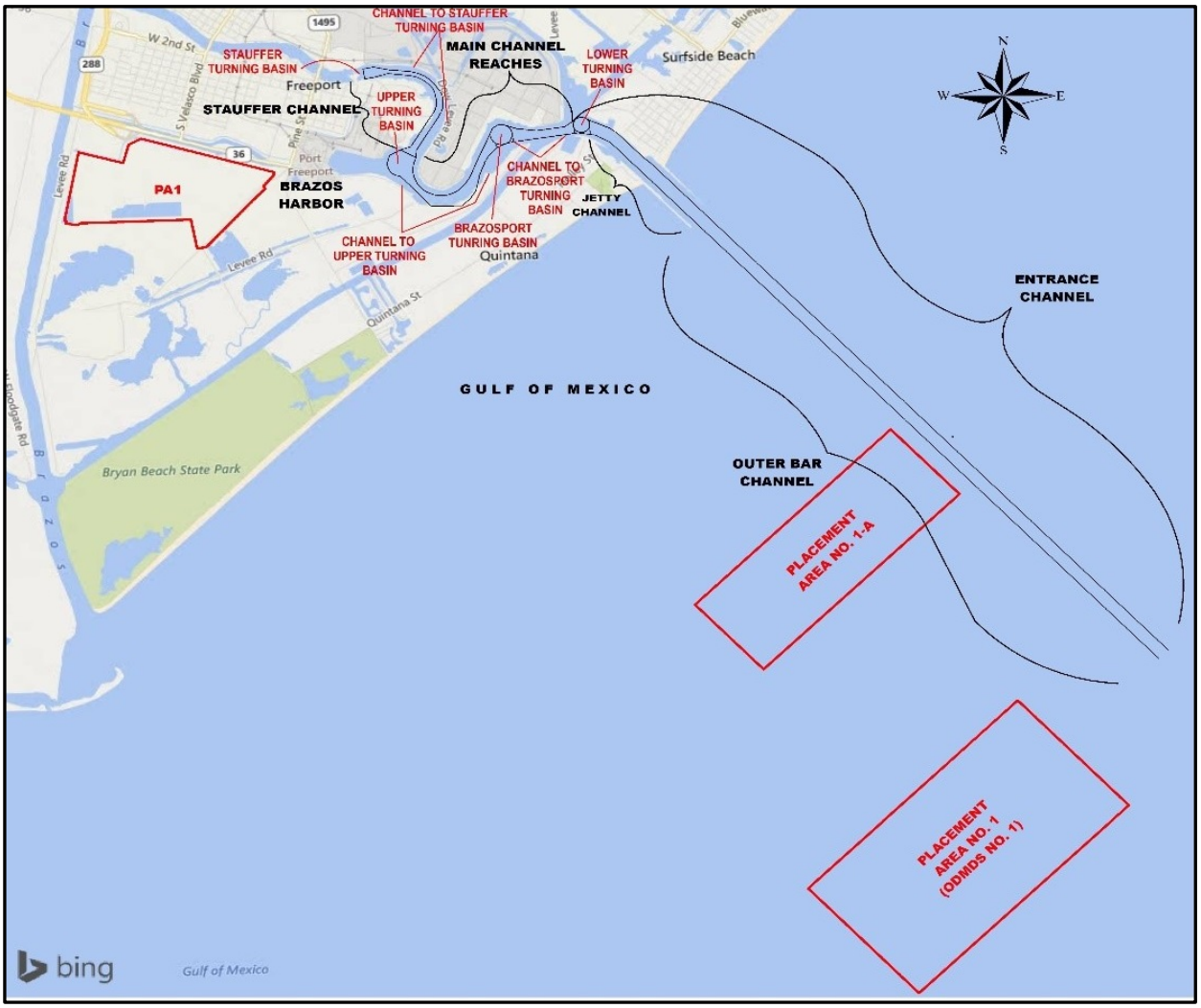

Figure 2-1. Dredged Material Placement Areas at Freeport Harbor

Two ocean disposal sites located in the Gulf of Mexico exist for offshore placement. Both ODMDS sites are located in a dispersive offshore environment and assumed to have unlimited capacity due to longshore drift processes. The New Work ODMDS 1 is designed for an approximately 2,236-acre bottom area and is located approximately 5.5 miles southwest from the mouth of the Jetty Channel and approximately six miles from shore. The Maintenance ODMDS 1A is designed for an approximately 1,129-acre bottom area and is located approximately 2.5

miles southwest from the mouth of the Jetty Channel and approximately 3 miles from shore. A recent U.S. Environmental Protection Agency (EPA) change to the ODMDS designation allows maintenance material from the entire vicinity of the FHC to be placed offshore into the ODMDS 1A. This is the current Operations and Maintenance (O&M) practice for the FHC and the assumption for this study is that the current O&M practice of the ODMDS 1A placement for all FHC maintenance material would continue in the future.

The currently authorized depth of the FHC does not allow fully loaded larger vessels to traverse the waterway so many vessels currently have to be light-loaded. To complete a lightering operation, large crude carriers remain offshore and transfer their cargo into smaller crude tankers, which transport the product for the remainder of the voyage.

2.2 PHYSICAL DESCRIPTION OF THE EXISTING PROJECT

One of the earlier ports on the Texas coast, Freeport Harbor was developed at the mouth of the Brazos River. The river was later diverted to an outlet in the Gulf of Mexico to the west of the original mouth, resulting in a ship channel that received no direct input from the Brazos River. Prior to development of the port, the area was comprised of habitats typical of the central Texas coast including coastal marsh and tidal flats, coastal prairie, tidal creeks and riparian habitats.

2.2.1 Tides

The FHC, which is formed from the natural outlet of the Brazos River, follows a winding course to the southeast before connecting to the GIWW and the Gulf of Mexico. The FHC receives no input from the Brazos River or any other major waterways. The mean tide range at National Oceanic and Atmospheric Administration (NOAA) Station 8772447 in Freeport, Texas is 1.39 feet, and the diurnal range is 1.8 feet (NOAA, 2016a).

2.2.2 Currents and Circulation

Offshore in the Gulf of Mexico, the dominant wave direction is from the southeast, producing currents flowing north, and transporting sediment northward. The largest waves tend to propagate from the north-northeast and southeast, representative of strong frontal passages and tropical storms, respectively. Large waves from the north can cause significant southerly transport of sediments, though the short duration and infrequent occurrence results in less cumulative influence than the predominant northward current. Circulation in the Jetty Channel is driven by both tidal and meteorological forces. Tidal flow passes through the Jetty Channel then flows northeast and southwest into the GIWW at the Lower Turning Basin, and northwest into the Main Channel. Tidal exchange within the FHC is limited because it is a dead-end channel with no connection to the Brazos River or other major waterways.

2.2.3 Relative Sea Level Rise

Relative Sea Level Rise (RSLR) was calculated for the 50-year period of analysis starting in year 2020 as the sum of average global sea level rise, vertical land movement, and regional basin trends utilizing USACE curves. The sea level rise analysis revealed a 50-year RSLR of between 0.71 feet assuming the USACE Low curve, 1.18 feet assuming the USACE Intermediate curve, and 2.68 feet assuming the USACE High curve. To maintain consistency with previous USACE studies in the region, a 50-year RSLR value of 1.18 feet was selected for this study based on the USACE Intermediate curve (**Engineering Appendix, Section 6.3**).

2.3 ENVIRONMENTAL AND HISTORIC RESOURCES

2.3.1 Description of the Ecological Region

The study area is in the Texas Gulf Prairies and Marshes ecological region (Gould, 1975). "This region is a nearly level, slowly drained plain less than 150 feet in elevation, dissected by streams and rivers flowing into the Gulf of Mexico. Soils are acidic sands and sandy loams, with clays occurring primarily in the river bottoms." Native vegetation in this region once consisted of tallgrass prairies and some post oak savannah woodlands; however, almost all of the region's historic native coastal tall grass prairie and its associated prairie wetlands have been lost through conversion to agricultural uses and urban development (USFWS, 2008). Although tall grass prairies, dominated by big blue stem (*Andropogon gerardi*), sea coast bluestem (*Andropogon littoralis*), indiangrass (*Sorghastrum nutans*), eastern gamagrass (*Tripsacum dactyloides*), gulf muhlly (*Muhlenbergia capillaris*) and some *Panicum* species, still exist; today, most have been invaded by trees, brush and introduced grasses (Native Prairies Association of Texas [NPTA], 2016). Common examples of invading trees and brush include mesquite (*Prosopis glandulosa*), live oaks (*Quercus virginiana*), prickly pear (*Opuntia ficus-indica*) and *Acacias*. Non-native grasses such as Bermuda and carpet grass that are common in pastures have germinated in nearby uncultivated land. Barrier islands, estuaries, and marshes line the coast in this region. Coastal prairies and marshes are typically dominated by Amaranth (*Amaranthaceae)* and Goosefoot (*Chenopodiaceae*). Native wetland species such as sedges (*Carex* sp. and *Cyperus* sp.), spikerush *(Eleocharis* sp.), rushes *(Juncus* sp. and *Scirpus* sp.), several cordgrasses (*Spartina spp.*), and seashore saltgrass (*Distichlis spicata*) are found in the salt marshes. Although much of the native habitat has been lost to agriculture and urbanization the region still provides important habitat for migratory birds and spawning areas for fish and shrimp" (Texas Parks and Wildlife Department [TPWD], 2016c).

2.3.2 Protected/Managed Lands in the Study Area

Federal refuges, a state managed area, and local sanctuaries are located partially within or near the study area. Federal refuges include the Brazoria National Wildlife Refuge and the San Bernard Wildlife Refuge. The Justin Hurst State Wildlife Management Area is located about five miles west of Freeport. Local sanctuaries that are located within or near the study area include the Neotropical Bird Sanctuary, and the Xeriscape Park. Both sanctuaries are administered by the town of Quintana.

2.3.3 Physical and Hydrological Characteristics of the Study Area

The study area is located along the central Texas coast situated between the Matagorda and Galveston Bay systems. FHC is a dead end channel without input from the Brazos River or other major waterways so water exchange occurs primarily at the intersection of the FHC and the GIWW and the main outlet into the Gulf of Mexico. Salinity in the FHC is measured at Station 11498, Old Brazos River Channel. With little watershed area and freshwater inflow, the average salinity at the station is almost the same as the coastal waters. The minimum salinity is over 18 parts per thousand (ppt) and the average is over 26 ppt (Texas Commission on Environmental Quality [TCEQ], 2016).

The study area is located within the Upper Coast division (Hatch et al., 1999) of the Gulf Coast Prairies and Marshes Ecoregion (Gould, 1975). This ecoregion is a nearly level plain less than 250 feet in elevation, covering approximately 10 million acres. The Gulf Coast Prairies include the coastal plain that extends approximately 30 to 80 miles inland, while the Gulf Marshes are located in a narrow strip of lowlands adjacent to the coast and barrier islands (Hatch et al., 1999). The study area is characterized as Quaternary (Recent and Holocene) Alluvium containing thick deposits of clay, silt, sand, and gravel, overlying the Pleistocene-aged Beaumont Formation. These formations consist mainly of stream channel, point bar, natural levee, and back-swamp deposits associated with former and current river channels and bayous. The Alluvium outcrops approximately 70 to 90 miles wide paralleling the Texas coastline. Beneath the surface deposits lies the Beaumont Formation, a massive and complex alluvial deposit of clay, silt, sand, and gravel deposited during the Pleistocene and estimated to be less than 1,000 feet thick. Offshore, the Beaumont Formation lies beneath a thin mantle of sand and extends as far as the continental shelf, with thicknesses ranging from 450 to 900 feet (Texas Water Development Board, 1990).

The climate of the Freeport area is humid subtropical with warm to hot summers and mild winters. The dominant air mass in summer is marine tropical; occasional showers or thunderstorms are common during this season. Winters are mild with considerable day-to-day variation. Periods of freezing temperatures are infrequent and usually last no longer than 2 or 3 days.

Rainfall averages about 43 inches annually at Freeport. The annual rainfall distribution is greater for the early summer and fall periods and least for the winter and late summer. Two principal wind regimes dominate the area and include persistent southeasterly winds occurring from March through November and strong, short-lived northerly winds from December through February. Severe weather occurs periodically in the area in the form of thunderstorms, tornadoes, and tropical storms or hurricanes.

2.3.4 Biological Communities in the Study Area

The following describes biological communities and wildlife habitat occurring in the placement areas, uplands, open water, and wetlands in the study area.

2.3.4.1 Placement Areas

Based on aerial interpretation, the areas designated as inland PAs are characterized as disturbed developed land with pockets of open water, shrubs, and herbaceous species that thrive in disturbed areas. PA 1 has been used for placement and as a result, it consists of several large unvegetated areas containing dredged material. PAs are not considered high-quality wildlife habitat due to recurring disturbance and lack of established native vegetation. The sparse vegetation in PAs consists mainly of opportunistic species that thrive on disturbed soils. The vegetation in PAs does not contribute significantly as a food or detritus source or as scrub habitat because it is physically and hydrologically isolated from the surrounding habitat by containment dikes. Fast growing species such as sea oxeye daisy (*Borrichia frutescens*), saltwart (S*alicornia bigelovii* and *Batis maritima*), Carolina wolfberry (*Lycium carolinianum*), false willow (*Baccharis halimifolia*), and narrow leaf marsh elder (*Iva angustifolia*) can be found in these PAs.

2.3.4.2 Terrestrial

Terrestrial uplands include developed areas, dunes and relict beach ridges, grasslands, and woodlands. The uplands found in the project area are primarily developed areas; however, dunes and relict beach ridges, grasslands, and woodlands are found within the study area.

Developed areas include the PAs described above, industrial development, residential development, transportation development (roads/railroads), and utility development (power lines/pipelines). There are industrial developments such as the Dow and Phillips refineries adjacent to the project area.

Coastal dunes are mounds or ridges associated with barrier islands and beaches that are formed from sands that are transported and deposited by the wind and the Gulf longshore current. Sand and coastal dunes are found outside the project area in Quintana Beach near the mouth of

Freeport Channel at the jetty. Typical plant species of the primary dunes in the broader study area include sea oats (*Uniola paniculata*), bitter panicum (*Panicum amarum*), Gulf croton (*Croton punctatus*), beach morning glory (*Ipomea pes-caprae*), and fiddleleaf morning glory (*Ipomea stolonifera*). Secondary dune species include marshhay cordgrass (*Spartina patens*), seashore dropseed *(Sporobolus virginicus*), seacoast bluestem (*Schizachirium littorale*), seashore saltgrass (*Distichlis spicata*), pennywort (*Hydrocotyle bonariensis*), and partridge pea (*Chamaecrista fasciculata*). The secondary dune community, which is located in the hummocky area leeward of the higher and drier primary dunes, is often a wetland community or considered a transitional community between upland and wetland.

Based on aerial interpretation there appears to be shrub/scrub vegetation outside the project area south of PA 1 and around nearby Bryan Lake. Typical forest and shrub/scrub vegetation that may occur in the study area include sugar hackberry (*Celtis laevigata*), cedar elm (*Ulmus crassifolia*), Chinese tallow (*Sapium sebiferum*), toothache tree (*Zanthoxylem clava-herculis*), pecan (*Carya illinoinensis*), mulberry (*Morus rubra*), honey locust (*Gleditsia aquatica*), gum bumelia (*Sideroxylon lanuginosum*), Jerusalem tree (*Parkinsonia aculeata*), yaupon holly (*Ilex vomitoria*), saw palmetto (*Serenoa repens*), Macartney rose (*Rosa bracteata*), trumpet creeper (*Campsis radicans*), poison ivy (*Toxicodendron radicans*), and sumpweed (*Iva* sp.).

There are only small areas within the study area with upland grassland vegetation such as along roadways, inland of sand dunes in Quintana, and along electrical transmission corridors. Upland grassland vegetation that may occur in the study area likely supports a mix of introduced pasture grasses such as bermudagrass (*Cynodon dactylon*) and bahiagrass (*Paspalum notatum*) and native species. These native species, remnants of the original coastal prairie, likely form only a small percentage of the upland grassland. They include little bluestem *(Schizachyrium scoparium*), brownseed paspalum (*Paspalum plicatulum*), Indiangrass (*Sorghastrum nutans*), rosettegrass (*Panicum oligosanthes*), and thin paspalum (*Paspalum setaceum*).

These upland areas may provide habitat for mammals such as the Virginia opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridanus*), hispid cotton rat (*Sigmodon hispidus*), northern raccoon (*Procyon lotor*), and coyote (*Canis latrans*), and reptiles such as the eastern six-lined racerunner (*Aspidoscelis sexlineata sexlineata*), little brown skink (*Scincella lateralis*), and western diamond-backed rattlesnake (*Crotalus atrox*). According to the Texas Parks and Wildlife Diversity Database (TPWD, 2016b), there are no recent records of rookeries or other animal assemblages in the project area.

2.3.4.3 Aquatic

Coastal wetlands (saline to freshwater) are distinct areas between terrestrial and aquatic systems where the water table is at or near the surface, or the land is covered by shallow water with

emergent vegetation. They are important natural resources that provide habitat for fish, shellfish, and other wildlife. Both estuarine and freshwater (palustrine) habitats occur in the study area. Estuarine areas include the open water channel within the project area and freshwater habitats occurring behind the HFPP levees. These are described briefly below; more detail can be found in the 2012 FEIS.

Estuarine and freshwater wetlands, tidal flats, and beaches provide habitat for a wide variety of bird species, including wading birds such as the great blue heron (*Ardea herodias*), great egret (*Ardea alba*), roseate spoonbill (*Platalea ajaja*), and black-necked stilt (*Himantopus mexicanus*); shorebirds such as the sanderling (*Calidris alba*), least sandpiper (*Calidris minutilla*), dunlin (*Calidris alpina*), and willet (*Catoptrophorus semipalmatus*); and gulls and terns such as the laughing gull (*Larus atricilla*), ring-billed gull (*Larus delawarensis*), Forster's tern (*Sterna forsteri*), and royal tern (*Sterna maxima*); and migratory waterfowl such as the northern shoveler (*Anas clypeata*), gadwall (*Anas strepera*), and green-winged teal (*Anas crecca*). Several colonial waterbird rookeries are known to occur in and near the project area. Tidal flats also provide habitat for the piping plover (*Charadrius melodus*) and red knot (*Calidris canutus rufa*), both federally listed as threatened.

Apart from avian species, wetlands also provide habitat for amphibians such as Blanchard's cricket frog (Acris blanchardi), American bullfrog (Lithobates catesbeianus) and southern leopard frog (Lithobates sphenocephalus), reptiles such as the western cottonmouth (*Agkistrodon piscivorus leucostoma*) and Gulf saltmarsh watersnake (*Nerodia clarkii clarkii*), and mammals such as the marsh rice rat (*Oryzomys palustris*).

Open water in the study area, as well as some of the wetlands, provide habitat for aquatic communities. In general, fish species found mainly in shallow areas include the Gulf killifish (Fundulus grandis), sheepshead minnow (Cyprinodon variegatus), and silversides (*Menidia spp.*). Inhabitants of marsh areas include the pinfish (*Lagodon rhomboides*), silver perch (*Bairdiella chrysoura*), and gizzard shad (*Dorosoma cepedianum*). Species often found in deeper areas include the Atlantic croaker (*Micropogonias undulatus*), Gulf menhaden (*Brevoortia patronus*), and hardhead catfish (*Arius felis*), while a number of fish are abundant in both marsh and deeper areas, including bay anchovy (*Anchoa mitchilli*), spot (*Leiostomus xanthurus*), and striped mullet (*Mugil cephalus*) (Pattillo et al., 1997).

2.3.4.3.1 Estuarine Habitats

Estuarine habitats occurring in the study area include emergent wetlands and shrub/scrub wetlands, and estuarine subtidal unconsolidated bottom. Estuarine wetlands are found in the study area along the Freeport Channel in areas with access to saline water such as those not

protected by the wave barrier or levees. Subtidal estuarine habitat occurs within the Old Brazos River channel in the project area.

The dominant species in the frequently inundated low salt estuarine emergent wetlands is smooth cordgrass (*Spartina alterniflora*), followed by seashore saltgrass (*Distichlis spicata*). These are often interspersed with low brackish marshes dominated by saltmarsh bulrush (*Bolboschoenus robustus*) and glasswort (*Salicornia virginicus*). Common species in the high salt/brackish marshes, which occur at slightly higher elevations and are thus less frequently inundated, include the sea ox-eye daisy, saltwort, and shoregrass (*Monanthochloe littoralis*).

The estuarine intertidal shrub/scrub category includes coastal wetlands dominated by woody vegetation and periodically flooded by tidal waters. Species include big leaf sumpweed (*Iva frutescens*) and the exotic invasive tamarisk (*Tamarix* sp.).

2.3.4.3.2 Freshwater Habitats

Five freshwater wetland habitats have been identified as occurring in the study area: freshwater aquatic vegetation – submerged and floating (palustrine aquatic bed); freshwater marshes (palustrine emergent wetland); freshwater shrub/scrub wetlands; freshwater forested wetlands; and freshwater flats (unconsolidated shore).

Freshwater marshes occur in the study in swales near the Quintana and Surfside beach shorelines. Common species included spikerush (*Eleocharis* sp.), flatsedge (*Cyperus* sp.), rushes (*Juncus* spp.), smartweed (*Polygonum* sp.), seashore paspalum (*Paspalum vaginatum*), coastal cattail (*Typha domingensis*), and American bulrush (*Schoenoplectus pungens*). Artificially flooded areas are present in the project area, in placement areas and areas impounded by levees and roads.

Freshwater shrub/scrub wetlands, which may include woody species such as common buttonbush (*Cephalanthus occidentalis*), baccharis *(Baccharis* sp.), big leaf sumpweed, and tamarisk occur in the study area. Similarly, freshwater forested wetlands likely dominated by black willow *(Salix nigra*), Chinese tallow, and other pioneer-type species occur within the study area. None of these wetlands has direct hydrologic connections to the Freeport Harbor Channel. Freshwater flats are unvegetated to sparsely vegetated areas with sand or mud substrate; common species are the same as for freshwater marshes.

More information on terrestrial and aquatic wildlife in the study area, including commercial and recreational species, can be found in the 2012 FEIS, and more information on threatened and endangered species in the study area is provided in the Biological Assessment (BA) (Appendix H) of this EA.

2.3.5 Essential Fish Habitat

Essential fish habitat (EFH) consists of those habitats necessary for spawning, breeding, feeding, or growth to maturity of species managed by Regional Fishery Management Councils, as described in a series of Fishery Management Plans, pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (PL 94-265) of 1996. The NOAA EFH Mapper has identified the study area as EFH for federally managed species such as the red drum (*Sciaenops ocellatus*), 43 species of reef fish, all of the coastal migratory pelagic species, and 4 species of shrimp (NOAA, 2016b). The categories of EFH that occur within the Project area include estuarine water column, estuarine mud and sand bottoms (unvegetated estuarine benthic habitats), estuarine emergent wetlands, marine water column, and marine nonvegetated bottoms. EFH that occurs within the project footprint includes marine water column and marine nonvegetated bottoms. Marine water column and marine nonvegetated bottoms occur in abundance within the study area. Habitat Areas of Particular Concern (HAPC) and EFH Areas Protected from Fishing (EFHA) were not identified in or near the 2012 Feasibiltiy/FEIS Project area.

2.3.6 Threatened and Endangered Species

Federally listed species potentially occurring within the vicinity of the study area include five species of sea turtle – the green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*); three bird species – the piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and whooping crane (*Grus americana*); the West Indian manatee (*Trichechus manatus*); four species of whales – fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaengliae*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter macrocephalus*); and four coral species – lobed star coral (*Orbicella annularis*), mountainous star coral (*Orbicella faveolata*), boulder star coral (*Orbicella franksi*), and elkhorn coral (*Acropora palmata*) (U.S. Fish and Wildlife Service [USFWS], 2016; National Marine Fisheries Service [NMFS], 2016a). The four whale species and West Indian manatee receive additional protection under the Marine Mammal Protection Act.

Additional state protected species are listed by TPWD as potentially occurring in Brazoria County: Eskimo curlew (*Numenius borealis*), jaguarundi *(Herpailurus yaguarondi)*, Louisiana black bear (*Ursus americanus luteolus*), ocelot (*Leopardus pardalis*), and red wolf (*Canis rufus*)

(extirpated) (TPWD, 2016a). These additional species are not likely to occur in the study area and were not identified by the jurisdictional Federal agencies (NMFS and USFWS). Furthermore, the Louisiana black bear has recently been removed from the Federal list of threatened and endangered species (81 Federal Register [FR] 13124–13171; March 11, 2016). Birds recently removed from the Federal list of threatened and endangered species such as the American peregrine falcon, Arctic peregrine falcon, peregrine falcon, brown pelican, and bald eagle are protected under the Migratory Bird Treaty Act (MBTA), and the bald eagle continues to receive additional protection under the Bald and Golden Eagle Protection Act (64 FR 46542–46558; 72 FR 37346–37372).

2.3.7 Water and Sediment Quality

The TCEQ has designated the old Brazos River Channel Tidal (Freeport Harbor) as Segment 1111. The designated uses for Segment 1111 are contact recreation (swimming) and high-quality aquatic habitat. Since April 2015, the salinity in the FHC ranged from 13.7 to 32.4 ppt and dissolved oxygen (DO) concentrations range from 1.2 to 8.6 milligrams per liter. The criterion for high-quality aquatic life use is 4 milligrams per liter for DO. Enterococci concentrations were below 10 Most Probable Number/milliliter, well below the criterion of 35 Most Probable Number/deciliter, indicating that the waters of the FHC support contact recreational use.

In its review of the 2012 FEIS, TCEQ concurred that there is reasonable certainty that the FHCIP would not violate water quality standards, and provided water quality certification for the Preferred Alternative of the FHCIP.

Coring and testing of sediments from the submerged bench at Dow Thumb waist were conducted in April of 2016 (Terracon, 2016). The testing included the collection of sediment, water and modified elutriate samples within the dredge prism at the "Waist" of the Dow Thumb. No significant contaminants were identified during the survey. Additional information from the sampling conducted by Terracon (2016) is provided in **Section 2.3.10** below.

The USACE conducted monitoring of the ocean placement of construction material from dredging of the Outer Bar and Jetty channels for the 45-foot Project (USACE, 1978). No unacceptable water quality impacts were found. According to the 2012 FEIS, no water column, sediment, or benthos problems were noted during the monitoring. There was also monitoring of the water column before, during, and after dredging and placement in the New Work ODMDS in the early 1990s (EH&A, 1994). No causes for concern for the water column were found upon placement of this material in the New Work ODMDS.

2.3.8 Air Quality

Brazoria County is included in the eight-county Houston-Galveston-Brazoria (HGB) ozone nonattainment area, which is classified as "severe" in terms of its degree of compliance with the 1997 8-hour ozone standard. This classification affects facilities that generate the ozone precursors, nitrogen oxide (NO_x), and volatile organic compounds (VOC). As such, the project is subject to the General Conformity Rule, which applies to all nonattainment and maintenance areas.

This project, as a federal action, is subject to the General Conformity Rule promulgated by the U.S. Environmental Protection Agency (EPA). The rule mandates that the Federal Government not engage in, support, or provide financial assistance for licensing or permitting, or approving any activity not conforming to an approved State Implementation Plan. In Texas, the applicable plan is the Texas State Implementation Plan, an EPA-approved plan for the regulation and enforcement of the National Ambient Air Quality Standards in each air quality region within the state.

2.3.9 Noise

Noise levels in the project area are elevated compared to undeveloped areas along the coast and are affected by petrochemical industry operations, vessel navigation, and vehicular traffic in the Freeport Harbor area.

The magnitude of noise is usually described by its sound pressure, usually in decibels (dB), and dB values are further defined in terms of frequency-weighted scales (A, B, C, or D). The A-weighted scale is most commonly used in environmental noise measurements because it places most emphasis on the frequency range detected by the human ear (1,000 to 6,000 hertz). Sound levels measured using A-weighting are often expressed as dBA. Although the vast majority of land use along the ship channel is dominated by commercial and industrial uses, noise-sensitive receivers such as single-family residences, recreational vehicle parks, and recreational areas do occur on both sides of the channel in the communities of Quintana, Surfside Beach, and Freeport, but do not occur in the project area.

2.3.10 Hazardous, Toxic and Radioactive Waste Concerns

The assessment of existing Hazardous, Toxic and Radioactive Waste Concerns (HTRW) conditions was conducted in general accordance with procedures described in the USACE Engineer Regulation (ER) 1165-2-132 - Water Resource Policies and Authorities Hazardous, Toxic and Radioactive Waste Guidance for Civil Works Projects (USACE, 1992). The assessment aims to identify the existence of, and potential for, HTRW contaminations on lands

in the project area, or external contamination, which could impact or be impacted by the project. Historical aerial photographs were reviewed to examine the historical usage of the project area and surrounding areas. A review of reasonably accessible regulatory database findings was conducted to evaluate areas of potential environmental concern to the project area. A site reconnaissance was conducted for the 2012 FEIS to verify the status and location of sites referenced in the regulatory database search or to locate any additional unreported hazardous materials site, as identifiable from public right-of-way. Results of the 2012 FEIS HTRW assessment found no concerns with the ocean or upland placement of sediments. There were also no known HTRW sites within the 2012 FEIS footprint. The 2015 Sabine Pass to Galveston Bay Draft Integrated Feasibility Report and Environmental Impact Study also included an HTRW review area encompassing this project area (USACE, 2015). According to the Appendix N of this report, the project area was assigned a low general risk level.

A recent analysis of environmental media found within the study area at the Dow Thumb was conducted by the Engineer Research and Development Center (Montgomery and Bourne, 2017). The primary objectives of this sampling event were to evaluate soils in the underwater berm around the DOW thumb for potential contaminants. Samples of sediment, surface water and modified elutriates were collected at six representative locations within the project area, and a chemical and miscellaneous analysis of each sample was performed. Analytical results for sediment, surface water and modified elutriates were compared to at least three State and/or Federal screening benchmarks for each media to evaluate potential adverse impacts. Of the sediment samples collected, 59 constituents were detected in at least one sample. Of the 59 constituents, only 4 constituents exceeded screening benchmarks for one or more samples (i.e., pesticides, polychlorinated biphenyls [PCBs], and arsenic). These exceedances were marginal; and are not expected to result in adverse effects during dredging or placement activities. In surface water samples, 29 constituents were detected as contaminants; however, there were no exceedances of screening benchmarks. Of the modified elutriate samples collected, 40 constituents were detected as contaminants. Similar to the surface water samples, none of the constituents detected in the modified elutriate samples exceeded screening benchmarks. An uncertainty analysis was also performed to verify data usability, and concluded that the results of this analysis are usable for dredging and placement decision-making.

2.3.11 Cultural Resources

Cultural resource investigations for both terrestrial and marine resources were performed for the project area in conjunction with the 2012 FEIS. This provided a well-developed cultural history for this portion of the Texas coast. The aboriginal inhabitants of this region seasonally exploited the Brazos River for its maritime and mainland resources; early European mariners utilized the mouth of the Brazos as a riverine passage to mercantile trade; and the nineteenth-century Austin

colonists developed the mouth of the Brazos into commercial and social centers. Therefore, cultural resources characteristic of this area range from prehistoric shell middens to early European shipwrecks to historic period sites such as Fort Velasco and the towns of Quintana and Velasco. Historical research and investigations identified one previously recorded archeological site (41BO175) within the project area. This site was located on the south bank of the Old Brazos River channel south of the Dow Thumb. It is identified as Fort Bend, a Civil War Era fort that was occupied from 1861 to 1865. When the site was recorded in 1990, all that remained were sand walls of the fort facing the river; no artifacts were observed. The landform on which the site was located has been destroyed.

2.3.12 Energy and Mineral Resources

According to the Railroad Commission of Texas (RCT) public GIS viewer (2016) there is one pipeline that crosses the study area and one adjacent abandoned pipeline. ConocoPhillips has one crude oil pipeline crossing the FHC between its two terminals that is active. There is an abandoned volatile natural gas pipeline adjacent to the bend easing portion of the study area. At this time, the USACE Galveston District has determined that all pipelines are deep enough so that no pipeline relocations are needed. There are no active wells in the study area.

2.3.13 Socioeconomic Considerations

A socioeconomic analysis was conducted for Brazoria County and the adjacent census tracts, block groups, and blocks within the study area. The project is located in an industrially developed port with few places for public access and no residential areas. Port Freeport provides access to one of the largest petrochemical complexes in the world. Major petrochemical industries operating out of the port include ConocoPhillips Petroleum, Dow Chemical, and Badische Anilin und Soda Fabrik (BASF). Port activities contribute to the local and regional economy by generating business revenues to local and national firms providing vessel and cargo-handling services at several public and private marine terminals. Businesses, in turn, provide employment and income to individuals. According to the 2012 FEIS, marine cargo activity at Freeport's public and private marine terminals in the navigation district is responsible for 11,131 direct jobs with local firms, 75 percent of which were held by residents of Brazoria County (USACE, 2012a). These direct jobs induce additional jobs within the local region. The current channel configuration is limiting to growth of the port, as the channel is not currently wide or deep enough to accommodate larger vessels.

The 2000, 2010, and preliminary 2015 Census population counts for Brazoria County are shown in **Table 2-2**. The population for Brazoria County had a 43 percent increase between 2000 and 2015.

Table 2-2 – Population Statistics for Brazoria County

Geographic Area	Population		
	2000	2010	2015
Brazoria County	241,763	313,166	346,321

U.S. Census, American Community Survey, 2014; U.S. Census Bureau 2016

There is a civilian labor force of 169,808 in Brazoria County, with an unemployment rate of 5.6 percent as of September 2016, according to the Texas Workforce Commission (2016). The 2010 to 2014 5-year American Community Survey median household income for Brazoria County was $69,092. There are census tracts and block groups in the study area; however, the direct project area currently has no population due to the open water nature and a portion of an undeveloped parcel of the area. The demographic breakdown for Brazoria County is 51.4 percent White (Caucasian), 28.6 percent Hispanic, 12.6 percent Black or African American, 5.9 percent Asian, and 1.6 percent other (U.S. Census Bureau, 2016). Two census block groups (BG) encompass the project area (census tracts 6642, BG 2 and 6644, BG 2). Based on the most recently available demographic data, census tract 6642, BG 2 has 26.0 percent of the population below the poverty level which is more than twice the county average of 11.2 percent below the poverty level indicating this block group contains an environmental justice (EJ) population (U.S. Census Bureau, 2016). Additionally, 75.1 percent of the population in census tract 6644, BG 2 identifies as a minority, indicating this block group contains an EJ population. According to aerial photographs, the only residential areas are a few scattered residences near Quintana beach and a neighborhood on the corner of Brazosport Boulevard and Levee Road. These residential populations are located more than a half mile from the project area. There are no populations of children, or facilities geared towards children (e.g. schools, playgrounds) in the project area. Quintana Beach and Jetty Park, both public parks, are located at the mouth of the FHC approximately one mile from the project area.

2.4 ECONOMIC CONDITIONS

The Economic Reaches in this GRR will mirror those utilized in the 2012 Feasibility Report. **Figure 2-2** displays the Economic Reaches.

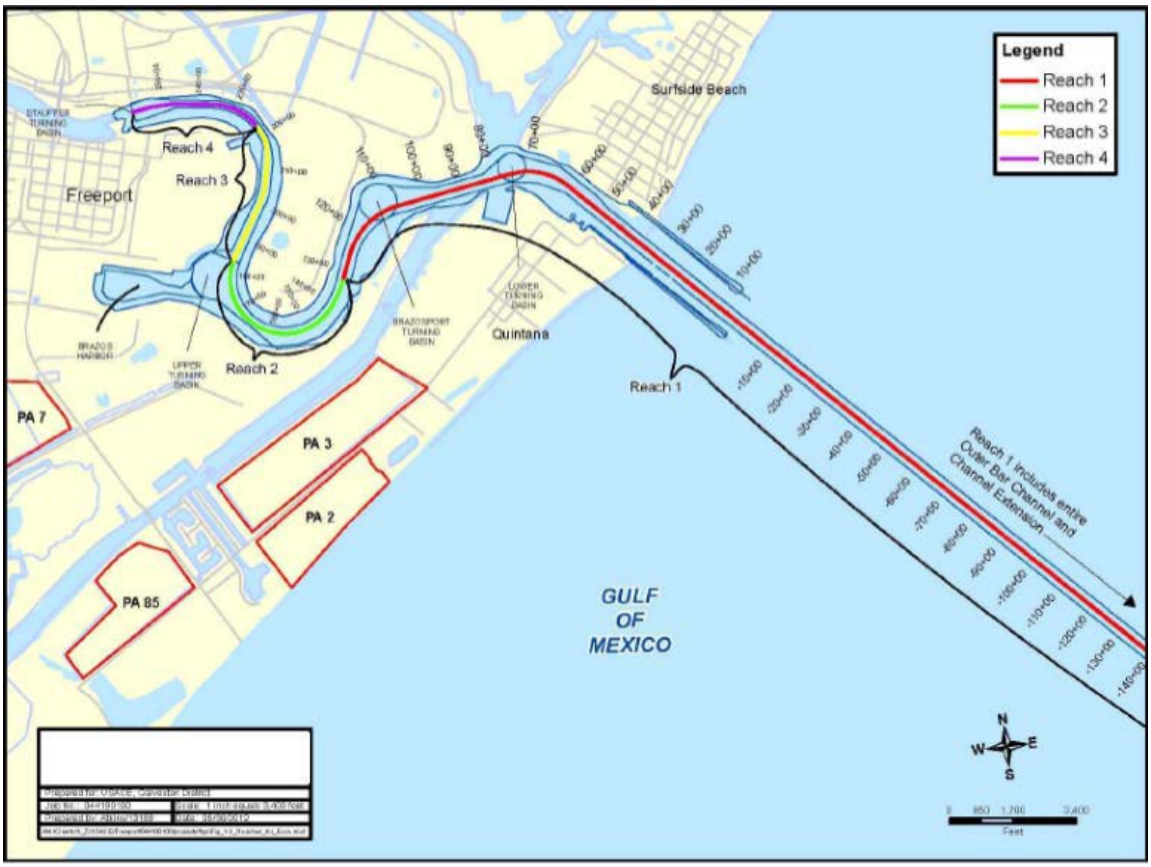

Figure 2-2 – GRR Economic Reaches

The current channel primarily serves the petrochemical industry, and the reaches at Freeport serve various commodities. Reach 1 is currently 48 feet MLLW (outside the jetties) and 46-feet MLLW (inside the jetties) and varies from 600 feet wide in the Entrance Channel to 400 feet wide as it crosses the GIWW. Freeport LNG (Liquefied Natural Gas), Seaway (crude oil, petroleum products), and some of Dow Chemical (chemicals) docks are in Reach 1. Reach 2 is 46-feet MLLW and 279-feet wide at the most constrained point, the waist of the Dow Thumb. Phillips (crude petroleum, petroleum products, chemicals, LPG) has Berths 2 and 3 in this reach. The Upper Turning Basin is also included in this reach, which is dredged to 46-feet MLLW and 1,200-feet wide. Berth 6, located tangent to the Upper Turning Basin is also dredged to 46-feet MLLW. Brazos Harbor, veering west of the Upper Turning Basin, is dredged to 37-feet MLLW, and is 750-feet wide. It previously served the market of banana imports, but those shipments have moved to a newly constructed container facility (Velasco Terminal). The Velasco Container Terminal is located in Reach 3 and currently has Berth 7 dredged to 46-feet MLLW. Berth 7 is adjacent to the Upper Turning Basin. Reach 3 is currently at a depth of 19-feet MLLW. Berth 8 is part of Port Freeport's future port expansions and will be part of the Velasco Terminal located in Reach 3. Reach 4 has not been deepened and has a depth of 19-feet MLLW.

Offshore supply vessels and other smaller vessels use Reach 4. **Figure 2-3** shows a general layout of existing facilities at Port Freeport.

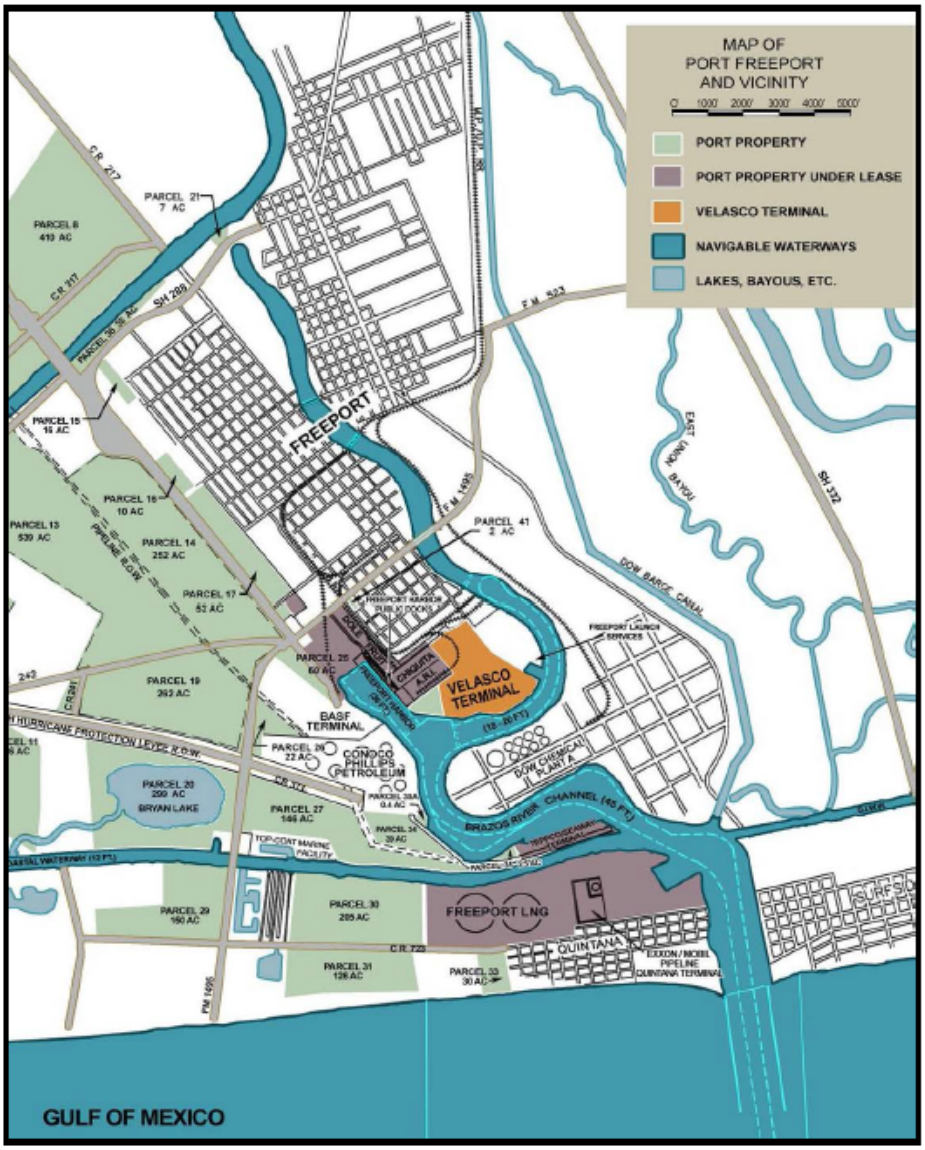

Figure 2-3. Existing Port Freeport Facilities

With growing demand in Texas due to population and economic growth in the region, there may be a need for an additional container facility near Houston. The Houston facilities have limited space and congestion within the channel. Therefore, to continue to provide for the region's needs, Port Freeport can help serve additional containers near Houston. Port Freeport is developing the Velasco Terminal under several phases. Phase I is complete and containerships began calling in October 2014. Future phases include expansions and development at Velasco Terminal. Additional information on economic conditions is included in the economic appendix (Appendix A).

3 FUTURE WITHOUT-PROJECT CONDITIONS*

For purposes of this study, the Future Without-Project (FWOP) is considered pre-WRRDA 2014 to establish a baseline for economic analysis and is compared only to alternatives proposed for modification in this GRR. Where necessary, the incremental difference between the 2012 Feasibility Report features and the features being reformulated under the GRR will be explicitly quantified or described applicable to cost, benefit, and environmental analysis.

The USACE is required to consider the option of "No Action" as one of the alternatives in order to comply with ER 1105-2-100 and the requirements of NEPA. With the FWOP, it is assumed that no project would be implemented by the Federal Government or by local interests to achieve the planning objectives. The FWOP forms the basis against which all other alternative plans are measured.

With the FWOP condition, the Panamax vessel would not be able to transit around the Dow Thumb in Reach 2 to call on the Velasco Container Terminal. The Panamax was the design vessel for Reach 3 in the 2012 Feasiblity Report.

3.1 Economic Conditions

Under the without-project conditions, the existing conditions will likely continue for both the Aframax tankers and sub-Panamax containerships. The channel will not be able to accommodate larger vessels than those that currently call. Existing pilot rules will likely continue. As demand for container imports and exports grow, it will take additional vessels to meet this demand. Since these vessels will not be able to utilize a deeper draft, the transportation costs will be higher. This higher cost could limit Port Freeport's ability to grow, and limit capitalizing on opportunities to contribute benefits to the Nation.

In the future with-project condition, potential benefits include transportation cost savings. By utilizing larger vessels or being able to load more fully, it will require fewer vessels to transport the same amount of goods, thereby decreasing at-sea transit costs. In addition, with larger vessels, container trade routes may include Europe and Far East in addition to Caribbean and South America, offering more opportunity for trade. Additional detail can be found in the economic appendix.

3.2 Dredged Material Base Plan Description

The FWOP Alternative is the existing 45-foot project, discussed previously in **Section 2.1**. The 45-foot project depth and existing width would be maintained throughout the project area. The Main Channel, turning basins, and Stauffer Channel dimensions would remain in their current

condition. Maintenance material from the project area would continue to be placed in the existing PA 1. This FWOP scenario assumes that the sponsors' Widening Project under DA Permit SWG-2014-00116 is constructed.

PA 1 is located approximately 0.5 mile south of SH 36, and approximately 1,000 feet east of the Brazos River Diversion Channel. The PA is approximately 320 acres with a perimeter of approximately 20,310 linear feet. The existing ground elevation is approximately 21 feet NAVD 88 with a dike height of 25 feet NAVD 88. Currently, PA 1 has an existing capacity of approximately 0.8 MCY. Once the dikes are raised to 31.5 feet NAVD 88, the PA will have an estimated capacity of 5.0 MCY. The dikes will be raised under the FWOP.

Lastly, ODMDS 1 and ODMDS 1A, discussed previously in Section 2.1, exist for offshore placement. This is the current O&M practice and the assumption for this study is that the current O&M practice of the ODMDS 1A placement for all FHC maintenance material will likely continue in the future.

3.3 Environmental and Historic Resources

Without construction of the TSP, minor and temporary effects of the construction in Reach 2 would be avoided. Environmental effects of the existing project would continue as they do today. The largest impact of the existing project is the adverse effect of hopper maintenance dredging on threatened and endangered sea turtles; no other listed species are affected by maintenance dredging or placement activities. Hopper dredging would continue to comply with the reasonable and prudent measures (RPMs) and implementing Terms and Conditions described in the Gulf Regional Biological Opinion for Hopper Dredging, Gulf of Mexico (NMFS, 2003 with 2005 and 2007 updates). Minor and temporary effects to air quality and noise levels would occur during maintenance dredging episodes. Sediment quality would be monitored to identify contaminants in the dredged material, even though no concerns with contaminated sediments have been documented in the project area in over 30 years of monitoring.

3.4 Engineering Considerations

Engineering considerations to the existing wave barrier (a feature of the Freeport HFPP) and storm surge analysis are known issues in the project area for the GRR and described here.

3.4.1 Storm Surge Modeling

An analysis of storm surge levels in Freeport Harbor was conducted for this GRR and showed no adverse impacts related to increases in storm surge for proposed modifications. The study took advantage of previous modeling conducted for the Federal Emergency Management Agency (FEMA) Region VI National Flood Insurance Program (NFIP) Risk MAP study and the existing

model used in the Sabine to Galveston (S2G) study for coastal storm risk management (CSRM) to depict the existing harbor configuration. A new grid was created for the with-project condition to represent the removal of the wave barrier and to update the bathymetry where the bend easing and channel widening/deepening are to take place.

Since the FWOP alternative does not incorporate any structural changes to the project, the only change from an engineering perspective is sea level rise. Storm surge modeling was performed for the GRR to examine the effects of sea level rise for a future without project alternative. An initial set of simulations was run using a present sea level configuration and a second set of simulations was run incorporating a future sea level rise value of 2.4 feet. A comparison of the resulting water surfaces show that the resulting increase is nonlinear and often greater than the modeled sea level rise of 2.4 feet.

3.4.2 Wave Barrier

The Freeport HFPP includes a wave barrier (North Wave Barrier) in the southwest portion of the project area, which is just one element of the HFPP. The wave barrier is an earthen barrier 9,447 foot (1.8 miles) long with a 20-foot crown width. It was installed to provide protection against the design hurricane. It is located on the south side of the existing Freeport Harbor Project and runs in front of the Phillips Petroleum facility. A roadway (Old Quintana Road) south and west of the wave barrier is at a higher elevation than the adjacent North Wave Barrier.

Over the last 40 years, USACE has constructed dredge disposal areas on Quintana Island, south and east of the wave barrier. The disposal areas are now at a higher elevation than the wave barrier. Based upon review of the previous analyses in the S2G study, the height of the dredge disposal areas on Quintana Island are higher than the subject wave barrier. Storm surge modeling conducted in conjunction with this study shows that these disposal areas currently intercept and impede waves expected from the modeled storms. Storm surge from the modeled storms inundate the GIWW, south of the wave barrier and roadway, as well as within the Freeport Harbor.

4 PROBLEMS AND OPPORTUNITIES

The authorized plan from the 2012 Feasibility Report included the following channel modifications shown in the bullets below. The economic reach for each modification is identified in brackets:

- Deepen the Outer Bar Channel into the Gulf of Mexico to 58 feet **[Reach 1**];
- Deepen from the end of the jetties in the Gulf of Mexico to the Lower Turning Basin to 56 feet **[Reach 1]**;
- Deepen from the Lower Turning Basin to Station 132+66 near the Brazosport Turning Basin to 56 feet **[Reach 1]**;
- Enlarge the Brazosport Turning Basin from 1,000 to 1,200 foot diameter **[Reach 1]**;
- Deepen from Station 132+66, above the Brazosport Turning Basin, through the Upper Turning Basin to 51 feet **[Reach 2]**;
- Deepen and widen the lower 3,700 feet of the Stauffer Channel to 51 feet and 300 feet wide **[Reach 3]**; and
- Dredge the remainder of the Stauffer Channel to 26 feet (its previously authorized depth was 30 feet) **[Reach 4]**.

Subsequent to the authorization it was determined that the channel width in Reach 2 prevents the safe, efficient navigation of the Panamax design vessel around the Dow Thumb precluding transit to and from the Velasco Container Terminal in Reach 3 (**Section 1.10 History of the Investigation**). Thus, the problems addressed in the Freeport GRR generally align with the stated problems in the 2012 Feasibility Report.

4.1 PROBLEMS

Problems in the GRR study area include:

- The existing channel system constrains a large portion of the container fleet because of its size (length and beam). The specific area of concern in the existing channel is located near Dow Thumb.
- Safety issues for industry.

4.2 OPPORTUNITIES

Opportunities in the GRR study area include the following:

- Identify significant transportation cost savings;

- Positively impact the regional economy;
- Positively impact life-safety risk; and
- Avoid or minimize impacts to the environment in the project area.

4.3 PLANNING GOALS

The goal of the study is to identify a plan that contributes to Federal objectives while protecting the Nation's environmental resources and complying with existing laws, regulations, and executive orders. All four accounts established to facilitate display of effects of alternative plans will be utilized including NED, environmental quality (EQ), regional economic development (RED) and other social effects (OSE) in the Freeport GRR. The RED and OSE accounts will be discussed qualitatively in the evaluation.

4.4 PLANNING OBJECTIVES

The objectives utilized in the Freeport GRR are the same as the objectives utilized for the 2012 Feasibility Report. The period of analysis for this study is 50 years. Those objectives were:

- Improve the navigational efficiency and safety of the deep-draft navigation system at Freeport Harbor within the period of analysis, and,
- Maintain or protect the quality of the Freeport Harbor area's aquatic, terrestrial, and cultural resources within the period of analysis.

However, in this reevaluation, the primary objective is:

- To allow for the safe and efficient movement of the Panamax design vessel around the Dow Thumb for transit to and from the Velasco Container Terminal.

This objective is necessary for the project to accrue the benefits for which Congress intended when the report was authorized under WRRDA 2014.

4.5 PLANNING CONSTRAINTS

The constraints of the study include:

- Modifications that cause unacceptable increases in risk to the Freeport HFPP will need to be mitigated; and
- Modifications to the Phillips Berth 2 will not be proposed to gain additional width at Dow Thumb.

4.6 RELATED DOCUMENTS

This DIGRR-EA contains an economic reanalysis of the 2012 Feasibility Report, inclusive of the proposed GRR modifications (TSP). The USACE evaluated environmental impacts of all elements of the authorized project in the 2012 FEIS for which a Record of Decision was issued on May 31, 2014.

4.7 DECISIONS TO BE MADE

This DIGRR-EA will provide recommendations for modifications needed to address the safe and efficient transit of the Panamax design vessels around the Dow Thumb and to and from the Velasco Container Terminal to realize the benefits of the 2012 Feasibility Report. Additionally, an economic update for the project will be performed. The decision to be made is to select a plan as the TSP from a final array to meet the objectives of the study. The planning objectives align with the Federal objective and the four accounts. The plan that best meets the objectives is identified as the TSP. This does not preclude a decision to refine or alter the TSP based on public and agency review of this DIGRR-EA.

5 FORMULATION AND EVALUATION OF ALTERNATIVE PLANS*

5.1 PLAN FORMULATION RATIONALE

Formulation for the Freeport DIGRR-EA was limited to determining what modifications to the 2012 Feasibility Report would allow the Panamax vessel to safely transit around the Dow Thumb (Reach 2) to and from the Velasco Container Terminal (Reach 3) and accrue the benefits intended by Congress. Formulation included avoiding, minimizing, and mitigating impacts to the environment and other Federal projects. Physical constraints have a significant bearing on the development of the final array in the project area. To address this, the PDT developed criteria for the development of the final array.

- Meet objectives and constraints: The alternative must contribute to the planning objective, which will be evaluated both quantitatively (NED and environmental quality (EQ)) and qualitatively (other social effects or OSE and regional economic development or RED).
- Safety Requirements: The alternative will meet USACE design criteria for channels and levees, allow adequate space for tugs, and meet U.S. Coast Guard (USCG) safety requirements.
    - Pilot Input: Initial input to the alternatives considered in the GRR was provided by the pilots to gain their assessment of whether the plans were suitable for their use from a safety and navigation standpoint. Initial input was provided by the pilots in writing and confirmed in the GRR ship simulation.
    - Previous Ship Simulation Input: Previous ship simulations performed in the study area were reviewed to inform the final array of alternatives (**Section 1.9.4**).
- Sponsor Input: The sponsor indicated they were interested in the narrowest channel width that will be found to safely accommodate the design vessel and that the pilots will support.

An initial set of alternative plans was developed to determine what modifications would be required. These plans were screened and further refined to select the TSP. The plans were also examined and compared against the Federal criteria of completeness, efficiency, effectiveness, acceptability, and constructability from the Principles and Guidelines (P&G), as well as for their potential impact to the environmental and other Federal project.

5.2 MANAGEMENT MEASURES

Individual measures (**Table 5-1)** that would allow the objective of safely and efficiently moving the Panamax design vessel around the Dow Thumb were considered in the process of formulating alternatives. Non-structural measures would not alleviate the issue around the Dow Thumb. Using the criteria listed earlier in **Section 5.1**, the three combined measures of bend easing, widening at Dow Thumb and a turning notch in the Upper Turning Basin would be necessary to reach the objective. Specifically, pilot input and information from previous simulations required the addition of the bend easing and turning notch. As such, these measures were not carried forward and analyzed as individual measures because that violated "Pilot Input" and "Previous Ship Simulation Input" criteria listed above. Smaller variations (footprint) of the final array were considered, but eliminated because they did not meet Pilot Input criteria. Non-structural measures would not alleviate the issue around the Dow Thumb; therefore, they were not considered further.

Table 5-1 – Freeport GRR Measures Considered

Measure	Description	Considered in Final Array (Yes/No)
Non-Structural Measures		
Adjust Vessel Speed	Vessels already operate at the slowest speed possible without affecting maneuverability.	No
Increase Tugboat Assistance	Current tug operations alone will not allow the Panamax to transit around Dow Thumb to reach the Velasco Container Terminal.	No
Structural Measures		
Deepening Only	Constraints on vessel classes are not benefited by deepening only.	No
Bend Easing/Widening Only	Pilots indicated the measures considered individually would not improve maneuverability.	No
Relocation of Phillips Berth 2	This was screened out because it would be cost prohibitive.	No

No Action Alternative (FWOP Condition) – The USACE is required to consider the option of "No Action" as one of the study alternatives in order to comply with the requirements of the National Environmental Policy Act (NEPA). With the No Action Plan (i.e., the FWOP Condition), it is assumed that no project would be implemented by the Federal Government or by local interests to achieve these particular planning objectives. However, it is assumed that normal operation and maintenance activities, along with other probable channel improvements, would be performed over the period of analysis. The No Action Plan, therefore, forms the basis to which all other alternative plans are measured. Details of the "No Action" plan are included in **Section 5.3**.

5.3 SUMMARY OF ALTERNATIVES ANALYSES

Alternatives - This study evaluated modifications in Reaches 2 and 3 to allow the Panamax design vessel to transit safely around the Dow Thumb to and from the Velasco Container Terminal. As shown in the introduction to **Section 4 Problems and Opportunities**, Reach 2 falls within the channel from approximately Station 132+66 to the Upper Turning Basin and Reach 3 includes the Upper Turning Basin and the lower reach of the Stauffer Channel. The "final array" for this reevaluation is presented as alternatives required for the first segment of construction. These alternatives are not significantly different from one another since they are similar in alignment. However, due to potential significant differences in implementation costs and potential impacts, they are presented here as the focused array of alternatives the PDT has evaluated to identify the TSP. Alternatives considered in the first segment of construction (to 46-feet) are listed in **Table 5-2**.

Table 5-2 – Alternatives to 46 feet MLLW

Alternative	Description
No Action Alternative	No Action or Future Without-Project Condition
Alternative 1	Widening at Dow Thumb (375 feet) + Bend Easing + Notch at Upper Turning Basin (required for incremental justification)
Alternative 2	Widening at Dow Thumb (400 feet) + Bend Easing + Notch at Upper Turning Basin
Alternative 3	Widening at Dow Thumb (425 feet) + Bend Easing + Notch at Upper Turning Basin (required for incremental justification and if the ship simulation does not pass the design vessel with 400-foot at Dow Thumb)
Alternative 4[1]	Widening at Dow Thumb (TSP width) + Bend Easing + Notch at Upper Turning Basin + optimization of the channel depth

[1] *Alternative 4 is for purposes of the incremental justification to determine whether the 46-foot depth is the National Economic Development Plan.*

Alternatives 1 through 4 include the bend easing and turning notch features based on results from previous ship simulations, and October 7 and October 29, 2016 meetings held with the Brazos Pilots. The bend easing and turning notch are considered critical components to the alternatives to enable the Panamax vessel to navigate to and from Berth 7 at the Velasco Container Terminal. The turn radius-to-ship length ratio for the channel near the Dow Thumb is approximately one. Since it is not possible to substantially increase the channel width to accommodate the navigation turn, a bend easing and turning notch are necessary to allow the pilots to align the ship prior to traversing the waist.

Due to the small cross sectional area and tight bend of the channel near the Dow Thumb, large vessels must pass at a slow speed to prevent potential damage to moored vessels caused by pressure field effects generated by the passing vessel. The very slow speed is not sufficient for steerage and safe control of the vessel. To facilitate safe maneuvering, a bend easing at the wave barrier (Station (Sta.) 147+00 to Sta. 160+00)) was incorporated into the alternatives. This feature also serves as a safety overrun when situated away from Berth 2 where the LPG vessels dock.

The turning notch was added to each alternative based on the 2014 ship simulation conducted with the Super-Panamax and the Post-Panamax vessels (Ever Ultra at 935x106x44 feet and the Maersk Kendal at 982.6x131x44 feet). The simulation indicated that the existing 1,200-foot turning diameter of the Upper Turning Basin was not sufficient for the maneuvering of the longer vessels. Per EM 1110-2-1613, *Hydraulic Design of Deep Draft Navigation Projects* (page 9-2),

> *"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 for Reach 3 (2012 Feasibility Report and GRR) has a LOA of 965 feet and requires a Turning Basin diameter of 1,447 feet. The pilots expressed the need for the Upper Turning Basin turning notch to allow for the rotation of the vessel, conduct a three-point turn, and dock the Panamax vessel at Dock 7, and eventually Dock 8. For these reasons it was determined that all alternatives would include the bend easing and the turning notch at the Upper Turning Basin.

5.3.1 No Action Alternative (FWOP Condition)

The No Action Alternative (**Figure 5-1**), is the existing depths and widths in the FHC as shown in **Table 5-3**. This alternative assumes the construction of the project authorized under WRRDA 2014 has not occurred and the GRR modifications and the Lower Stauffer Channel WIK have not been implemented in Reach 2 and Reach 3, respectively. The Outer Bar Channel and Jetty Channel (not shown) have been widened from 400 feet to 600 feet by the NFS under DA Permit SWG-2004-02311, and maintenance has been assumed by USACE. The existing channel depths and widths are shown in text boxes within the figure. In the No Action Alternative, there are no impacts to the HFPP underwater berm or wave barrier. Conversely, the benefits for which the project was authorized will not be accrued. The limits of the economic reaches are drawn in a bold red line (Refer back to **Figure 2-2** for the defined reaches).

Figure 5-1 –No Action Alternative (FWOP Condition)

Table 5-3 – Alternative 1 – No Action (FWOP) Depths and Widths of FHC

Reach	Approx. Station Start	Approx. Station End	Depth (MLLW)	Width (feet)	Turning Basin (TB) Dimeters (feet)
Reach 1[1]	-300+00	132+66	46	Varies 350-600[1]	Lower TB (750); Brazosport TB (1,000)
Reach 2	132+66	184+20	46	350-375 (waist 279[2)]	Upper TB (1,200)
Reach 3	184+20	222+00	19	200	N/A
Reach 4	222+00	260+00	19	200	Stauffer TB (500)

[1] *Reach 1 in the 2012 Feasibility Report includes a future channel extension, which has not been surveyed or constructed and is not included as part of the Existing Condition. Port Freeport widened the Outer Bar and Jetty Channel (Station -300+00 to Station 71+52) to 600 foot width per DA Permit SWG-2004-02311; deepening is not authorized under the Permit.*

[2] *The minimum width at Dow Thumb is included in this alternative.*

5.3.2 Alternatives 1-3: Widening at Dow Thumb (375 feet, 400 feet, 425 feet) + Bend Easing + Notch at Upper Turning Basin

Figure 5-2 provides a graphical representation of Alternatives 1, 2, and 3. The difference between these alternatives is the width of the channel (375, 400, or 425) in Reach 2 around the Dow Thumb. The footprint of the bend easing, and turning notch features would be the same for all three alternatives. The stability wall (or similar mitigation feature) would provide levee

stability to offset removal of the underwater berm around the Dow Thumb. This is necessary to widen the channel. The yellow rectangle shown in Reach 3 corresponds to work in the Lower Stauffer Channel that Port Freeport intends to construct as WIK under an MOU. This WIK effort is discussed later under **Implementation Requirements in Section 8.4**.

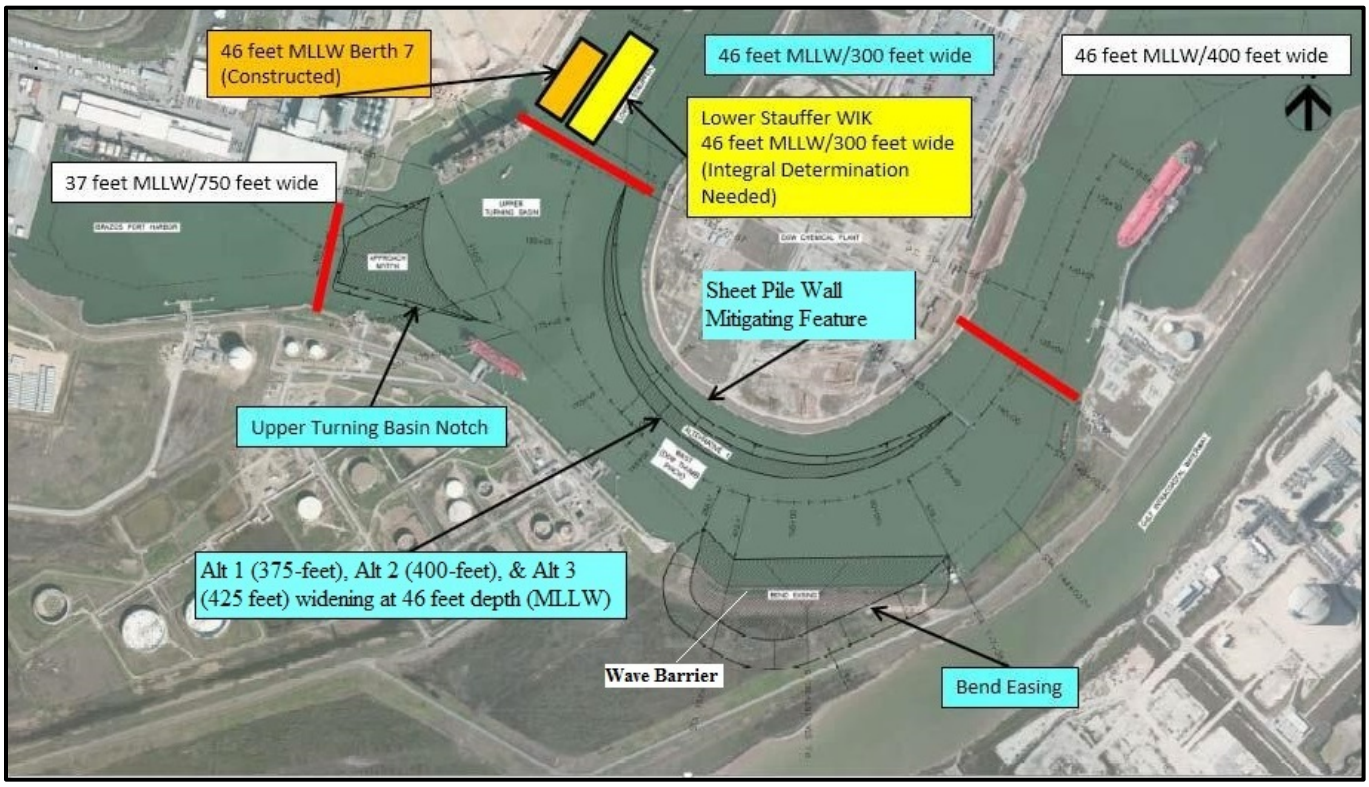

Figure 5-2 –Alternatives 1, 2, and 3 to 46 Feet MLLW Depth

Table 5-4 presents the depths and widths of Alternatives 1 through 3. All major features (widening at Dow Thumb, bend easing and the notch in the Upper Turning Basin) are required together.

Table 5-4 – Alternative 1, 2, and 3 to 46 Feet Depth and Widths

Reach	Depth (MLLW)	Width (feet)
Reach 1	46	600
Reach 2	46	375, 400, 425
Reach 3	19, portion dredged to 46 as WIK	300
Reach 4	19	200

5.3.3 Alternative 4: Widening at Dow Thumb (TSP width) + Bend Easing + Notch at Upper Turning Basin + Optimization of Channel Depth

Alternative 4 **(Figure 5-3**, **Table 5-5)** takes the selected bend easing, turning notch and widening plan from Alternatives 1, 2 and 3 and performs an incremental justification on depth.

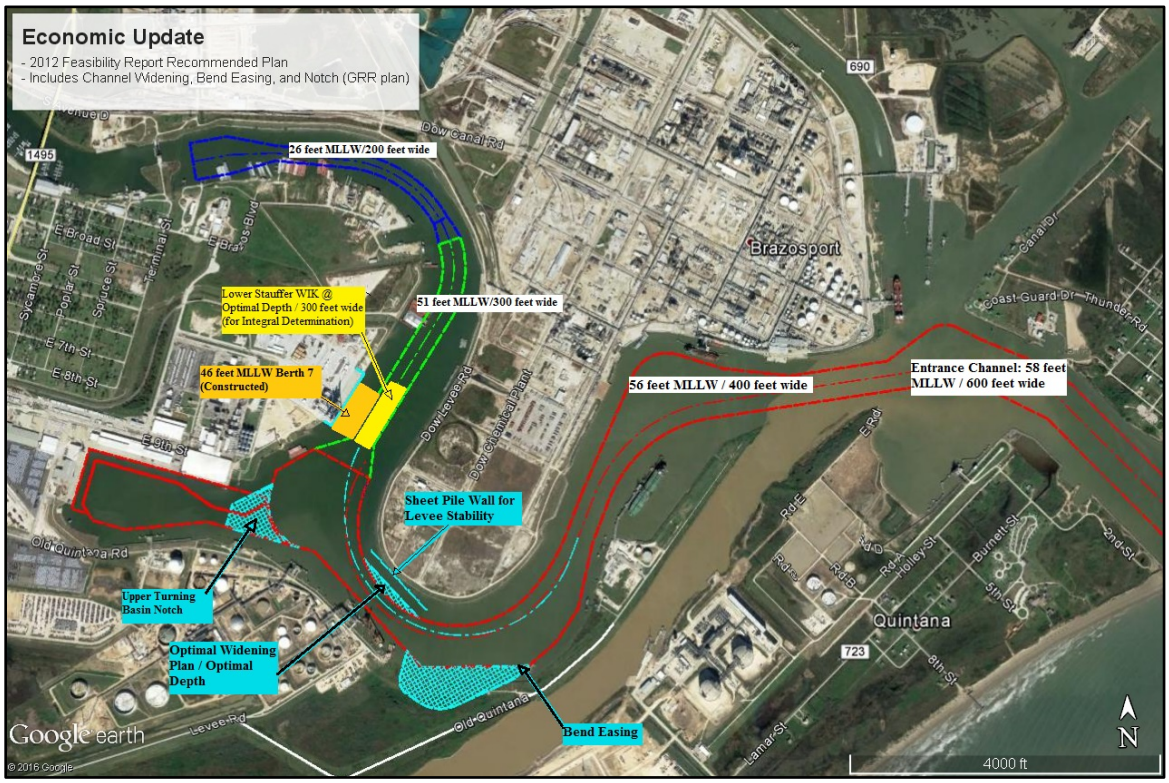

Figure 5-3 – Alternative 4: TSP Alternative at Incrementally Justified Depth

Table 5-5 – Alternative 4: TSP Alternative at Incrementally Justified Channel Depth

Reach	Depth (MLLW)	Width (feet)
Reach 1	46	600
Reach 2	46	To Be Determined
Reach 3	Incrementally Justified Depth	300
Reach 4	19	200

5.4 First Screening of Final Array Based on 2016 Ship Simulation Results

The Pilot input and previous ship simulations resulted in the inclusion of both the bend easing and the turning notch into the final array of alternatives. However, a ship simulation was deemed necessary to determine which alternative provided for the safe, efficient transit of the Panamax vessel around the Dow Thumb to the Velasco Container Terminal.

A limited ship simulation study (**Engineer Appendix, Attachment 3**) was performed at the STAR Center based in Dania Beach, Florida to examine the proposed modifications required to allow safe transit around the Dow Thumb to the Upper Turning Basin. Participants included two Pilots from the Brazos Pilots Association, Engineer Research and Development Center (ERDC) technical oversight, and observers including commissioners and staff from Port Freeport, HDR Engineering, Inc., and Galveston District.

It is important to note the 2016 ship simulation did not dock the vessel at the Velasco Container Terminal at Berth 7. The intent of the 2016 ship simulation was to determine what modifications were necessary for the design vessel to make it around the Dow Thumb. The 2014 ship simulation used vessels of comparable length. **Figure 5-4** shows the vessel tracks from 2014 ship simulation and the maneuvering of the vessel outside the existing 1,200-foot Upper Turning Basin. An approximate representation of the existing diameter of the Upper Turning Basin has been added to the figures to demonstrate where the diameter is inadequate for the safe maneuvering of the vessel.

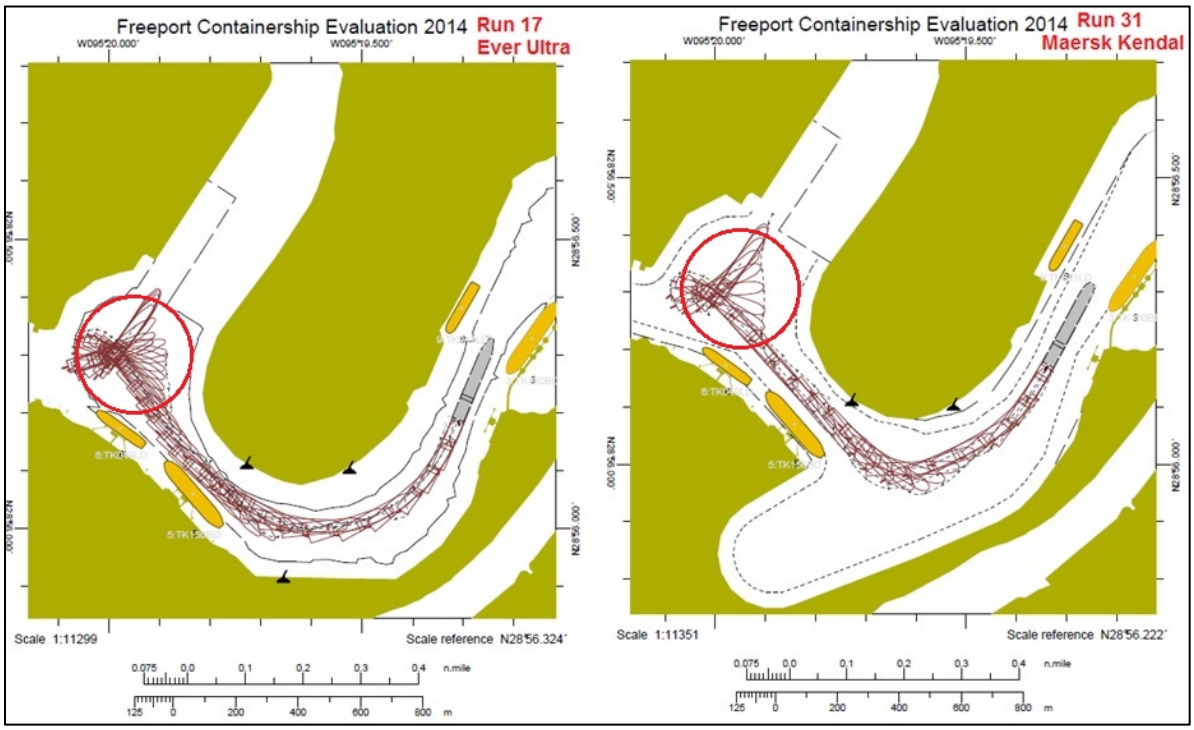

Figure 5-4 – 2014 Ship Simulation with Vessel Tracks at Upper Turning Basin

The 2016 simulation used the hydrodynamic model of a Panamax sized container vessel, the CMA CGM Virginia for the study (964.6 feet LOA, 105.6 feet Beam, and 42.6 feet draft). The recommendations of the 2016 Ship Simulation concluded that:

- Safe inbound and outbound transits with the Panamax sized vessel are possible with the 400-foot channel width;
- Three assist tugboats are critical for both inbound and outbound transits.

Based on the results of the 2016 ship simulation an initial screening of the Final Array of Alternatives was conducted (**Table 5-6**). If an alternative would not provide for the transit of the Panamax vessel around the Dow Thumb, it was screened out of the Final Array. Therefore, based on the results of the 2016 Ship Simulation, the remaining alternatives carried forward for final screening process are Alternative 2 (Widening at Dow Thumb (400 feet) + Bend Easing + Notch) and Alternative 3 (Widening at Dow Thumb (425 feet) + Bend Easing + Notch).

Table 5-6 – Screening of Alternatives[1] Based on 2016 Ship Simulation Results

Screening Criteria	**No Action Alternative** (FWOP Condition)	**Alternative 1** Widening at Dow Thumb (375 feet) + Bend Easing + Notch to 46 feet	**Alternative 2** Widening at Dow Thumb (400 feet) + Bend Easing + Notch to 46 feet	**Alternative 3** Widening at Dow Thumb (425 feet) + Bend Easing + Notch to 46 feet
Ship Simulation Confirmed Panamax Can Transit around Dow Thumb (Yes/No)	No	No	Yes	Yes
Forwarded for Evaluation	No	No	Yes	Yes

[1] Alternative 4 is for purposes of the incremental justification to determine whether the 46-foot depth is the National Economic Development Plan.

5.5 Final Comparison of Alternative Plans / Decision Criteria

Criteria used to evaluate the remaining two alternatives include an evaluation of costs and benefits of the proposed modification as a separable element (**Table 5-7**). Benefits were calculated utilizing the HarborSym model. The Project First Cost includes the HFPP Mitigation Feature (stability wall) needed prior to removal of the underwater berm, and widening of the channel, constructing the bend easing, and dredging of a turning notch, all to 46 feet MLLW. However, the costs to re-designate the west end of the North Wave Barrier to the elevated Old Quintana Road to allow for construction of the bend easing are not included. These costs will be addressed in the final report.

Environmental impacts were considered in the screening by including estimated fish and wildlife/wetland mitigation costs. However, none of these alternatives would result in environmental impacts requiring mitigation. Therefore, no environmental mitigation or monitoring costs are included in the estimated Project First Cost.

The First Cost of Construction for deepening to 46 feet MLLW, O&M, environmental mitigation, and monitoring costs ($0), and the HFPP mitigation feature (stability wall) cost were included in the Average Annual Costs. The cost to re-designate the west end of the North Wave Barrier to the elevated Old Quintana Road is not included; however, this will be addressed prior to the final report.

Table 5-7 – NED Benefit[2] Analysis for GRR Alternatives ($000)

Screening Criteria		**Alternative 2** Widening at Dow Thumb (400 feet) + Bend Easing + Notch	**Alternative 3** Widening at Dow Thumb (425 feet) + Bend Easing + Notch
		Oct 2016 Price Levels and 2.875% Interest Rate	
Total Costs	Project First Cost	$**57,006**	Greater than $**57,006**
	O&M Cost	$100,646	$100,646 or Greater
	Environmental Mitigation / Monitoring	$0	$0
	HFPP Mitigation Feature	$15,342	$15,342
Average Annual	Average Annual Costs[1]	$4,374	Greater than $4,374
	Average Annual Benefits	$6,452	$6,452
	BCR	1.47	Less than 1.47
	Net Excess Benefits	$2,078	Less than $2,078

[1] First cost of construction, O&M, and stability mitigation included in this cost; reassignment of wave barrier will be added for final report.
[2] The table shows costs and benefits at 46 feet.

Alternative 3 was not evaluated quantitatively because it could be removed through logical deduction. It is obvious that costs to widen to 425 feet would be more than the costs widening to 400 feet. Additional soil would need to be removed, and additional engineering might potentially be required to address levee stability. Additional dredging will also be needed since the footprint is larger than at 400 feet. Hence, the average annual costs are higher at 425 feet width than at 400 feet width. Meanwhile, the benefits are unchanged. With a 425-foot wide channel, there may be an increased safety margin, but quantifiable benefits are negligible. Vessel speeds will remain the same. Vessel classes, loading patterns, routes, and commodities all remain the same with both alternatives. Average annual benefits do not change. Therefore, Alternative 3 is deemed to have lower net excess benefits than Alternative 2.

Table 5-8 provides a comparison of the remaining two alternatives against the four criteria in the P&G: completeness, effectiveness, efficiency, and acceptability. Both alternatives in the final array are considered acceptable. While both alternatives would allow the transit of the Panamax design vessel around the Dow Thumb while avoiding and minimizing environmental impacts to the greatest extent possible during the 50-year period of analysis, the plan with the greatest net

excess benefits is considered the most complete, efficient, and effective plan. Therefore, Alternative 2 (Widening at Dow Thumb (400 feet) + Bend Easing + Notch) is the plan which best meets the four P&G criteria.

Table 5-8 – Comparison of P&G Criteria for Remaining Alternatives

Alternative Comparison to P&G Criteria	**Alternative 2** Widening at Dow Thumb (400 feet) + Bend Easing + Notch, all to 46 feet	**Alternative 3** Widening at Dow Thumb (425 feet) + Bend Easing + Notch, all to 46 feet
Acceptability *meets all laws, regulations, and guidance. Note this is also a safety issue.*	Acceptable; addresses safety issue.	Acceptable; addresses safety issue.
Completeness *provides and accounts for all necessary investments or other actions to ensure the realization of the planning objective.*	Plan is a complete solution to all planning objectives.	Plan is a complete solution to all planning objectives.
Efficiency is the e*xtent to which an alternative plan is the most cost effective means of achieving the objective.*	• Least cost alternative; • Most cost effective means of achieving the objective.	• Most expensive alternative; • Achieves same objective as least cost alternative; • This alternative not most cost effective alternative.
Effectiveness is the e*xtent to which the alternative plan contributes to achieve the planning objective.*	This alternative is effective for the Panamax transit around Dow Thumb and to and from the Velasco Container Terminal.	This alternative is effective for the Panamax transit around Dow Thumb and to and from the Velasco Container Terminal.

5.6 COMPARISON OF ENVIRONMENTAL IMPACTS OF FINAL ARRAY OF ALTERANTIVES

Environmental effects of the two alternatives would be very similar. Neither of these alternatives would affect the existing salinity, long-term water quality, EFH, protected species, wetlands, submerged aquatic vegetation (SAV), or prime farmlands, or have negative socio-economic effects. All of the channel modifications would be dredged to the existing authorized depth of 46 feet MLLW. The only difference in impacts would be associated with temporary and minor impacts of channel widening on the east bank of the Old Brazos River at the Dow Thumb. The channel would be widened from 279 to 400 feet under Alternative 2 and from 279 to 425 feet under Alternative 3. Channel widening with Alternative 2 would affect about 9.9 acres of submerged bottom, while widening to 425 feet would increase the channel widening impacts to submerged bottom by about 10 percent. Widening would result in the removal of part of the submerged berm around the Dow Thumb, deepening it from a current average depth of 30 to 40 feet MLLW to about 46 feet MLLW. Benthic organisms in the dredged area would be removed by the dredging, but recolonization is expected. No submerged aquatic vegetation

would be affected. Alternative 3 would also require a slightly longer construction period, resulting in slightly longer duration turbidity and slightly greater air emissions and noise impacts. A stability wall at the Dow Thumb would be required for both alternatives; it would be approximately the same size for both alternatives. This wall would be constructed between the existing HFPP's Old River North levee and the river's edge, on the existing levee slope. No wetlands would be affected by this construction and sediment barriers would be used to minimize the amount of sediment entering the river during construction. Turbidity impacts from construction would be minor and temporary.

Both Alternative 2 and Alternative 3 would include the following features, resulting in the same effects. Each would:

- dredge about 7.5 acres of submerged bottom and excavate 16.4 acres of emergent land to ease a bend on the west side of the channel south of the Dow Thumb;
- require the relocation of a portion of the HFPP wave barrier by re-designating a segment of the Old Quintana Highway to serve as the wave barrier; and
- dredge about 8.3 acres of submerged bottom to create a "Notch" at the Upper Turning Basin northwest of the Dow Thumb .

Dredging of submerged lands for the bend easing and notch would result in the deepening of a total of about 15.8 acres of subtidal bottom to 50 feet MLLW (depth includes advance maintenance and overdepth). The current water depth at the bend easing location is essentially the same as the deep draft channel; current depth in the notch area averages about 20 feet MLLW. Benthic organisms in the dredged area would be removed by the dredging, but recolonization is expected. No submerged aquatic vegetation would be affected. Excavation of 16.4 acres of emergent land for bend easing would result in no wetland impacts. The area has been disturbed by construction of the wave barrier, and is impounded by the barrier, Old Quintana Road and upland development. It is comprised primarily of the wave barrier and slope, and vegetated with Bermuda grass and other common grasses.

New work dredging for both alternatives would be conducted primarily with a hydraulic cutter head dredge, although mechanical excavation will be utilized for a portion of the bend easing area. All new work material would be placed in the existing upland confined PA 1. Maintenance dredging for both alternatives would be conducted with a hopper dredge and the material would be placed in existing ODMDS 1A. Potential impacts to threatened and endangered sea turtles, which are associated with hopper dredge use, would be the same for both alternatives. All potential takes are covered by the existing Gulf of Mexico Regional Biological Opinion (NMFS 2003, 2005, 2007).

Based upon the comparison of effects, there are only minor different potential impacts related to implementation of either of the action alternatives. Although long-term impacts for both projects are expected to be roughly equivalent, construction-related impacts are slightly less for Alternative 2. Thus, Alternative 2 has been identified as the environmentally preferable alternative. The No Action Alternative would not provide the socioeconomic benefits of improved navigation efficiency.

5.7 PLAN SELECTION

Alternative 2 is the most cost effective of the final array of alternatives for the first segment of construction to 46-feet deep. This plan involves widening the channel at the Dow Thumb to 400 feet, and constructing the bend easing and turning notch, all to 46 feet MLLW as the first segment of construction. The pilots concurred that the TSP would allow for the efficient, safe transit of the Panamax around the Dow Thumb and to and from the Velasco Container Terminal. No environmental mitigation would be required for Alternative 2. New work material for the TSP would be placed in PA 1

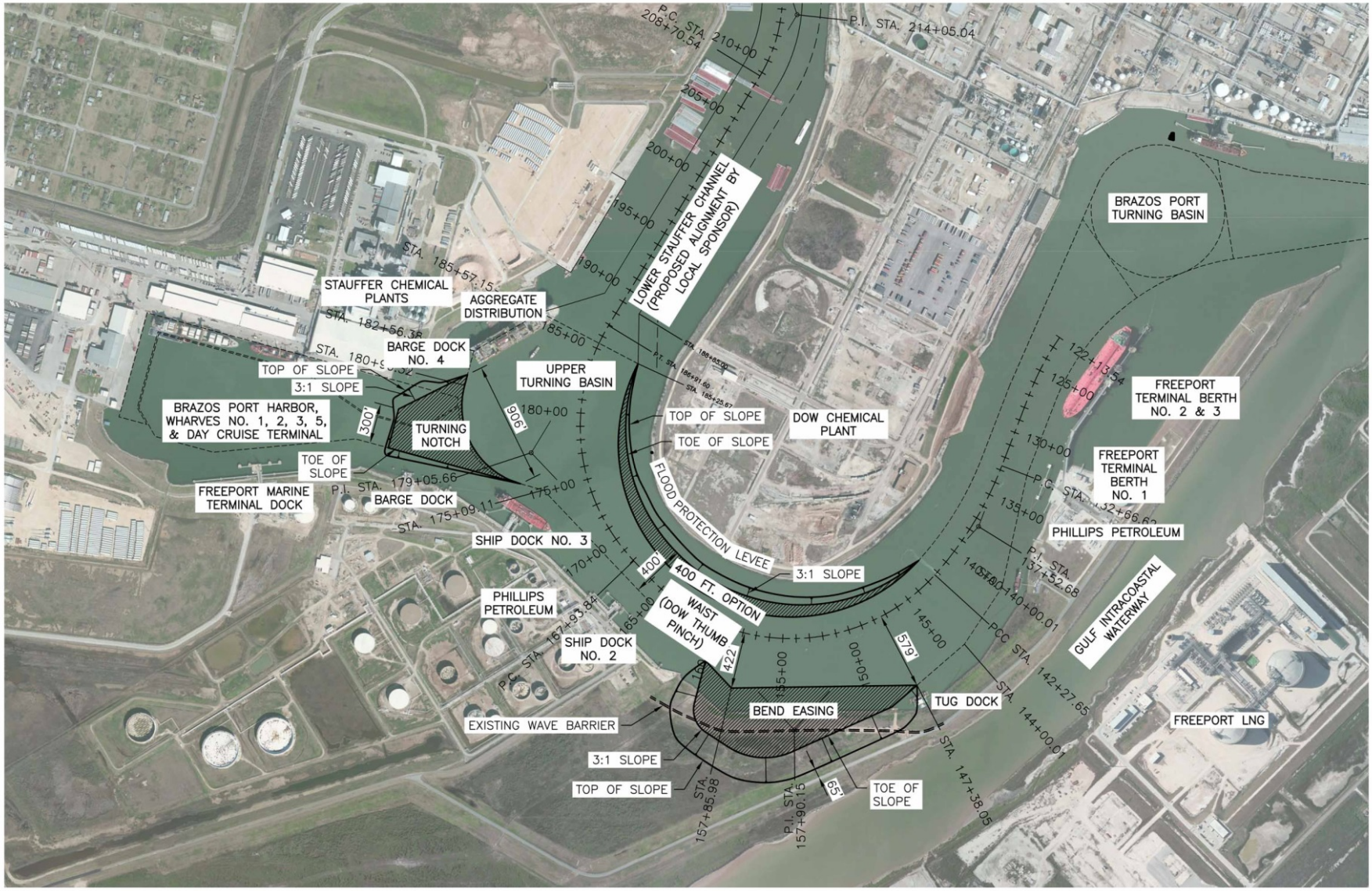

Figure 5-5 – Tentatively Selected Plan

5.7.1 NED Benefits

The economic analysis shows a benefit cost ratio of 1.68 at a channel depth of 46 feet for the TSP, as shown in **Table 5-9**.

Table 5-9 - Summary of Benefits and Costs at 46 Feet

	Economic Update	**TSP**
	October 2016 Price Levels, 2.875 % Interest Rate	
Project First Cost	$342,172,000	$57,006,000
Total O&M Cost (50 years)	$529,055,318	$100,645,700
Average Annual Cost	$26,051,693	$4,297,531
Average Annual Benefit	$36,158,939	$7,340,796
BCR	1.39	1.68
Net Excess Benefits	$10,107,246	$2,966,394

Alternative 4 [Widening at Dow Thumb (TSP width) + Bend Easing + Notch at Upper Turning Basin + optimization of the channel depth] was used for purposes of conducting an incremental analysis to determine the optimal depth for the TSP. The costs were calculated at 46 feet and 40 feet. Intermediate depths were interpolated based on a linear trend. HarborSym was used to calculate benefits, and individual model runs were conducted for the channel depths of 42 feet, 43 feet, 44 feet, 45 feet, and 46 feet. Depths for 41 and 40 feet were interpolated. The assumptions used at 46 feet were also used for each of the other depths. The only changing factor was the vessel's ability to load to its draft-constrained depth. The results showed that a channel depth for Reach 3 and the TSP showed the highest net benefits at an increment of 46 feet.

Economic justification requires that benefits exceed costs and therefore the benefit/cost ratio must exceed 1.0. The incremental analysis presented in **Table 5-10** shows the net excess benefits of the 44-foot, 45-foot, and 46-foot channel increments are increasing. The NED rule requires the USACE to select the plan that reasonably maximizes net benefits. The PDT believes that because the net benefit is increasing, that the additional depth is warranted in order to avoid the stair-step depth that would result around this tight curve of the channel around the Dow Thumb. Although the PDT cannot quantify any incremental increase in navigation risks, we believe the additional depth is warranted.

Table 5-10 – Incremental Analysis Summary ($000)

Channel Depth	40	41	42	43	44	45	46
	(2016 Price Level, 2.875 % Interest Rate)						
Average Annual Benefits	$3,123	$3,789	$4,455	$5,111	$5,598	$6,010	$6,452
Average Annual Costs	$4,270	$4,287	$4,305	$4,322	$4,340	$4,357	$4,374
Net Excess Benefits	($1,147)	($499)	$150	$788	$1,259	$1,653	$2,078
BCR	0.73	0.88	1.03	1.18	1.29	1.38	1.47

The NED plan is 46-feet. At this depth, the benefit cost ratio is 1.47 with net excess benefits of $2,078,000. As shown in **Figure 5-5** below, the break-even point on the investment, using only transportation cost savings as the source of benefits, is the year 2049 at 46 feet given current interest rates. Generally, a longer duration to the break-even year has a greater level of risk associated with the investment because of the uncertainty surrounding the assumptions. Simply stated, it is easier to predict what will happen next year versus 30 years from now.

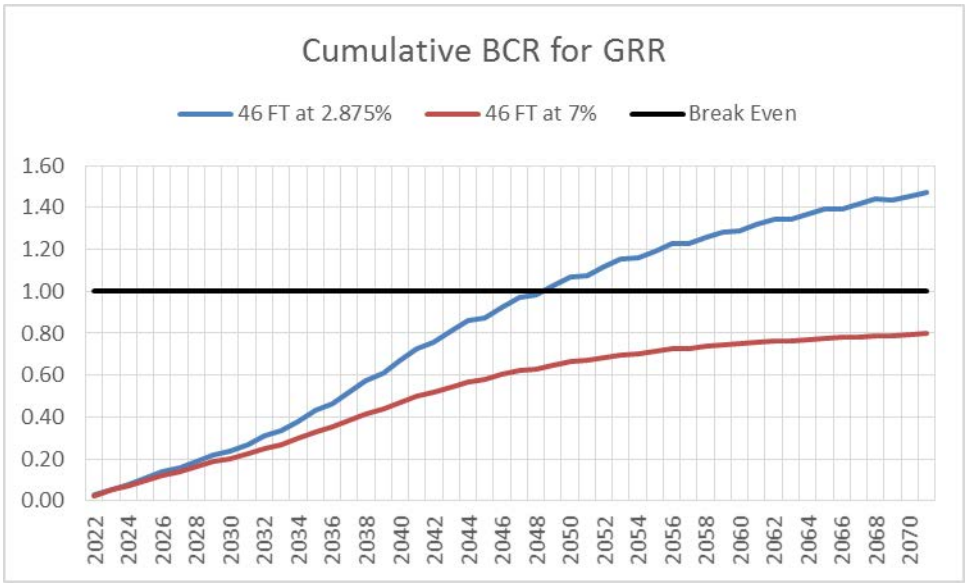

Figure 5-6 – Cumulative BCR for GRR

5.7.2 Least Cost Disposal Alternative

Placement options were evaluated to determine the best placement alternative for all material from the TSP, both new work and O&M. These alternatives considered possible beneficial use (BU) of dredged material, as well as traditional PAs.

5.7.2.1 Beneficial Use Opportunities

In accordance with existing Federal policy and guidance, the potential for BU of the limited quantity of new work material that would be generated by construction of the TSP was given additional consideration beyond the previous USACE (2012c) study. The BU analysis is focused

on the limited amount of new work material from the TSP features (1,730,000 cubic yards – primarily soft sandy clay). Based on a review of aerial photography, the nearest potential marsh restoration area is a small degraded marsh area in the southern Oyster Creek watershed, adjacent to the GIWW and just east of the project area (**Figure 5-5**). The pumping distance to this area from the Bend Easing feature is about 3.1 miles. The Bend Easing is the TSP feature closest to the BU area and contains the largest amount of new work material. It is possible that approximately 8 acres of marsh could be constructed with the available material. The pumping distance from the Bend Easing feature to PA 1 (the upland, confined placement area identified for material from this area) is about 2.3 miles. The PAs or BU areas selected in the DMMP are those, which provide the needed capacity at the lowest cost per cubic yard. Based solely on pumping distance, the least-cost disposal option would be PA 1 since the closest potential BU site is about 30 percent farther away. The TSP placement area selection is based upon the least-cost, environmentally acceptable alternative. However, the BU plan could be recommended if the NFS or other interested entity were willing to fund the difference (increase) in placement and construction costs over the least cost placement plan for the TSP.

Figure 5-7 - Potential BU Site

5.7.2.2 Screening for TSP Least Cost Plan (DMMP)

The BU Opportunities discussion in **Section 5.7.2.1** indicates that the closest potential BU site is approximately 30 percent farther pumping distance than the upland confined PA 1. Physical characteristics (bathymetry, geotechnical etc.) of this potential BU site are not known. While dike construction costs are similar to upland construction, additional costs for shore protection would be required for potential BU site. Based on the additional dredging costs for longer pumping distances and site development costs, the use of PA 1 for the new work material is the least cost alternative for the new work material.

5.7.3 Interrelation between the S2G Recommended Plan and the GRR TSP

The GRR study is proposing modification to the FHC in the area of the Dow Thumb. Earlier in **Section 1.9.6** and **Section 1.10**, it was mentioned that the S2G study was developing recommendations to modify the Old River North Levee as part of their recommended plan. The S2G study has proposed modifications on the terrestrial portion of the Dow Thumb as part of their recommended plan. The Freeport GRR and S2G are independent studies being conducted under separate business lines (navigation vs flood risk management or FRM). The PDTs for the Freeport GRR and S2G studies have coordinated and considered the potential effect that one project would have on the other.

The S2G study evaluated alternatives that would provide flood reduction for multiple areas along the upper Texas coast. One of the areas the S2G study focused on was the Freeport area. The S2G PDT evaluated improvements that could to be implemented to the existing Freeport HFPP (**Figure 5-6**). The S2G PDT determined that the levee required an elevation raise in the area around the Dow Thumb. Currently the levee is an earthen embankment and the S2G's recommended plan proposes to replace the earthen embankment with a pile founded T-wall. With the area currently at a questionable FOS for global stability, placing additional earthen material on the levee would further lower the FOS. Therefore, the earthen embankment around the Dow Thumb would be degraded to an elevation, which provides an acceptable FOS (per current guidance) for global stability of the level section. Then a T-wall would be placed on the earthen levee section (**Figure 5-7**). Upon completion of the S2G construction, the levee would meet current acceptable FOS.

The Freeport GRR TSP is currently considering the existing FOS of the levee as the FWOP condition since the S2G Recommended Plan has not yet been authorized. Although these features of the two studies (S2G and Freeport GRR) are located immediately adjacent to each other, the studies are not proposing alternatives that would limit the ability to implement either proposed project or FOS correcting mitigation feature. The S2G study is proposing a solution that would affect the earthen levee itself and replace the feature with a T-Wall that is supported

by deep-driven piles. The Freeport GRR TSP is proposing a solution that would insert a stability feature (i.e. A-Z Wall) into the terrestrial portion of the Dow Thumb at the waterside toe of the HFPP levee. Each of the proposed solutions are implementable on their own and could be implemented together.

Figure 5-8 - Map displaying location of the HFPP levee on Dow Thumb

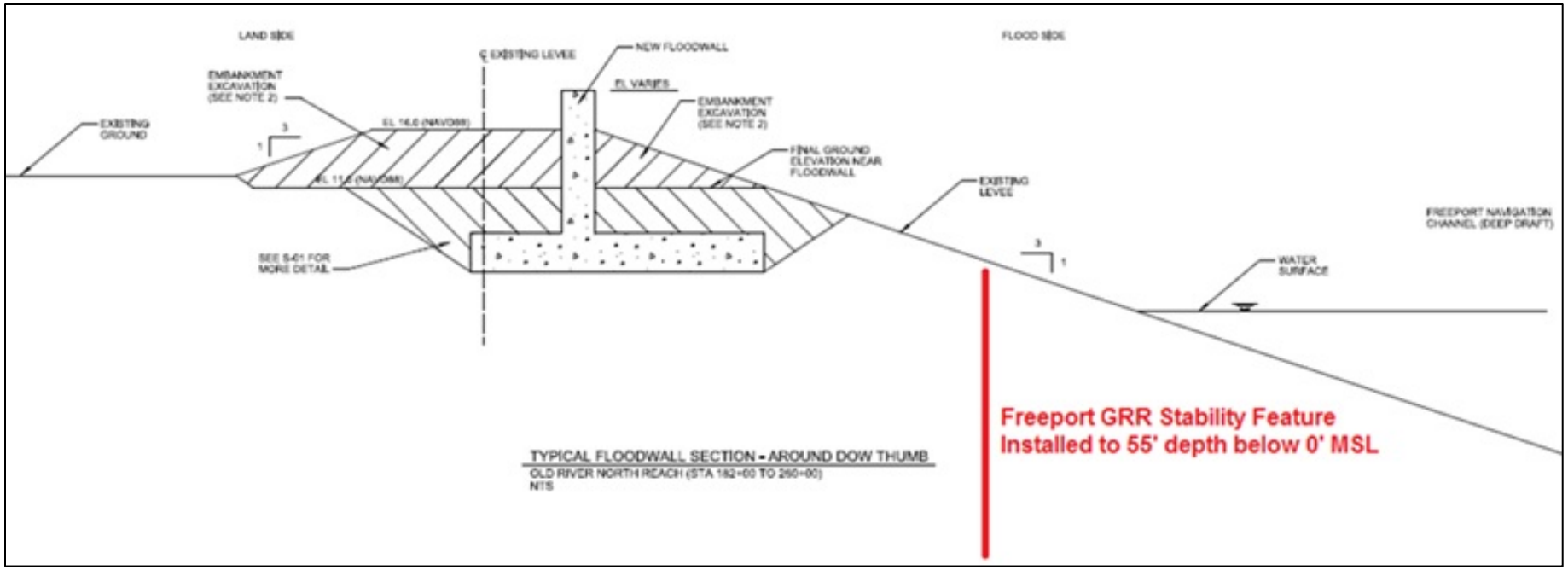

Figure 5-9 - S2G Typical Floodwall Section and Freeport GRR Proposed Modifications for TSP

6 TENTATIVELY SELECTED PLAN

The TSP for modification of the 2012 Feasibility Report is identified as Alternative 2. This alternative addresses the safe, efficient navigation of the Panamax vessel around the Dow Thumb, for transit to and from the Velasco Container Terminal. This alternative is considered the most cost effective alternative of the final array of alternatives.

6.1 PLAN COMPONENTS

The TSP consists of the following features:

- Channel widening to 400 feet from approximately Sta. 142+28 to Sta. 184+20. This would include removal of the underwater berm around the perimeter of the Dow Thumb;
- Dredging a new bend easing at the wave barrier from Sta. 147+00 to Sta. 160+00 (re-designating west end of wave barrier to Old Quintana Road); and
- Dredging a new turning notch at the Upper Turning Basin (Sta. 175+00 to 182+00) situated adjacent to the Brazos Port Harbor.

6.1.1 New Work Construction

Alternative 2, the TSP, consists of widening the channel around the Dow Thumb to 400 feet between Station 142+28 and Station 184+20. The HFPP levee was constructed tightly close to the FHC and the north slope of the FHC in this area is the toe and underwater berm of the HFPP levee. The underwater berm provides slope stability to the levee. To widen the channel to 400 feet, the underwater berm must be removed. Due to slope stability concerns, the foundation reinforcement would be constructed prior to removal of the underwater berm.

6.1.1.1 Underwater Berm and Stability Wall Prior to Channel Widening

A slope stability analysis was conducted on the levee in the Dow Thumb area. Based on available foundation strength information from 1978 investigations, the computed FOS once the underwater berm is removed was calculated to be about 1, which is non-compliant with the national levee safety guidance specified in EM 1110-2-1902 and EM 1110-2-1913, which recommend a FOS value of 1.3. Discussions with the District Levee Safety Program indicated the navigation project must implement engineering solutions to make the FRM project (the FHPP) whole by bringing the levee up to an acceptable FOS (>1.3), which based on existing data, would be above the current FOS of the levee in this area.

To facilitate removal of the underwater berm while increasing the FOS for the HFPP, two design alternatives that would meet current levee safety guidance with the underwater berm removed

are proposed. One design alternative is to construct a sheet pile wall out of commercially available steel Pipe-PZ or Pipe-AZ systems; the other design alternative is to use deep soil mixing to strengthen the critical foundation soil stratum. Preliminary slope stability analysis demonstrates a possibility of increasing the factor of safety to 1.698 by using this combined system to 55 feet below zero elevation. The deep soil mixing would provide a slightly lower FOS (1.682) for higher cost.

6.1.1.1.1 Discussion of Low Soil Shear Strength Concern

It must be noted that no new geotechnical data was gathered for this study. All stability and design analysis was done using existing information. The current slope stability analyses are based upon the historical foundation information obtained in 1970s. The latest foundation investigation was conducted by PSI; however, the strength information provided a similar strength data as the District 1970's subsurface investigation. Therefore, PSI data was not used for the slope stability analyses for the GRR. The District concluded the existing strength data is questionable due to the very low strength; however, this is the only information with field logs and lab report available for the GRR study. Therefore, the District recommends collection of additional foundation soil information during PED to validate the existing critical foundational strata and validate the current conceptual design.

6.1.1.2 Channel Widening, Bend Easing, and Turning Notch Construction

Construction of the TSP would result in approximately 1.734 million cubic yards (MCY) of new work dredged material **(Table 6-1**). Quantities from each of the TSP features are provided with the soil classification for the material to be dredged. All TSP new work material is designated for placement at PA 1 by transfer through pipeline (**Engineer Appendix, Section 4.3)**.

Table 6-1 – Classification of TSP New Work Dredged Material Volumes

Reach	Station		Soil Classification[1] of New Work			Total Quantity
			Soft Silty Sand	Soft Silty Clay	Soft Sandy Clay	
	Start	End	(cy)			
Bend Easing	147+00	159+85	0	0	1,478,000	1,478,000
Turning Notch	175+77	181+41	0	106,000	0	106,000
Channel Widening	142+28	184+20	106,000	29,000	15,000	**150,000**
Total TSP New Work	**142+28**	**185+26**	**106,000**	**134,000**	**1,490,000**	**1,734,000**

[1]*Soil classification based on historical boring logs from the project area.*

The dredging of the bend easing would cut into the west end of the existing North Wave Barrier at this location. Therefore, the elevated Old Quintana Road, located immediately south of the

existing wave barrier, would be re-designated as the wave barrier (**Figure 6-2**). A new flood-protection levee easement would be conveyed to the VDD for the right to operate and maintain the re-designated wave barrier. Designating this portion of the North Wave Barrier to the road would situate this portion of the wave barrier contiguous with the remainder of the barrier running eastward along Old Quintana Road.

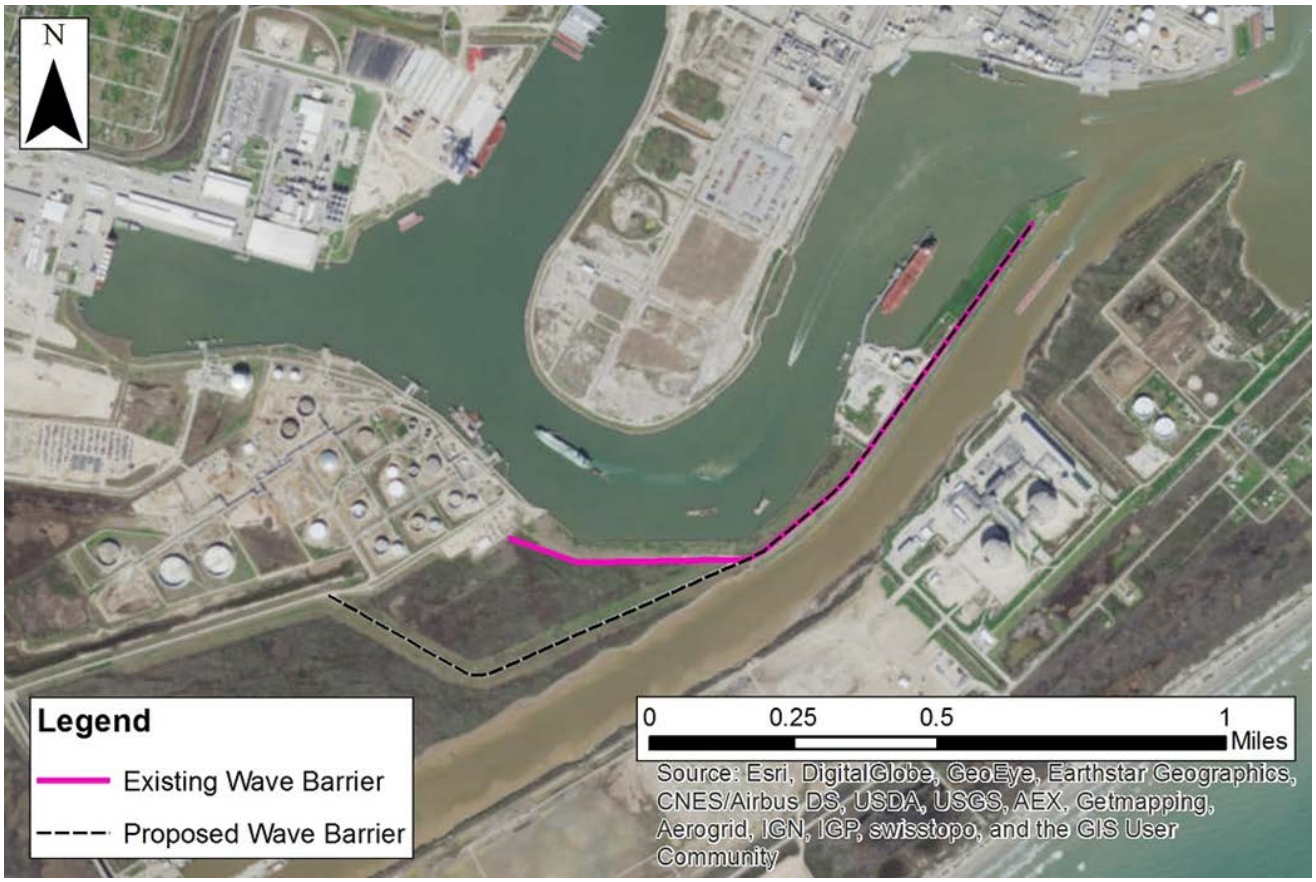

Figure 6-1 – Relocate/Redesignate Wave Barrier Portion to Old Quintana Road

6.1.2 Dredged Material Management Plan

A summary of dredged material placement is presented below, with a more detailed DMMP for the TSP included in **Appendix K** of this report.

6.1.2.1 New Work Placement

The construction of the TSP will result in approximately 1.73 MCY of new work dredged material. Additionally, although not part of TSP, the NFS WIK on the Lower Stauffer Channel, conducted under the WRRDA 2014 authorization, will result in new work dredging quantities of approximately 270,000 CY to be placed in PA 1. Therefore, those quantities are also included in the table to confirm adequate capacity is available in PA 1 for the TSP and WIK new work material. In total, all new work dredged material, totaling approximately 2.0 MCY, will be

transferred through pipeline to PA 1 (**Table 6-2**). For additional information, see **Engineer Appendix Section 4.3.6.1**.

Table 6-2 – New Work Dredging and Placement Plan for TSP

Feature	Stations		In-place Vol. (cy)	Bulk Factor	Bulk Vol. (cy)	Placement Location
	From	To				
Channel Widening	142+28	184+20	150,000	1.425	213,750	PA1
Bend Easing	147+00	159+85	1,478,000	1.425	2,106,150	PA1
Turning Notch	175+77	181+41	106,000	1.425	151,050	PA1
TSP Total New Work			**1,734,000**	1.425	**2,470,950**	**PA1**
Lower Stauffer WIK[1]	184+20	198+50	270,000	1.425	384,750	PA 1
Total Including WIK Volumes			**2,004,000**	**1.425**	**2,855,700**	**PA1**

[1] *Not part of the TSP, provided for PA capacity assessment purposes only*

PA 1 is located in Freeport roughly 0.5 mile south of SH 36 and approximately 1,000 feet east of the Brazos River Diversion Channel (USACE 2012a). The PA is approximately 320 acres, with a perimeter length of approximately 20,310 linear feet. Existing ground elevation is approximately 21 feet NAVD with a dike height of 25 feet NAVD. While the existing capacity of PA 1 is approximately 0.8 MCY, the PA is estimated to provide up to 3.4 MCY of capacity if the dikes are raised to 31.5 feet NAVD. This DMMP proposes a dike elevation increase to 31.5 feet NAVD for PA1. This height includes 3 feet for ponding and freeboard above the targeted bulk dredged fill height. The footprint of the existing PA will not be expanded outside of the existing PA right-of-way (**Engineer Appendix, Section 4.3.1.3).**

6.1.2.2 Maintenance Material Placement

As noted previously, the Sponsor's WIK quantities will be included in the TSP Placement Plan to ensure adequate capacity is available for the Federal project. After the completion of new work dredging for the TSP and the Sponsor's WIK at Lower Stauffer Channel, the project will require periodic maintenance dredging to maintain navigability. It is estimated that the entire FHC (Stations 71+52 to 185+26) will receive an annual shoaling volume of approximately 261,000 cubic yards. Additionally, it is estimated that the Lower Stauffer Channel will receive an annual shoaling rate of approximately 2,500 cubic yards.

The DMMP developed for this project is based on maintenance dredging in 3-year cycles. Sixteen (16) dredging cycles are expected to occur within the 50-year timeframe covered by the DMMP, with a total dredged volume of approximately 2.7 MCY for TSP features. All maintenance-dredged volume is designated for placement at the Maintenance ODMDS. **Table**

6-3 contains the 50-year placement plan for the maintenance-dredged material (**Engineer Appendix, Section 4.3.6.2**).

Table 6-3 – 50-Year Placement Plan for Maintenance Dredged Material for TSP

Reach	Stations		Annual Volume	Cycle Length	Volume per Cycle	No. of Cycles	Total Volume	PAs
	Start	End	(cy)	(year)	(cy)		(cy)	
Channel Widening	142+28	185+26	12,900	3	38,700	16	619,200	ODMDS 1A
Bend Easing	147+00	159+85	30,900	3	92,700	16	1,483,200	ODMDS 1A
Turning Notch	175+77	181+41	10,800	3	32,400	16	518,400	ODMDS 1A
Lower Stauffer Channel[1]	185+26	260+00	2,500	12	30,000	4	120,000	ODMDS 1A
Total Maintenance	142+28	260+00	**57,100**	**varies**			**2,740,800**	ODMDS 1A

[1] *Not part of the TSP, provided for capacity assessment purposes.*

6.1.3 Environmental Mitigation

The TSP would result in no significant environmental or historic property impacts and therefore no mitigation is required.

6.1.4 Cost Estimate for TSP (Alternative 2)

A Class 4 parametric cost, using historical and unit costs, was applied to develop the estimated cost estimate for screening the final array (**Table 6-4**). As per ER 1110-2-1302, in a Class 4 estimate, certain construction elements can be estimated in detail; however, there is still a great deal of uncertainty relative to major construction components.

A cost estimate using Microcomputer Aided Cost Estimating System (MCACES) was developed for the draft report; however, this estimate will be refined with implementation of feasibility-level design following the concurrent public and agency review, policy review, and ATR. The Civil Works Cost Engineering and Agency Technical Review Mandatory Center of Expertise will provide a mandatory ATR of the final cost estimate prior to certification.

Table 6-4 – Estimated Project First Cost for TSP ($000)

Cost Account and Feature	GRR First Cost *(Oct 2016 Price level)*
01 Lands & Damages (100% Non-Federal)	3,989
11 Levees & Floodwalls	20,767
12 Navigation, Ports & Harbors	25,695
16 Bank Stabilization	1,163
30 Preconstruction Engineering & Design (PED)	3,725
31 Construction Management (E&D, S&A)	1,667
Total Project First Cost	**57,006**

6.1.5 Project Schedule and Interest During Construction

A project schedule and interest during construction plan will be developed for the plan carried forward for feasibility-level design following the concurrent public and agency review, policy review, and ATR.

6.2 DESIGN AND CONSTRUCTION CONSIDERATIONS

6.2.1 Value Engineering

A Value Engineering (VE) study was performed to determine alternatives that would improve ship navigation efficiency and safety, and possibly identify potential savings of project costs. The VE study was performed subsequent to the 2016 ship simulation so it was based on the preliminary results from those studies and limited to a plan for widening the channel to 400 feet wide, bend easing, and a turning notch. The VE study resulted in seven VE alternatives (**Table 6-5**). The PDT reviewed each of the VE alternatives and the VE teams projected values for the initial cost savings and the life cycle cost savings. Then a determination was made as to whether the VE alternative would be accepted, rejected, or deferred.

Table 6-5 –Recommended VE Alternatives and Evaluation

VE Alt	Description	Cost Savings • Initial, • Life Cycle	Accepted/Rejected/Deferred
1.1	Increase channel widening from 400 feet to 600 feet at DOW Thumb	•$3,242,000 •$42,459,000	Not Accepted; outside scope, defer to future study
1.2	Consult with HFPP to authorize design waiver to remove existing underwater berm without mitigation	•$11,746,000 •$0	Rejected, removing the underwater berm with the HFPP levee in the current location would leave an unacceptable Factor of Safety for the levee.
2.0	Reduce bend easing footprint by 20 percent and reconfigure optimally	•$3,591,000 •$0	Rejected, the pilots, being the experts of the Freeport Harbor Channel and large vessel operation, considered what would be needed and realistic to facilitate safe transit.
3.0	Use a combination of mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging	•$1,263,000 •$0	Accepted, excavated material from terrestrial portion of bend easing would be reasonably dry allowing immediate use to raise levees, etc. However, contractor determines least cost method.
4.0	Sell above-ground excavated material to local developers or back to Port Freeport	•$300,000 •$0	Rejected, at this level of design in the feasibility state a high variability of uncertainty exists in regards to availability of potential buyers of the material. Additionally this requires additional contract and legal aspects.
5.0	Reduce advanced maintenance dredging from 2 feet to 1 foot across the footprint of the dredging	•$1,771,000 •$7,867,000	Rejected, PDT does not agree with the VE team recommendation that lessening the advanced maintenance would result is an overall cost savings. In addition, cost of O&M would have to increase the frequency of the dredging cycles, as the channel would shoal past the authorized depth more often.
6.0	Pre-purchase steel sheet piling through USACE to reduce timing and save sales tax costs	•$393,000 •$7,867,000	Rejected, while the Corps purchasing steel sheet pile may save the sales tax, the Corps would have to accept the risk for material quality and delivery. Additionally, the Corps would then need to store the material adding additional cost. The PDT also states the Corps as a Federal entity does not pay sales taxes, neither does the contractor working on behalf of the Corps. Risks overweigh the relatively low cost savings.

6.2.2 With-Project Sea Level Rise

Relative Sea Level Rise (RSLR) was calculated for 50 years starting in year 2020 as the sum of average global sea level rise, vertical land movement, and regional basin trends utilizing USACE curves. The sea level rise analysis revealed a 50-year RSLR of between 0.71 feet assuming USACE Low curve, 1.18 feet assuming USACE Intermediate curve, and 2.68 feet assuming USACE High curve. To maintain consistency with previous USACE studies in the region, a 50-year RSLR value of 1.18 feet was selected for this project based on the USACE Intermediate curve (**Engineer Appendix, Section 6.3**).

6.2.3 Storm Surge

The channel's wave climate was modeled in STWAVE under the No Action Alternative and the TSP, assuming an extreme storm event consisting of 100-year wind speed and 100-year still water level. Wave modeling was repeated with RSLR added to investigate possible effects of RSLR. Wave modeling shows little change (<0.1 feet) in wave height between the TSP and the No-Action Alternative. Due to minor increase of wave heights imposed by the TSP, it was concluded that the TSP would have minimal effect on the overtopping of levees and seawalls protecting the Dow and Stauffer plants.

Using the wave characteristics obtained from the wave analysis, the levees and floodwalls protecting the Dow and Stauffer plants were analyzed for overtopping. Construction of the TSP requires partial removal of the wave barrier on the south side of the channel. The original intent of the wave barrier was to limit wave attack on the flood protection structures leeward of the barrier and to impede storm surges to the navigation channel. As confirmed thorough numerical modeling performed as part of the current investigation, the increased land elevations at Quintana greatly reduce the wave impacts on the wave barrier, with emergent land expected to remain even during the design storm. Furthermore, a roadway (Old Quintana Road) which passes along the south side of the FHC, separating it from the GIWW before turning northwest to Phillips, is both seaward of the wave barrier and at a higher elevation than the existing wave barrier.

Analyses suggest that implementation of the TSP would have minimal effect on the channel's hydrodynamics. See **Engineer Appendix, Attachment 2**, *Final Hydrology and Hydraulics Report, Freeport Harbor Channel Improvement Project, General Reevaluation Report, Brazoria County, Texas*, dated November 28, 2016 (Final Hydrology and Hydraulics Report), for detailed information.

6.3 REAL ESTATE CONSIDERATIONS

The existing HFPP includes a levee and an underwater berm situated along the perimeter of the Dow Thumb and parallel to the proposed widening in Reach 2 of the FHC. Widening at Dow Thumb would require removal of the underwater berm (exercised under navigation servitude), necessitating the incorporation of a stabilizing structure along the waterside of the HFPP levee. The structure would be inserted into the soil on the land portion of the Dow Thumb along the waterside of the HFPP levee most likely within the Right-of-Way (ROW) of the existing HFPP. VDD holds a perpetual easement from Dow Chemical for the current levee structure. The easement grants an estate with subordination of all rights to the drainage district, which are not specifically constrained except by reference to the overall purpose of the HFPP. Based on this

easement the sponsor would be able to conduct the work within the described footprint of the easement. As such, there are no anticipated real estate issues with this feature.

The bend easing feature on the southern bank of the channel located across from the Dow Thumb would require Port Freeport to provide the necessary real property interests to facilitate construction. There are no anticipated real estate issues with this feature and Port Freeport is aware of the real estate requirement and stated that it will provide the necessary real property interest. The addition of a turning notch situated adjacent to the current Upper Turning Basin would not require additional real property acquisition and would be constructed under Navigation Servitude.

Assumption is that a new flood protection easement can be conveyed from the non-Federal sponsor to the VDD for the re-designation of the west end of the North Wave Barrier due to the bend easing. The VDD currently has an existing flood-protection levee easement. For the proposed feature, the current flood-protection levee easement would need to be revoked and a new easement issued. If terms cannot be agreed upon between the non-Federal sponsor and the VDD, delays in the project schedule prior to construction and increase in project costs would be incurred.

6.3.1 Lands, Easements, and Rights-of-Way

The Project Sponsor is required to furnish the lands, easements, and rights of way (LERRD) for the proposed cost-shared project. The real estate requirements must support construction as well as O&M of the project after completion.

The 2012 Feasibility Report DMMP included the use of the existing PA 1, and future use of PAs 8 and 9, once constructed. The tract on which PA 9 was to be constructed is no longer owned in fee by Port Freeport and a new maintenance plan has been developed. It has been demonstrated that placing all maintenance material from the FHC into the ODMDS 1A is the least cost placement; therefore, PA 9 is no longer necessary for placement of dredged material from the authorized project or the TSP.

All new work material from the TSP is designated for placement into PA 1, for which the sponsor owns the land in fee. A 20-year temporary disposal easement for PA 1 was conveyed by the sponsor to the Government for the period from December 16, 2004 to December 2024. The subject term easement will need to be converted to a non-standard perpetual dredge material easement to the Government.

The bend easing will require an estimated 10 acres of land to be cut away from two tracts owned by the NFS in fee. The NFS will be required to convey a perpetual channel improvement easement to the Government. The material from construction of the bend easing would be placed into PA 1. Construction of the bend easing would also require cutting into the portion of the North Wave Barrier not running along the Old Quintana Road. The wave barrier would be re-designated from its current location to the Old Quintana Road and contiguous with the remainder of the North Wave Barrier.

The Future PA 8 is part of the 2012 Feasibility Report DMMP. The NFS owns the land in fee for PA 8. As such, a non-standard perpetual dredge material easement and a dredged material pipeline easement to the Government will still be required.

6.3.2 Facility Removals/Deep-Draft Utility Relocations

There are two known pipelines crossing the channel (Freeport LNG and Enbridge Power Corporation). It has been determined that no pipeline relocation or removals are required.

The bend easing project feature would impact the west end of the existing North Wave Barrier of the HFPP. This structure will need to be relocated and a new flood-protection levee easement will need to be conveyed to the VDD for the right to operate and maintain the relocated levee. The cost for the re-designation of the wave barrier is not currently included in the total project cost.

6.4 OPERATIONS AND MAINTENANCE CONSIDERATIONS

The sedimentation analysis suggested annual shoaling rates in Freeport Harbor Channel would increase from approximately 281,000 cy/year for the No Action Alternative to approximately 315,000 cy/year for the TSP, an increase of 12 percent. Additional details on the anticipated shoaling rates are presented in the Engineer Appendix, Attachment 2, Final Hydrology and Hydraulics Report.

6.4.1 Environmental Quality

Adverse EQ effects of the TSP are negligible and there is no required fish and wildlife or historic property mitigation. All factors that would be relevant to the TSP were considered, including impacts on wetlands, effects on essential fish habitat and listed species, air quality, water and sediment quality, hazardous materials, historic properties, and socioeconomic, and environmental justice impacts. Potential effects were evaluated under the EQ account and are detailed in **Section 7**.

6.4.2 Regional Economic Development Benefits

At the aggregate level, U.S. demand for imported containerized goods is recognized as a function of domestic income, population, and other factors influencing demand, such as exchange rates. Demand for containerized exports depends upon economic activity in other countries, exchange rates, and other factors. The geographic pattern of U.S. demand for container port services depends upon (1) the location of domestic consumers with respect to foreign sources for imports, (2) the location of manufacturers, farms, resource industries, and other exporting businesses relative to foreign markets for their goods, and (3) the availability and relative costs of intermodal transport from sources to markets. Correlation between population and container volume, particularly imports, is cited by several analysts. While population is one of several variables affecting traffic growth, it is recognizably a key variable, particularly for this study region, where over 90 percent of the existing container tonnage is served by trucks. Population growth for the counties within the Freeport and Houston port areas is presented in **Table 6-6**. While the population forecast shows fairly high growth for the region included in the HGB Statistical Metropolitan Area, regional population has increased at higher rates than expected **(Table 6-7)**.

Table 6-6 – Metropolitan Statistical Area Population Project Texas Counties Adjacent to Freeport, Texas

County	2000	2010	2020	2030	2040	2050	2060	Average Annual Growth Rate (%) 2000–2060
Brazoria County	241,767	313,166	331,731	375,664	416,157	459,078	503,894	1.2
Harris County	3,321,660	4,092,459	4,416,793	4,964,463	5,512,168	6,059,895	6,607,635	1.2
Fort Bend	354,452	585,375	630,624	802,486	979,196	1,210,945	1,475,761	2.4
Wharton County	41,188	41,280	46,045	47,647	48,567	48,590	48,074	0.3
Galveston	250,158	291,309	284,731	294,218	298,057	300,915	302,774	0.3
Matagorda	37,957	36,702	43,295	44,991	45,925	45,793	45,377	0.3

Source: Texas Water Development Board, 2006 Regional Water Plan, County Population Projections 2000–2060.

Table 6-7- Houston-Galveston Statistical Metropolitan Area 2000-2010 Population Estimates, Select Counties

County	2000	2010	2000–2010 Growth Rate (%)
Brazoria County	241,767	313,166	2.6
Harris County	3,321,660	4,92,459	2.1
Fort Bend	354,452	585,375	5.1
Wharton County	41,188	41,280	0.0
Galveston	250,158	291,309	1.5
Matagorda	37,957	36,702	–0.3
Total	4,247,182	5,360,291	2.4

Source: U.S. Bureau of Census

The distance from Freeport to towns and cities within and adjacent to Freeport was examined to determine the immediate market area. **Table 6-8** displays mileages from Freeport to towns and cities within and adjacent to Brazoria County. In addition to relative distances from Freeport, the location of "distribution centers" (DCs), also referred to as "inland ports," was examined. It is noted that the inland ports of Alliance (Forth Worth), Wilmer (Dallas), and Kelly (San Antonio) are part of the Texas freight distribution network. The inland ports are noted to complement the overland border ports of entry, where consolidation of North American Free Trade Agreement–related trade transfers can take place. It is recognized that DCs previously functioned primarily as warehouses but currently are involved in repackaging cargo for retailers and adding value to commodities. These centers are established along supply chains to service retail outlets such as Wal-Mart, Target, Home Depot, and Lowes. While Houston has clear mileage advantages over Freeport for cargo traveling to Dallas/Fort Worth, the comparative one-way distance to San Antonio is less than 5 miles. Plans to widen the Panama Canal to accommodate larger container vessels will increase Texas container traffic. Over the next 20 years, Texas ports, waterways, highways, and rail facilities will handle between 50 and 85 percent more freight, depending on the mode of transportation, according to "Texas Ports 2007–2008 Capital Program," a report by the Texas Department of Transportation.

Table 6-8 – Mileage Comparison to Cities Within or Adjacent to Brazoria County

City	Freeport miles	LaPorte miles	Freeport Advantage Plus (+)	County
Lake Jackson	10	64	54	Brazoria
Rosenberg	58	58	0	Ft. Bend
Bay City	49	90	41	Matagorda
Angleton	27	54	27	Brazoria
Freeport	0	74	74	Brazoria
El Campo	101	102	1	Wharton
Clute	8	69	61	Brazoria
Wharton	60	82	22	Wharton
Palacios	72	128	56	Matagorda
West Colombia	26	66	40	Brazoria
Sweeny	27	75	48	Brazoria
Brazoria	18	66	48	Brazoria
Jones Creek	8	72	64	Brazoria
Danbury	25	41	16	Brazoria

6.4.3 Other Social Effects

As previously stated, the GRR features will help alleviate safety concerns expressed by the pilots as they traverse the Dow Thumb. This increase of safety will help reduce the risk of allisions and collisions. The TSP is the safest alternative for the projected traffic. Hence, public safety may be increased by addressing safety concerns expressed by the pilots.

6.5 RISK AND UNCERTAINTY

Risk and uncertainty is an important part of the USACE planning process and is emphasized in Goal 2 of the USACE Campaign Plan, later addressed in **Section 8.12.1**.

6.5.1 Engineering Data and Models

Baseline storm surges used for the analysis were composed of the suite of storm surges produced from the Federal Emergency Management Agency (FEMA) Texas Joint Storm Surge Study (JSS). The FEMA Texas JSS used the Advanced Circulation (ADCIRC) model together with the ERDC Steady State Wave model (STWAVE) to perform storm surge and wave simulations.

In the Freeport region, without project storm model results were applied for both with- and without-project conditions. This approach includes uncertainty associated with still water level overtopping and potential adjacent impacts.

Ship simulation modeling reproduced real-time vessel responses to various interacting forces including wind force, bank forces, tug and bow thruster forces, and ship-to-ship interaction. Final results for the optimized channel were based on simulation runs for the existing and proposed conditions, and analyses of vessel tracks and pilot evaluations. Although there is a degree of uncertainty involved in the accuracy of visual and environmental data, the real-time simulation by ship pilots determined the optimal channel widths required for safe navigation. The real-time runs are guided by the personal experience and knowledge of the pilots, and their testing is subjective. As such, the risk-based analysis is somewhat inappropriate for ship simulation.

6.5.1.1 Relative Sea Level Rise

This study uses current USACE sea level change guidance as required for USACE studies. Total RSLR at Port Freeport is slightly greater that the average global sea level rise primarily due to land subsidence and regional oceanographic behavior of the Gulf of Mexico. Based on NOAA scenarios, the relative sea level rise is estimated to be between 0.96 feet and 3.66 feet for the period of 2020-2070. Similarly, USACE scenarios predict a relative sea level rise of between 0.71 feet and 2.68 feet for the same period.

An intermediate-high 50-year rate of RSLR (2.4 feet) was used for the storm surge modeling. An intermediate 50-year rate of RSLR (1.18 feet), as calculated with the corps climate tool, was used as the “most likely” estimate of RSLR in the other analyses for this project, in accordance with the USACE planning guidance. The functioning of the navigation features would not be significantly affected by the full range of potential sea level change. Construction dredging would not be affected by future rates of RSLR. While shoaling rates toward the end of the period of analysis could increase due to an enlarged cross section and greater saltwater penetration, this small effect would probably be offset by increased overall water depths.

6.5.1.2 Geotechnical Data used for Levee Stability Feature Design

The current slope stability analyses are based upon the historical foundation information obtained in 1970s. The latest foundation investigation was conducted by PSI; however, the strength information provided a similar strength data as Galveston District’s 1970's subsurface investigation, so PSI data was not used for the slope stability analyses for the GRR study. The District concluded that the existing strength data is questionable due to the very low strength. Nonetheless, this is the only information with field logs and lab report available for the GRR

study. For that reason, the District recommends collection of additional foundation soil information to validate the existing critical foundational strata and to validate the current conceptual design of the stability wall.

6.5.1.3 Re-designating the Wave Barrier to Old Quintana Road

All of the evaluated alternatives, except the No-Action Alternative require the bend easing feature to facilitate transport of the Panamax vessel to and from the Velasco Container Terminal in Reach 3. The creation of this feature requires the re-designation of a wave barrier associated with the HFPP. Since the feature is part of another Federal project, if the feature cannot be re-designated to the elevated Old Quintana Road or something comparable, the GRR study does not have a valid alternative.

Feedback provided by the Pilots was used to design the features and a ship simulation was conducted to verify the Panamax design vessel would be able to transit efficiently, safely around the Dow Thumb to the Upper Turning Basin. ERDC conducted storm surge modeling and the Sponsor conducted hydrodynamic wave overtopping analysis to show that the wave barrier is not needed for its intended function due to changes in geography (area was elevated sustainably) on Quintana Island.

6.5.1.4 Sediment Sampling on the Dow Thumb

The TSP would result in the insertion of a stability structure on land located along the HFPP levee toe waterside. The Dow Chemical Company has been operating in this general area since World War II and there are rumors that releases of HTRW may have occurred in this area. If contaminated sediments were identified in a study/analysis during PED, there would likely be a delay in the project schedule and increased costs would be incurred for proper disposal of any material that would be disturbed by construction.

The PDT conducted a review of the available records and contacted the owners requesting information. For the last 20 years, the general area has been used as a rail storage yard with no plant facilities situated immediately adjacent to the levee. Prior to that time, one area near the north end of the proposed location for the stability feature may have been used as a plant facility. An HTRW records search indicates no open violations or remediation orders in this area. No sediment testing/quality information was received from Dow Corporation. Additionally, the PDT sampled sediment from the underwater berm for contaminants and found that the material is suitable for upland placement. Since sampling of the sediment from the underwater berm did not show contaminants, it is reasonable to assume the immediately adjacent terrestrial soils would also not be contaminated.

6.5.2 Economic Data and Models Analysis

As with most deep-draft navigation studies, key uncertainties exist that could affect the investment decision. The primary uncertainties pertain to growth rates of the associated commodities, loading patterns of those commodities, routes of the vessels, size and distribution of those vessels, fuel costs, market shifts, and exchange rates. Further explanation is given in the economic appendix.

6.5.3 Project Cost and Schedule Risk Analysis

A Cost and Schedule Risk Analysis will be performed on the plan carried forward for feasibility-level design following the concurrent public and agency review, policy review, and ATR.

6.5.4 Environmental Data and Analyses

The most current available data was used for the environmental analyses of the study area and assessment of impacts of the TSP. No significant environmental impacts were identified, and therefore no ecological modeling was required to quantify impacts or mitigation. No significant risks to environmental resources are expected with construction of the TSP. No significant uncertainties have been identified in the environmental data used to evaluate the TSP impacts. However, a low risk to the construction cost and schedule has been identified due to the deferment to the PED phase for sediment testing of the construction area for the stability feature located outside of the HFPP levee on the Dow Thumb. This has been determined to be low-based risk based upon the results of contaminant analyses of in-situ sediments of the underwater berm immediately adjacent to this area, and from information from the HTRW records search.

6.6 CONSISTENCY WITH OTHER STATE AND FEDERAL LAWS

This EA has been prepared to satisfy the requirements of all applicable environmental laws and regulations and has been prepared using the Council on Environmental Quality (CEQ) NEPA regulations (40 CFR Part 1500–1508) and the USACE's regulation ER 200-2-2 - Environmental Quality: Policy and Procedures for Implementing NEPA, 33 CFR 230. In implementing the TSP, the USACE would follow provisions of all applicable laws, regulations, and policies related to the proposed actions. The following sections present brief summaries of Federal environmental laws, regulations, and coordination requirements applicable to this EA.

6.6.1 Clean Air Act

The General Conformity Rule is applicable only to nonattainment and maintenance areas. The proposed structural alternatives associated with the TSP will be located in Brazoria County, Texas. Brazoria County is included in the eight-county HGB ozone nonattainment area, which is

classified as "severe" in terms of its degree of compliance with the 1997 8-hour ozone standard. This classification affects facilities that generate the ozone precursors, NO_x, and VOC. As such, the TSP is subject to the General Conformity Rule, which applies to all nonattainment and maintenance areas.

The TSP structural features (widening, bend easing, and turning notch) have been evaluated in terms of the relevant direct and indirect emissions associated with construction of the TSP. This analysis and the determination reports are presented in Appendix J. Based on this evaluation, it has been determined that a General Conformity Determination for NO_x emissions would be required for the TSP as emissions of NO_x are estimated to exceed the 25 tons per year (tpy) applicability threshold. Emissions of VOC for the construction activities for the TSP are exempt from a General Conformity Determination because they are below the 25 tpy applicability threshold.

The following paragraph will be included in the FIGGR-EA, subject to TCEQ review and approval of the DIGRR-EA:

> *Based on the evaluation of the proposed project description, estimated air quality emissions, and with consideration of the General Conformity concurrence letter from the TCEQ, the USACE has determined that its approval of the proposed GRR Structural Features will meet the General Conformity requirements of 40 CFR 51 Subpart W and 40 CFR 93 Subpart B.*

6.6.2 Clean Water Act

Waters of the U.S. are protected under Sections 401 and 404 of the Clean Water Act (CWA). The stated objective of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." In Texas, Section 401 of the CWA (State Water Quality Certification Program) is regulated by the TCEQ. Compliance will be achieved through coordination of this report with TCEQ to obtain water quality certification for the TSP. Coordination includes an evaluation of the TSP based on the Section 404(b)(1) Guidelines as presented in Appendix F.

The CWA 404(b)1 Evaluation concludes that construction of the project is not expected to have any substantial adverse impacts to water quality; thus no violation of water quality standards is anticipated. A water quality certification is being sought with the submittal of the DIGRR-EA for TCEQ review.

6.6.3 Section 103 of the Marine Protection, Research, and Sanctuaries Act

This Act requires a determination that dredged material placement in the ocean would not reasonably degrade or endanger human health, welfare, and amenities, or the marine environment, ecological systems, or economic potential of shellfish beds, fisheries, or recreational areas. Section 103 of MPRSA authorizes USACE to place dredged material within an EPA-designated ODMDS, subject to EPA concurrence and the use of EPA dumping criteria. Both of Freeport's ODMDS are EPA-designated sites.

The annual shoaling rate from the TSP is expected to increase from approximately 280,000 cubic yards per year to 316,000 cubic yards per year, an increase of approximately 12 percent for this reach. The net increase of 36,000 cubic yards represents less than a 1 percent increase in the total quantity of maintenance material forecast for ODMDS placement by the 2014 authorized project. ODMDS analysis and modeling is presented in Appendix A of the 2012 EIS. This modeling indicates the existing Maintenance ODMDS is large enough to accommodate maintenance material from the TSP, and that future new work and maintenance material is expected to have the same properties as dredged material placed previously at the ODMDS. USACE would continue to use the Maintenance ODMDS, pending EPA concurrence that management and monitoring meet EPA guidelines. Use of the ODMDSs would be in accordance with a Site Monitoring and Management Plan that is under development.

6.6.4 Section 7 of the Endangered Species Act

Informal interagency consultation under Section 7 of the Endangered Species Act (ESA) has been undertaken. A Draft BA was prepared describing the study area, federally listed threatened and endangered species of potential occurrence in the study area as identified by the NMFS and USFWS, and potential impacts of the TSP on these protected species (Appendix H). USACE has determined that the TSP would have no effect on any listed species. The Draft BA was submitted to USFWS and NMFS for review on December 1, 2016. Neither agency generally provides concurrence when a "no effect" call is made by the action agency.

6.6.5 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (PL 94-265), as amended, establishes procedures for identifying EFH and requires interagency coordination to further the conservation of federally managed fisheries. EFH consists of those habitats necessary for spawning, breeding, feeding, or growth to maturity of species managed by Regional Fishery Management Councils in a series of Fishery Management Plans. Submittal of the DIGGR-EA to NMFS initiated EFH consultation. USACE anticipates minor and temporary impacts to benthic

organisms and turbidity during construction, but no significant or long-term effects. EFH consultation is being initiated with submittal of this draft report to NFMS.

6.6.6 Section 106 of the National Historic Preservation Act

Compliance with the National Historic Preservation Act of 1966, as amended, requires identification of all historic properties in the Area of Potential Effect (APE) and development of mitigation measures for those adversely affected in coordination with the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation. A thorough file review did not identify any National Register of Historic Places-listed or eligible sites or State Antiquities Landmarks within the project's area of potential effect. Therefore, coordination with the SHPO is not required.

6.6.7 Coastal Zone Management Act

Under the Texas Coastal Management Program (TCMP), enacted under the Coastal Zone Management Act in 1972, the Texas General Land Office (GLO) reviews Federal activities to determine whether they are consistent with the policies of the TCMP. USACE has prepared a Consistency Determination that evaluates the TSP for consistency with the TCMP and has concluded that it is fully consistent to the maximum extent practicable with the enforceable policies of the Texas program. This determination is provided in Appendix G. USACE is requesting concurrence from GLO on the prepared Consistency Determination with coordination of this DIGRR-EA.

6.6.8 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act provides for consultation with the USFWS, and in Texas, with TPWD whenever the waters, or channel of a body of water are modified by a department or agency of the U.S. A Coordination Act Report (CAR) was prepared by the USFWS and is included in Appendix I. The CAR recognizes that the TSP avoids significant impacts to fish and wildlife resources, including federally listed, threatened, and endangered species. The CAR included eight recommendations. These recommendations included using the BU of the dredge material in the TSP, creating a nesting bird island, incorporating specific Best Management Practices (BMPs) to avoid inadvertent impacts to wildlife during construction, coordinating with NMFS, testing all new work and maintenance material for contaminants, and reevaluating the need for mitigation and ESA consultation if the project changes in the future. To the greatest extent possible, the USFWS recommendations have been integrated into the TSP. USACE has agreed to fully adopt four recommendations, and partially adopt two recommendations. Two recommendations cannot be adopted due to USACE policy. Recommendations and all partial or non-adopts are fully explained in **Section 7.6**.

6.6.9 Marine Mammal Protection Act of 1972

The Marine Mammal Protection Act was passed in 1972 and amended through 1997. It is intended to conserve and protect marine mammals and establish the Marine Mammal Commission, the International Dolphin Conservation Program, and a Marine Mammal Health and Stranding Response Program. A draft BA for the TSP was prepared in October 2016 that concluded that the project would have no effect on marine mammals, as they are highly unlikely to occur in the project area. The draft BA was submitted to NMFS and USFWS for ESA coordination on December 1, 2016. Neither agency generally provides concurrence when a "no effect" call is made by the action agency.

6.6.10 Federal Water Project Recreation Act

This 1995 Act requires consideration of opportunities for outdoor recreation and fish and wildlife enhancement in planning water-resource projects. The TSP is not expected to have any long-term effects on outdoor recreation opportunities in the area.

6.6.11 Coastal Barrier Improvement Act of 1990

This Act is intended to protect fish and wildlife resources and habitat, prevent loss of human life, and preclude the expenditure of Federal funds that may induce development on coastal barrier islands and adjacent nearshore areas (Coastal Barrier Resources System, 2010). There are no Coastal Barrier Improvement Act (CBRA) units within the project area. Because the TSP would have no effect on a CBRA unit, no coordination in association with the CBRA is necessary.

6.6.12 Farmland Protection Policy Act of 1981 and the CEQ Memorandum Prime and Unique Farmlands

In 1980, the CEQ issued an Environmental Statement Memorandum "Prime and Unique Agricultural Lands" as a supplement to the NEPA procedures. Additionally, the 1981 Farmland Protection Policy Act requires Federal agencies to evaluate the impacts of federally funded projects that may convert farmlands to nonagricultural uses and to consider alternative actions that would reduce adverse effects of the conversion. None of the soils impacted by the TSP are classified as prime or unique farmlands. Therefore, there is no potential for impacts to prime or unique farmlands.

6.6.13 Executive Order 11988, Floodplain Management

This Executive Order (EO) directs Federal agencies to evaluate the potential effects of proposed actions on floodplains. Such actions should not be undertaken that directly or indirectly induce growth in the floodplain unless there is no practicable alternative. The entire project area is

mapped as Zone VE (coastal flood zone with wave velocity hazard) including the existing waterway. Approximately 16.4 acres of emergent land within Zone VE would be impacted for the bend easing portion of the TSP. However, this impact would not change the floodplain designation or increase flooding in the project area.

6.6.14 Executive Order 11990, Protection of Wetlands

This EO directs Federal agencies to avoid undertaking or assisting in new construction located in wetlands, unless no practicable alternative is available. No wetlands would be impacted by the TSP.

6.6.15 Executive Order 12898, Environmental Justice

This EO directs Federal agencies to determine whether the TSP would have a disproportionately adverse impact on minority or low-income population groups within the TSP project area. An evaluation of potential EJ impacts based on a review of the U.S. Census information has been conducted. There are two census block groups within the TSP area; one (census tract 6642, BG 2) contains a low-income population and the other (census tract 6644, BG 2) contains a minority population. Channel improvements would be confined to industrial areas or those within the existing waterway and are not located in or adjacent to the residential portions of the census tracts identified above. The TSP would not be expected to adversely affect any low-income or minority populations. Local benefits would include the creation of temporary construction jobs and the maintenance or growth in the economy of the Port.

6.6.16 Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds and the Migratory Bird Treaty Act

The Migratory Birds and the MBTA of 1918 (as amended) extends Federal protection to migratory bird species. Among other activities, nonregulated "take" of migratory birds is prohibited under this Act in a manner similar to the ESA prohibition of "take" of threatened and endangered species. Additionally, EO 13186 "Responsibilities of Federal Agencies to Protect Migratory Birds" requires Federal activities to assess and consider potential effects of their actions on migratory birds (including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds). The effect of the TSP on migratory bird species has been assessed, and no impacts are expected to migratory birds or their habitat in the project area. Construction contracts would include instructions to avoid impacts to migratory birds and their nests from construction-related activities.

6.6.17 Executive Order 13045, Protection of Children from Environmental and Safety Risks

This EO requires Federal agencies to make it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children and to ensure that policies, programs, activities, and standards address these risks. This report has evaluated the potential for the TSP to increase these risks to children, and it has been determined that children in the TSP area would not likely experience any adverse effects from the proposed project.

7 ENVIRONMENTAL CONSEQUENCES*

Environmental consequences of the No Action and TSP alternatives are compared below. A detailed comparison of all factors compared in evaluating the Final Array of alternatives, including environmental effects, is presented in **Section 5.6** of this report.

7.1 Impacts to Protected/Managed Lands

Federal and State lands would not be affected by either the No Action Alternative (FWOP) or the TSP alternative. Under the FWOP, Federal and State lands in the study area would continue to be unaffected by maintenance activities. No direct impacts would occur because Federal and State lands do not exist within the TSP project footprint.

7.2 Impacts to Physical and Hydrological Characteristics

Under the No Action Alternative, the existing FHC would continue in operation at its current depth and length. The improvements described for the 2012 Feasibility Report would be carried forward. The existing PAs and maintenance ODMDS would continue to be used. RSLR over the 50-year period of analysis would be expected to result in small increases in inundation and tidal circulation in the study area.

The TSP involves widening existing portions of the channel that is volumetrically minor compared to the water volume of FHC and the conversion of about 16.4 acres of upland to deep water. The proposed action also does not involve bathymetric changes to the channel that would interfere with or increase tidal exchange, increase shoreline currents, or change the littoral sediment transport. The TSP does not change the freshwater input or wind driven circulation within the project area. Therefore, no impacts to tides, currents, and associated processes, are anticipated.

Although the size of the proposed modifications are negligible compared to the volume or the tidal prism of the channel and would have negligible influence on water level, the proposed activities will widen, but not fill portions of the current FHC System. As such, it would not impact storm surge and/or coastal flooding adversely. Because the FHC is not a part of a riverine channel, it has no potential to alter riverine flow or floodplains. Therefore, no impacts to flooding from altering water levels in the FHC during storm conditions are expected.

7.3 Storm Surge Effects on the Study Area

The improvements proposed in the authorized project would increase storm surge elevations by about 0.16 foot locally, inside the jetties. However, this increase was considered small given the

general inundation of the greater Freeport area during a significant storm surge, and will not have a substantial effect on the level of protection offered by the current levee system. A majority of the study area is protected by existing wave barriers and the levee system. This study is recommending that the west end of the North Wave Barrier) located south of the proposed bend easing be re-designated to the elevated Old Quintana Road. This effect of this change on coastal storm risk management has been evaluated, and no increase in surge risk was found.

7.4 Impacts to Biological Communities

Under the No Action Alternative, no effects would occur to the sensitive biological communities found in the study area. Impacts to biological communities as a result of the TSP are as follows.

7.4.1 Terrestrial

The TSP would result in impacts to approximately 16.4 acres of uplands to accommodate the bend easing. Terrestrial vegetation in this area would be converted to the navigation channel, which also serves as open water habitat. Equipment staging areas and dredge pipelines used for construction of the TSP would result in temporary minor effects to uplands in the project area; however, appropriate BMPs would be implemented where necessary to avoid and minimize potential effects. Placement of new work material would be confined to existing approved PA1. Hydraulic pipelines would access the PA through existing waterways and across surface soils. BMP's would be utilized to minimize impacts. Construction to raise the levee heights of PA 1 would be conducted entirely within the existing PA right-of-way.

Equipment staging areas and dredged pipelines may result in temporary direct and indirect minor impacts to wildlife and habitats during construction. These will be minimized and appropriate BMPs would be implemented where necessary. Dredged material placement into existing PA 1 would not impact native habitat, or wildlife.

7.4.2 Aquatic

Aquatic communities would be temporarily affected by construction of the TSP. Approximately 25.7 acres of existing aquatic habitat would be disturbed during construction for the bend easing, channel widening, and turning notch. Benthic organisms would be removed by construction, but recolonization is expected. Aquatic organisms in the area would be impacted by short-term increases in turbidity as a result of excavation of the channel bottom. Short-term turbidity increases may also be associated with construction of the stability wall at the Dow Thumb. Sediment barriers would be used to minimize the amount of sediment entering the river during construction. Elevated turbidities during construction and maintenance dredging may affect some aquatic organisms near the dredging activity; however, turbidities can be expected to return

to near ambient conditions within a few hours after dredging or construction ceases. No special aquatic sites regulated under 40 CFR 230 are present within the TSP footprint.

Additionally, placement of material at the ODMDS would result in temporary local impacts to aquatic communities (primarily benthos) from increased sedimentation and turbidity. The additional amount of dredged material that would result from construction of the TSP is negligible. The maintenance ODMDS is currently used for placement of dredged material from maintenance cycles, and, therefore, continued placement of maintenance material at the site would not be expected to change current conditions. Generally, motile organisms are mobile enough to avoid highly turbid areas – under most conditions, fish and other motile organisms are only exposed to localized suspended-sediment plumes for short durations (minutes to hours) (Clarke and Wilber, 2000). No significant impacts to fishes or other pelagic fauna are anticipated from project construction or maintenance dredging.

7.5 Essential Fish Habitat Impacts

Under the No Action Alternative (FWOP condition), the impacts to EFH associated with maintenance dredging would continue. Impacts from current maintenance dredging include temporary increases in water column turbidity during and for a short time after dredging and burial of benthic organisms at the maintenance ODMDS. Recovery of benthic macroinvertebrates following burial is typically rapid (recovering within months rather than years) (VanDerWal et al., 2011; Wilber et al., 2006; Wilber and Clarke, 2001) and, consequently, no long-term effects are expected.

EFH within the project area is discussed in **Section 2.3.5.** The project area includes EFH for red drum, reef fish, coastal migratory pelagic fish, and shrimp. The majority of impacts to managed species and their associated EFH would be limited to the estuarine benthic environment where the actual dredging would take place, as well as temporary impacts to the water column as a result of increased turbidity. The life stages anticipated to be impacted the most are the egg and larval stages, with those utilizing benthic habitats within the dredged footprint expected to experience the most impact (DiMarzio et al, 2016). The majority of the juvenile and adult life stages present in the project footprint are primarily forage and pelagic species capable of detection and avoidance behavior when exposed to unfavorable conditions. It is expected that construction of the TSP would not have any direct impacts to juvenile and adult fish other than a temporary displacement, and individuals would re-inhabit temporarily affected areas upon dredging completion. No aquatic vegetation has been identified in the dredged or adjacent buffer zone areas, therefore no impacts to seagrass or the nursery habitat it provides to juvenile fish would occur from the TSP. Therefore, only minimal impacts to benthic EFH are expected to occur. Turbidity generated by the TSP could affect the foraging behavior of certain predators

and the efficiency of filter feeders. Turbidity would be expected to affect only a small area surrounding the project area relative to the total habitat available to managed species, and dissipate quickly. Impacts from maintenance dredging would include short-term increases in water column turbidity and benthic impacts, although no long-term effects would be expected.

The TSP project area is not in or near any of the areas identified as Habitat Areas of Particular Concern (HAPC), as these areas are located offshore. Therefore, no impacts to HAPC are expected from construction or maintenance of the TSP. Additionally, the project area is not in or near any of the areas identified as Essential Fish Habitat Protected from Fishing.

7.6 Threatened and Endangered Species Impacts

Potential impacts to federally listed species are similar for both the No Action Alternative and TSP. The project area was evaluated for habitat and potential occurrence of each listed protected species. Both the FWOP and the TSP would have no effect on the listed animal and plant species.

As described in the BA (Attachment H), the TSP would not affect the following federally listed species potentially occurring within the vicinity of the study area: five species of sea turtle (green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle), the piping plover, red knot, and whooping crane, the West Indian manatee, four species of whales (fin whale, humpback whale, sei whale, and sperm whale) and four coral species (lobed star coral, mountainous star coral, boulder star coral, and elkhorn coral) (USFWS, 2016; NMFS, 2016a)).

Birds recently removed from the Federal list of threatened and endangered species such as the American peregrine falcon, Arctic peregrine falcon, peregrine falcon, brown pelican, and bald eagle are protected under the MBTA, and the bald eagle continues to receive additional protection under the Bald and Golden Eagle Protection Act (64 FR 46542–46558; 72 FR 37346–37372).

7.7 Fish and Wildlife Coordination Act Recommendation

The USFWS has provided a CAR which recognizes that the TSP avoids all significant impacts to fish and wildlife resources, including federally listed, threatened, and endangered species, and that no mitigation is required for the TSP (Appendix I). To the greatest extent possible, the USFWS recommendations have been integrated into the TSP. USACE has agreed to fully adopt four recommendations and partially adopt two recommendations, but cannot adopt two recommendations due to USACE policy. All partial or non-adopted recommendations are fully explained in Appendix I.

- USACE has agreed to utilize specific BMPs to avoid impacting wildlife during construction, coordinate with NMFS about EFH impacts of the TSP, and reevaluate project and ESA impacts if the TSP plans change. A detailed description of the BMPs is presented in **Appendix B, Section 5**.

- USFWS recommended that USACE work with Freeport Harbor Channel tenants and operators to BU dredged material. USACE has no direct relationship with the Port Freeport tenants or operators, and thus cannot fully adopt this recommendation. However, USACE will encourage Port Freeport to work with tenants and operators to beneficially use dredged material where feasible. USFWS recommended that USACE test all new work and maintenance material for contaminants, and to properly dispose of contaminated sediments should they be identified. This recommendation will be partially adopted by USACE. Testing of Dow Thumb bench sediments has found no significant contamination and the HTRW assessment of the project area has determined that the TSP project area is unlikely to contain contaminated sediments. Therefore, further sediment testing of dredged material is not currently planned. Should contaminated materials be identified during PED or construction, those materials would be placed in an approved landfill site in accordance with applicable regulations. Maintenance material is tested for contaminants, and results are coordinated with EPA.

- USACE could not adopt two recommendations.

    - USFWS recommends that USACE adopt a standard policy to use 75% of maintenance and new work material beneficially, and to include the beneficial use of the dredge material in the TSP. Adoption of a standard policy regarding the beneficial use of new work and maintenance material is beyond the purview of this study. However, in accordance with existing policy and guidance, USACE has reviewed the potential for beneficial use of the limited quantity of new work material that will be generated by construction of the TSP; the amount of additional maintenance material associated with the TSP is negligible. Limited opportunities for beneficial use (BU) exist in close proximity to the project area. Evaluation of the nearest potential BU area, a degraded marsh that could be restored with new work material from the TSP, determined that the least-cost disposal option would be the proposed upland site, PA1. Therefore, the BU option was not included in the TSP.

    - USFWS recommended that USACE create a nesting bird island at a suitable site, located in bays several miles from the project area. Construction of a bird island as part of this project could only be accomplished as mitigation as the study authorization does not include ecosystem restoration. The USACE environmental impact analysis has determined that the project would result in no wildlife impacts

requiring mitigation, and USFWS has concurred in this determination. Thus, construction of a bird island in conjunction with the TSP is not required nor is it authorized.

7.8 Water and Sediment Quality Impacts

In the No Action Alternative (FWOP condition) condition, water and sediment quality are not expected to substantially change in the FHC. Inflow from the Gulf of Mexico would continue to dominate water quality in the study area.

Water Quality

No new construction or maintenance would occur in the project area under the No Action Alternative. Only the periodic maintenance dredging and dredged material placement already performed for the FHC System occurring over the next 50 years, and the temporary and localized effects due to increases in turbidity associated with those actions, would continue. Therefore no new temporary or localized effects would occur.

Dredging activities proposed in the TSP would result in minimal impacts and are not expected to significantly degrade the short-term or long-term water quality in the FHC. These effects would be consistent with those that are occurring during the normal maintenance dredging operations discussed previously under the FWOP. Temperature, salinity, turbidity, and density distribution patterns would temporarily be affected as a result of water column mixing during dredging and placement activities. These patterns would return to their previous baseline condition following completion of dredging. Any impacts to the distribution patterns for these water quality parameters from dredging would be minimal.

Short-term changes in DO, nutrients, and contaminant levels could occur due to mixing and disturbance of sediments into the water column during dredging and dredged material placement. Temporary decreases in DO concentration could occur during and immediately after dredging activities due to the movement of anoxic water and sediments through the water column. Temporary DO decreases could occur due to short-term increases in organic material in the water column, and the associated aerobic decomposition. These minimal impacts would be expected to be limited to the immediate vicinity of dredging and dredged material placement activities. Once the dredging activities stop, disturbed material would settle, and DO, nutrient, and contaminant concentrations would return to pre-disturbance levels. These impacts would be minimal and similar to impacts occurring during the periodic maintenance dredge activity and placement that currently takes place in FHC. Therefore, temporary effects are expected from dredging due to short-term changes in DO, nutrients, and contaminant levels.

Dredging could cause short-term increases in turbidity. However, numerous studies indicate that dredge-induced turbidity plumes are typically localized, and spread less than a thousand meters from their sources and dissipate to ambient water quality within several hours after dredging is completed (Higgins et al., 2004). The vast majority of re-suspended sediments resettle close to the dredge within an hour (Anchor Environmental CA L.P., 2003). The anticipated dredging technique for the TSP would be hydraulic cutterhead dredging, which generally produces small plumes that rapidly decay (Reine et al, 2002). Atkins conducted baseline, 1-month post-disposal, and 6-month post disposal monitoring and testing at the ODMDS in 2015. The results of the monitoring surveys performed at 1 month (Atkins, 2016a) and 6 months following the disposal of the Freeport Harbor new work material at the offshore new work ODMDS did not indicate any adverse effects of the material on the benthic habitat in comparison with the baseline survey performed in October 2014 (Atkins, 2016b) prior to placement of dredged material (Atkins, 2016c). Properly operated dredges can confine elevated suspended bottom sediments to several hundred meters from the cutterhead with levels dissipating exponentially towards the surface with little turbidity actually reaching surface waters, and in many cases, at concentrations no greater than those generated by commercial shipping operations or during severe storms (Higgins et al., 2004). Therefore, only temporary, minor effects are expected from dredging activities due to increased turbidity.

Sediment Quality

Under the No Action Alternative, no new construction or maintenance would occur within the project area. Therefore, sediment quality would remain as described in **Section 2.3.7** of this GRR and the 2012 FEIS.

According to the 2012 FEIS, sediment within the project area in the FHC is not contaminated. Therefore, material dredged as a result of the TSP and normal FHC maintenance is safe for placement in existing upland placement area, PA1 and the maintenance ODMDS. Impacts to sediment quality as a result of the TSP are anticipated to be temporary and negligible.

7.9 Air Quality Impacts

No new dredging construction emission sources are associated with the No Action Alternative. However, it is anticipated that air contaminants in the project area would increase due to a possible increase in ship traffic due to growth of existing business and from new business.

Air contaminant emissions that may result from ongoing maintenance dredging activities would include exhaust emissions from fuel combustion in engines that power the marine vessels (dredge and support) and on-shore construction equipment for dredged material placement.

Emissions associated with maintenance dredging are not expected to change from current conditions.

The emission sources for the TSP would consist of marine and land-based mobile sources that would be utilized as scheduled for construction. Marine emission sources would likely include a 30-inch hydraulic cutterhead dredge, a 250-ton crane with a vibratory driver for setting sheet piles, and support equipment such as tugboats, a spill barge, and crew boats. The land based emission sources would include off-road equipment utilized for constructing levees and placing dredged material in the placement sites, and on-road vehicles for employees commuting to and from the work site. The marine emission sources and off-road equipment would consist primarily of diesel-powered engines. The on-road employee vehicles would consist primarily of gas-powered vehicles.

The TSP has been evaluated in terms of the relevant direct and indirect emissions associated with emissions from dredging, setting sheet pile walls for the stability wall, support equipment, land-based construction equipment used in the placement of dredged material, and employee vehicles used to commute to and from the work sites. More information on the methods used for estimating air contaminant emissions and calculations is included in the report Draft General Conformity Determination, Freeport Harbor Channel Bend Easing Project, dated July 2016 (Appendix J).

The schedule for construction of the TSP is currently projected to commence early in 2019, and is projected to be completed within that calendar year. A summary of estimated NO_x and VOC emissions resulting from the activities associated with the TSP is shown in **Table 7-1**.

Table 7-1. Summary of Estimated NOx and VOC Emissions

Activity	NOx Emissions [a]	TSP VOC Emissions [a]
Sheet Pile Placement and Dredging	106.83	1.41
Land Side Dredged Material Placement	8.07	0.76
Employee Commuter Vehicles	0.42	0.43
Total	115.31	2.61

[a] *Emissions in tons per year.*

Based on the evaluation, it was determined that a General Conformity Determination for NO_x emissions would be required for the TSP as emissions of NO_x are estimated to exceed the 25 tons per year applicability threshold. Emissions of VOC for the construction activities for the TSP are exempt from a General Conformity Determination because they are below the 25 tons per year applicability threshold. The General Conformity Determination was conducted pursuant to the Clean Air Act, Section 176(c)(1), to document that emissions that would result from

construction of the TSP are in conformity with the State Implementation Plan for the HGB ozone nonattainment area.

There would be temporary impacts to air quality during construction of the TSP. Dredge barges and construction equipment would temporarily increase emissions as described in **Table 7-1**. These emissions might impact recreational and commercial boaters in the project area during construction. Therefore, impacts to air quality as a result of the TSP are anticipated to be temporary and negligible. Estimated GHG emissions from construction activities during a portion of 2019 for the TSP were estimated as shown in the project emission-calculation tables associated with the General Conformity Determination in Appendix I. The total greenhouse gas emissions from the bend-easing marine and land-based construction activities are estimated to be 9,163 metric tons per year of CO2e.

7.10 Noise

Potential noise impacts would be similar for both the No Action Alternative and TSP. Noise sensitive receptors would be limited to recreational boaters in the project area. No permanent noise sources would be installed as part of the TSP. The TSP would create short-term noise level increases similar to increases during maintenance dredging for the existing project. Therefore, impacts to noise as a result of the TSP are anticipated to be temporary and negligible. The noise of equipment and increased human activity during dredging activities may disturb some local wildlife, particularly birds, especially during the breeding season. Such impacts would be temporary and not likely have significant long-term implications. Furthermore, noise and artificial lighting impacts related to proposed activities would have minimal additive effects, given the current environment is affected by a number of transportation-related (e.g., barges, railway, roadway) and heavy industrial activities.

7.11 Hazardous, Toxic and Radioactive Waste Impacts

Potential HTRW impacts would be similar for both the No Action Alternative and TSP. According to a review of reasonably accessible regulatory database findings conducted for the 2012 FEIS and the 2015 draft report for the Sabine Pass to Galveston Bay feasibility study (USACE 2015), there are no concerns with the placement of sediments within PA 1 and the maintenance ODMDS. Therefore, no adverse impacts from HTRW are anticipated under the No Action or as a result of the TSP. In addition, based on recent sediment and surface water chemical analysis (USACE, 2016a), constituents exceeding regulatory thresholds in the FHC channel at the Dow Thumb are considered to be negligible and would result in no adverse environmental impacts during routine maintenance or during the dredging and upland confined placement described in the TSP.

7.12 Cultural Resources Impacts

Impacts to cultural resources would be similar for both the No Action Alternative and the TSP. The activities associated with the TSP are limited to the channel widening, bend easing, and construction of the turning notch at the Dow Thumb, construction of the stability wall, and the placement of dredged material from construction within existing PA1 and from maintenance in ODMDS 1A. Investigations for both terrestrial and marine cultural resources were performed for the project area as part of the 2012 FEIS. Information from this investigation has been compiled and evaluated to determine potential impacts to historic properties. All areas to be impacted by the TSP have been covered by these surveys. Based on the disturbed nature of the terrestrial and marine portions of the project area and the absence of historic properties within the project area, no impacts are anticipated to historic properties as a result of the No Action Alternative or the TSP. As a result, no coordination with the SHPO is necessary.

7.13 Energy and Mineral Resources Impacts

Impacts to energy and mineral resources would be similar for both the No Action Alternative and the TSP. According to the Railroad Commission of Texas' public GIS viewer (2016), energy resources identified within the project area include one active pipeline and one abandoned pipeline located adjacent to the bend easing. As determined by the Galveston District, both pipelines are buried below the area of potential effect of new work dredging for the TSP. Maintenance dredging of the existing FHC and the placement of dredged materials at ODMDS would continue under the No Action Alternative and TSP, which would not impact any known energy and/or mineral resources other than impacts from the current status quo.

7.14 Socioeconomic Impacts

Under the No Action Alternative, the proposed corrective actions would not be implemented; therefore, improvements to vessel safety and mobility within the channel would not be improved. The FHCIP would still be constructed; however, it would not improve the FHC enough to allow the larger containment vessels to reach the Velasco Terminal. Brazoria County would continue to have similar population and socioeconomic trends; however, if the dimensions of the channel are not enlarged to accommodate larger vessels then potential economic benefits of increased container traffic may not be realized.

Minimal negative impacts are expected to the human environment because all work would be located in the existing channel except for a small, uninhabited portion for the bend easing which would impact the undeveloped shoreline. Population increases in Brazoria County are driven primarily by the development of the petrochemical industry. The TSP would likely have a negligible effect on population growth trends within surrounding cities, and counties, which are

located near the project area. As a result of the TSP, a small temporary increase in jobs in the region and therefore an economic benefit, associated with construction would be expected, and a small permanent increase associated with container ships and terminal traffic would be expected. No impacts would be expected as a result of maintenance dredging events over the 50-year period of analysis.

7.14.1 Environmental Justice

Under the No-Action Alternative, there would be no direct impact to EJ populations. The TSP would not be expected to adversely affect any EJ communities because there are none located in the project area. Potential benefits would include the creation of jobs in the regional economy.

7.14.2 Protection of Children from Environmental and Safety Risks

Potential environmental and safety effects to children would be similar for both the No Action Alternative and the TSP. EO 13045 of 1997 entitled, "Protection of Children from Environmental and Safety Risks" requires Federal agencies to make it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children and to ensure that policies, programs, activities, and standards address these risks. Land use near the project area is primarily industrial and would likely remain industrial. There are no schools, day care centers, or residences located immediately adjacent to the channel. No contamination issues are associated with the water or the dredged sediments in the project area, and no contamination issues are expected from construction of the TSP. Therefore, children in the project area would not likely experience any adverse effects from the TSP.

7.15 Cumulative Impacts

Cumulative impacts are defined in 40 CFR 1508.7 as, "…the impact on the environment which results 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 person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." Cumulative impacts for the TSP were assessed in accordance with guidance provided by the President's Council on Environmental Quality (CEQ).

7.15.1 Individual Project Impact Evaluations

Past, present, and reasonably foreseeable projects/activities within the study area were compared to the TSP, to determine whether the TSP, when combined with the impacts of other actions, could have cumulatively significant impacts on the environment. The 2012 EIS Cumulative Impact analysis included the past, present and reasonably forseeable actions in the project area.

Only actions not covered by the 2012 EIS are described in this analysis, but the cumulative analysis includes all projects described by the 2012 EIS and this document. In addition to the previous work in the FHC there are three specific actions and various state highway improvements that are considered in this cumulative impacts analysis: recent construction of the Freeport Liquefied Petroleum Gas (LPG) Export Terminal, and potential improvements to the Freeport HFPP and Port Freeport Velasco Terminal.

7.15.1.1 Past and Present Actions)

Freeport Harbor Channel Project

The existing Freeport Harbor Project was authorized by the 1950, 1958, and 1970 RHAs. The 1950 and 1958 RHA provided for an Entrance Channel (comprised of the Outer Bar and Jetty channels) of 38-foot depth and 300-foot width from the Gulf to inside the jetties, and for interior channels of 36-foot depth and 200-foot width up to and including the Upper Turning Basin. The 1970 RHA authorized the re relocation and deepening of the Jetty Channel to a 45-foot depth and 400-foot width and the Outer Bar Channel to a 47-foot depth and 400-foot width, with an extension of approximately 4.6 miles into the Gulf. Construction of the project was completed in 1993, which generally deepened and widened the previously authorized project from the 1950s. The project authorized under WRRDA 2014 would modify the 45-Foot Project; however, it has not yet been constructed. It is anticipated that construction would occur after construction of the GRR Modifications. A Chief of Engineers Report was signed on January 7, 2013. A ROD was signed by the ASA (CW) on May 31, 2014.

Freeport Liquefied Petroleum Gas Export Terminal

Improvements to the Phillips 66 Berth 2 have recently been completed in the project area, between the proposed bend easing, and notch locations on the west side of the channel. Improvements to this berth are related to the Freeport LPG Export Terminal that started operations in December 2016 (Butane-Propane News, 2016; Phillips66, 2016). The facility is located on the site of the existing Phillips crude import marine terminal in Freeport and utilizes existing Phillips midstream, transportation, and storage infrastructure. Export terminal infrastructure includes a 550,000-bbl refrigerated propane tank, LPG salt dome storage, and four refrigeration trains. There are two new LPG-ship-capable loading docks and two loading arms per dock.

Reasonably Foreseeable Actions

Improvements to the Freeport HFPP

Improvements to the Freeport HFPP have been recommended by USACE in the Sabine Pass to Galveston Bay Draft Integrated Feasibility Report and Environmental Impact Statement, which was submitted for concurrent public and agency review, policy review, ATR, and independent external peer review in September 2015. The final report is currently in preparation, and a Chief's Report is scheduled for completion by the summer of 2017. The study proposes overall modifications to the Freeport HFPP, including modifications to the Old River North Levee located in Reach 2, adjacent to channel widening at the Dow Thumb and the associated stability wall. The existing levee in the project area would be raised to provide an increased level of flood risk management.

Port Freeport Velasco Terminal Improvements

The 2012 EIS described Phase I improvements at the Velasco Terminal. Freeport has overall plans for improvements at Velasco Terminal that are being implemented in phases. Phase I is complete and includes deepening at Berth 7. Port Freeport has also recently installed two new container cranes. Currently, 26 acres are concrete paved at this terminal, but with the planned development the developed area will increase to about 90 operational acres. Port Freeport has plans to install an additional 5 Post-Panamax Gantry Cranes to expedite the cargo operations for the larger ships that will be arriving (Port Freeport, 2016).

Various Roadway Improvement Projects

Several roadway improvement projects are planned for the area including the SH 36 expansion to four lanes from U.S. Highway (US) 59 to farm-to-market road (FM) 1495 in Freeport planned for letting in fiscal year (FY) 2018. TxDOT is also proposing to replace the FM 1495 bridge and approaches over the FHC and construct a bridge on SH 332 over FM 1495 both to let by FY 2018. There is also a proposed project letting in 2018 to replace the concrete pavement on SH 288 to begin the first quarter of 2017 (TxDOT, 2016a).

7.15.2 Resource Impact Evaluation

In assessing cumulative impacts, only those resources expected to be directly or indirectly impacted by the TSP, as well as by other actions within the geographic scope and time frame were chosen for cumulative impact analysis. Based on these criteria, the following resources were identified as relevant resources for the cumulative impacts analysis:

- air quality;

- water quality;
- biological communities; and
- EFH.

7.15.2.1 Air Quality

The study area is located within a severe nonattainment area for ozone. As described in the 2012 FEIS, new work dredging activities associated with the TSP are expected to exceed the NO_x conformity threshold of 25 tons per year. A General Conformity Determination was prepared by the USACE (Appendix J). The NO_x emissions that would result from the TSP would be negligible relative to the total national emissions inventory, and would not have a significant effect on global warming. Furthermore, increased air contaminant emissions are not expected with TSP channel improvements. The more efficient use of the Panamax fleet is projected to result in a small decrease in vessel trips, which would result in a small decrease in air contaminant emissions. The reasonably foreseeable projects identified may also impact air quality. The improvements to Port Freeport and the Velasco Terminal may increase vessel traffic in the FHC. However, the vessels would be larger, more efficient vessels as part of the TSP therefore no cumulative impacts to air quality are anticipated.

7.15.2.2 Greenhouse Gas

Air emissions from the operation of internal combustion engines that produce exhaust result in GHG emissions that could contribute to global climate change. The CEQ published “Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews", August 1, 2016 (CEQ, 2016). The Guidance suggests that the impacts of projects directly emitting GHG be considered in a qualitative and quantitative manner in NEPA reporting; however, there are no implementing regulations to direct development of these analyses for Federal projects. All emissions would come from individual mobile internal combustion engines in on-road and non-road equipment, and it is likely that the total GHG emissions from mobile sources for all the present and reasonably foreseeable projects would exceed 25,000 metric tons per year of CO2e per year when considered cumulatively. Estimated GHG emissions from construction activities during a portion of 2019 for the TSP were estimated as shown in the project emission-calculation tables associated with the General Conformity Determination in Appendix I. The total greenhouse gas emissions from the bend-easing marine and land-based construction activities are estimated to be 9,163 metric tons per year of CO2e.

7.15.2.3 Water Quality

The historical and most recent testing data for the TSP project area indicates an absence of contamination. Dredging and placement at open-water and upland PAs may increase suspended solids, bound nutrients, and deplete oxygen. However, this impact is temporary, localized, and except for turbidity, insignificant. If temporary degradation occurs due to turbidity, the area should rapidly return to ambient conditions upon completion of dredging. The impacts of the other dredging projects included in this analysis would be similar. With implementation of BMPs and other permitting requirements, no cumulative surface water quality impacts are expected related to the TSP and other projects.

7.15.2.4 Biological Communities

7.15.2.4.1 Terrestrial

Approximately 16.4 acres up upland would be removed to create the bend easing that is part of the TSP. An additional 130 acres of uplands would be developed as part of the Velasco terminal expansion plans. Approximately 795 acres of additional ROW would be required for the SH 36 project (TxDOT, 2016b) and minor ROW additions would be required for the other road projects. The TxDOT and Velasco Terminal projects would occur without the proposed project. Therefore, the TSP would convert 16.4 acres of uplands into open water habitat. The TSP impacts to upland would not be significantly cumulative when considered with the other past, present, and reasonably foreseeable projects.

7.15.2.4.2 Aquatic

Approximately 25.7 acres of existing aquatic habitat in the FHC would be directly impacted during construction for the bend easing, channel widening, and turning notch. Aquatic organisms in the area would be impacted by short-term increases in turbidity, excavation of the channel bottom, and dredged material placement. Direct aquatic impacts to jurisdictional streams, wetlands, and ponds by the Velasco Terminal expansion, and TxDOT roadway projects would be covered by Section 404 nationwide or individual permits. No wetland or other aquatic habitat impacts have been identified for improvements to the Freeport HFPP (USACE, 2015).

The primary effects to bays and deep water habitats in the TSP project area would be to benthos. Organisms present on water bottoms are affected by dredging and placement of dredged materials. Past and present actions and reasonably foreseeable future actions in the study area would result in in benthic community impacts that are similar to those that would be caused by the TSP. Previously dredged areas were deepened or maintained, resulting in minor and temporary direct impacts to benthic organisms that had recolonized those areas after prior

dredging. TSP impacts would not result in the addition of permanent new benthic impacts and would not significantly increase the area of water bottom that is affected by dredging.

Dredged material placement at the ODMDSs buries and temporarily smothers benthic organisms within those areas. With the exception of the existing FHC project, none of the other past or present projects evaluated here utilize the ODMDSs. TSP impacts associated with use of PA 1 and Maintenance ODMDS would not change the existing impact areas or frequency. The impact would be limited and of a relative short duration. The area is dispersive and material would be carried off by currents within 6 months. The TSP would not be expected to contribute to long-term benthic organism impacts. No cumulative benthic impacts are expected related to the TSP and other projects.

7.15.2.5 Essential Fish Habitat

EFH would not be significantly affected by construction of the TSP. The TSP would temporarily reduce the quality of submerged soft bottom habitats in the vicinity of the dredging and some individual fishes of managed species may be temporarily displaced. Past or present projects and potential projects in the study area have resulted in minor EFH impacts to the study area that are similar to those that would be caused by the TSP. Inasmuch as all of these impacts are minor and temporary, the TSP would not permanently add to cumulative EFH impacts.

7.15.3 Conclusions

Cumulative impacts due to past, existing, and reasonably foreseeable future projects, along with the proposed TSP, are not expected to have significant adverse effects in the study area. Many of the projects occurring in the vicinity of FHC, including the TSP impacts, are part of the continuing port and shipping industry development. Impacts associated with the TSP would be temporary and minor, requiring no compensatory mitigation. With compliance to environmental regulations and use of BMPs during construction, these projects are not expected to have long-term detrimental effects on environmental resources in the area.

8 IMPLEMENTATION REQUIREMENTS

8.1 Division of Plan Responsibilities and Cost-Sharing Requirements

ER-1105-2-100 (Page E-62) states under 2(a) Harbors, General Navigation Features, Section 101 specifies cost shares for general navigation features (GNF) that vary according to the channel depth: (20 feet or less, greater than 20 feet but not more than 45 feet, and greater than 45 feet). For GNF features not changing depths, such as breakwaters, locks, channel widening, etc., cost sharing shall be at the percentage applicable to the authorized or existing depth, whichever is greater. The percentage also applies to mitigation and other work cost shared the same as GNF. The cost share is paid during construction. Section 101 also requires the project sponsor to pay an additional amount equal to 10 percent of the total construction cost for GNF. This may be paid over a period not to exceed thirty years, and LERRDs acquired for this project may be credited against it. Note, the Water Infrastructure Improvements for the Nation Act of 2016, Section 1111 (WIIN Act) modifies the cost share percentages for new work, originally stated in WRDA 1986. USACE implementation guidance is forthcoming.

The TSP for the modifications includes mobilization (mob/demob) costs. See **Table 8-1** for General Cost Allocation breakout.

Table 8-1. General Cost Allocation

Feature	Federal Cost %[1]	Non-Federal Cost %[1]
General Navigation Features (GNF)[2]	●90% from 0 feet to 20 feet ●**75% from 20 feet to 50 feet** ●50% for 50 feet and deeper	●10% from 0 feet to 20 feet ●**25% from 20 feet to 50 feet** ●50% for 50 feet and deeper
Mitigation[3]	●**51.4%**	●**48.6%**
Navigation Aids	●**100% USCG**	●**0%**
Operation and Maintenance		
GNF	●**100% except cost share 50**% costs for maintenance > 50 feet.	●0% except cost share 50% costs for maintenance > 50 feet.

[1] The non-Federal sponsor shall pay an additional 10 percent of the costs of GNF over a period of 30 years, at an interest rate determined pursuant to Section 106 of WRDA 86. The value of LERRD acquired for this project shall be credited toward the additional 10% payment.

[2] WIIN Act (2016) modified new work cost share percentages originally stated in WRDA 1986.

[3] The mitigation cost share for the project authorized under WRRDA 2014 was prorated.

8.2 Cost for the Tentatively Selected Plan

Table 8-2 reflects the estimated cost allocation of the TSP at October 2016 price levels using a Class 4 cost estimate. A Class 3 cost estimate will be developed and certified for the FIGRR-EA. At that time, the project costs and escalation (calculated by estimating the midpoint of the

proposed contracts) are combined to create the fully funded cost. The estimated project first cost for the TSP is $57,006,000. These costs include:

- Stability wall to reinforce the portion of the HFPP Old River North Levee where the underwater berm is to be removed to allow for the widening of the channel, and
- Construction of the TSP features (widening to 400 feet, bend easing, and turning notch).

The cost of re-designating the west end of the North Wave Barrier from where the bend easing would be constructed to the elevated Old Quintana Road is not included in the project first cost. However, this cost will be addressed in the final report.

For implementation of the GRR modifications (TSP), the non-Federal sponsor, Port Freeport, would supply all necessary items of local cooperation, including the non-Federal shares of design and construction costs, lands, easements, and rights-of-way. There are no associated berth deepening, pipeline removals or relocations. There is no environmental mitigation or cultural resource mitigation associated with construction of the TSP. The mitigating bank-stabilizing feature for the HFPP levee would have to be incorporated prior to initiating the removal of the underwater shelf required for widening of the channel around the Dow Thumb. Dredging of the bend easing would occur once the North Wave Barrier was re-designated to Old Quintana Road. Dredging of the bend easing and turning notch could be completed prior to initiating construction of the stabilizing wall.

Table 8-2. Tentatively Selected Plan – Estimated Project First Costs ($000)

Cost Account	**Project Features**	**Estimated Project First Cost** (*Oct 2016 Price Level)*
Construction General - General Navigation Features		
01	Lands and Damages (Non-Federal 100%)	$3,989
11	Levees & Floodwalls	$20,767
12	Navigation-Deep Draft	$25,695
16	Bank Stabilization	$1,163
30	Preconstruction Engineering & Design (PED)	$3,725
31	Construction Management (E&D, S&A)	$1,667
	Total Estimated Correction Action Cost	**$57,006**

8.3 Additional non-Federal Sponsor Cash Contribution

This Section will be addressed in the FIGRR-EA, post Agency Decision Milestone (ADM).

8.4 Non-Federal Sponsor PED Efforts Conducted Concurrent with Study

Most preconstruction engineering and design (PED) activities of the project authorized in WRRDA 2014 are on hold until the GRR is approved; however, some PED efforts for a portion of the "Lower Stauffer Channel" will be performed by the local sponsor under a Memorandum of Understanding (MOU) concurrent to the development of the GRR. The MOU will allow Port Freeport to receive credit against the non-Federal share of the Federal project, provided the work accomplished is integral to the Federal project. Approval to allow execution of the MOU with Port Freeport to construct the Lower Stauffer Channel prior to the public release of the draft GRR was obtained from the ASA (CW) on October 8, 2015. The work to be conducted under the MOU involves dredging a portion of the Lower Stauffer Channel to 46 feet MLLW. Note the Lower Stauffer Channel is authorized to 51 feet MLLW under WRRDA 2014.

The proposed WIK will be evaluated per the requirements of ER 1165-2-208, *In-Kind Contribution Credit Provisions of Section 221 of the Flood Control Act of 1970, as Amended*, dated 17 February 2012, and an integral determination made on what materials and/or service provided by the NFS is integral to the study. To be integral to the study or project, the material or service must be part of the work that the Federal Government would otherwise have undertaken for the study or for construction of what is ultimately determined to be the Federal project.

8.5 Policy Decision on Authorities Required to Construct the TSP Features

8.5.1 Authorities Required to Modify Features of the TSP

The USACE may implement the proposed bend easings and channel widening, and turning notch expansion pursuant to the Chief of Engineers' discretionary authority and statutory authority contained in 33 U.S.C. 562. However, any modifications to another Federal Project, such as the HFPP Project, will require either congressional authorization or a Section 408 approval. Additionally, a modification for which a Section 408 approval is sought would be constructed by the NFS at 100-percent non-Federal expense. **Table 8-3** differentiates which features would be allowed under the discretionary authority of the WRRDA 2014 authorization and which would features would require congressional authorization or Section 408 approval.

Section 408 of Title 33 of the U.S. Code (33 U.S.C. 408) generally requires non-Federal entities to obtain permission from the Secretary of the Army to alter or modify existing USACE projects. The Secretary of the Army has delegated this approval authority to the USACE Chief of Engineers.

Table 8-3 – Authority Required per TSP Feature (and Resulting Modifications)

Feature	Work Resulting from Construction	Alteration to	Authority Required
Channel Widening	Insert Stability Wall to mitigate reduced FOS of Levee	Old River North Levee	•Congress, or •Section 408
	Dredge out Underwater Berm	Underwater Berm	[1]
	Channel Widening to 400 feet at Dow Thumb (Reach 2)	WRRDA 2014	•Discretionary; 33 U.S.C. 562
Bend Easing	Relocate Wave Barrier	North Wave Barrier	•Congress, or •Section 408
	Dredge/Excavate Bend Easing once Wave Barrier Relocated/Re-designated	WRRDA 2014	•Discretionary; 33 U.S.C. 562
Turning Notch	Dredge Turning Notch Adjacent to Upper Turning Basin	WRRDA 2014	•Discretionary; 33 U.S.C. 562

[1] *From a geotechnical stability perspective, the underwater berm is considered a component of the HFPP Old River North Levee; however, when the levee was constructed/accepted into the Federal Project it was the natural ground adjacent to the levee toe.*

This DIGRR-EA represents the complete plan to achieve an implementable solution. However, the method for implementing this plan will be determined at the ADM, which will make the determination as to the path forward for the WRRDA 2014 components versus the Section 408 components. If the HFPP modifications were conducted under a Section 408 approval, those modifications would have to be completed prior to construction of the channel widening or bend easing features.

8.6 Changes in Project Purpose

There have been no changes in project purpose.

8.7 Changes in Local Cooperation Requirements

There have been no changes to the Local Cooperation Requirements.

8.8 Changes in Location of Project

There have been no changes in the location of the project.

8.9 Changes in Scope of Authorized Project

ER 1105-2-100 states the following: "*Changes in scope are increases or decreases in the outputs for the authorized purposes of a project. Outputs are the projects physical effects which (usually) have associated benefits (hence, project purpose).*" The following are changes in scope for the overall project.

8.9.1 Removal of Future PA 9 from the 2012 Feasibility Report DMMP

The placement plan for the authorized project included the future construction of PA 9 on a land tract that was under use as pasture. The site is located northwest of the FHC, west of the Brazos River Diversion Channel, and north of the SH 36. The NFS no longer owns the tract in fee.

The DMMP coordinated during the Feasibility study has been updated and the following assumptions verified to determine the least cost placement plan.

- Proposed PA 8 has sufficient capacity to contain all new work material from the construction of the authorized project that was designated to go to PA 8 and PA 9.
- All maintenance material for the authorized project would go offshore to the ODMDS 1A as is current O&M practice. This has been demonstrated to be the least cost placement plan.

8.9.2 Reduction of Environmental Mitigation Associated with Future PA 9

Per the 2012 Feasibility Report, the construction of PA 9 would result in impacts to 16 acres of ephemeral freshwater wetlands, and impacts to 21 acres of riparian forest. These impacts would no longer occur and mitigation for the project would be reduced significantly, as more than half of wetland impacts for the entire authorized project were associated with this proposed PA.

All historic property impacts associated with the 2012 Feasibility Report were associated with development of proposed PA 9; elimination of this feature avoids all historic property impacts.

8.10 Design Changes

The only design changes associated with the authorized project would be those proposed under the reevaluation; the navigation features proposed under the TSP. The TSP would consist of increasing the existing width of FHC in Reach 2 to 400 feet and thus eliminating the constriction in the channel around Dow Thumb, providing a bend easing, and providing a turning notch at the Upper Turning Basin, all to 46 feet MLLW. These features are necessary to allow the Panamax design vessel for Reach 3, to transit around the Dow Thumb, to and from the Velasco Container Terminal. Widening of the FHC around the Dow Thumb would require: 1) insertion of a stability wall into the terrestrial portion of the Dow Thumb at the waterside toe of the HFPP levee, and 2) the removal of the underwater berm along the toe of the levee. The construction of the bend easing would require: 1) the re-designation of the west portion of the North Wave Barrier to the Old Quintana Road, and 2) the dredging of the bend easing. Without these modifications to the 2012 Feasibility Report, the Panamax design vessel will not be able to transit efficiently and safely to the Velasco Container Terminal and the benefits associated with Reach 3 would not be accrued as intended by Congress.

8.11 Comparison of the 2012 Feasibility Report DMMP and Revised DMMP

Because PA 9 is no longer available for the authorized project, a new placement plan was developed to establish adequate placement for the project with the TSP quantities included.

8.11.1 New Work Placement Comparison

Table 8-4 provides the new work placement plan for the 2012 Feasibility Report as authorized and a revised placement plan with new work material originally designated for placement in PA 9 now being placed into PA 8. TSP new work quantities have been included in the revised new work placement plan.

Table 8-4 – Comparison of New Work Placement Plans (Authorized and Revised)

Channel Reach	Begin Station	End Station	2012 Feasibility Report New Work Placement Plan		Revised New Work Placement Plan with TSP quantities	
			Volume (CY)	PA	Volume (CY)	PA
Channel Extension and Jetty Channel	470+00	78+52	9,733,297	ODMDS 1A	9,733,297	ODMDS 1A
Lower Turning Basin to Brazosport Turning Basin	78+52	123+40	1,853,144	PA 8	1,853,144	PA 8
Brazosport TB to Stauffer Channel	123+40	260+00	2,765,559	PA 9	4, 499,559	PA 8
		TOTALS	**14,352,000**		**16,086,000**	

8.11.2 Maintenance Placement Comparison

The **Table 8-5** provides a comparison of the maintenance plan in the 2012 Feasibility Report and the modified maintenance placement plan to account for the loss of PA 9 and the addition of the TSP maintenance volumes.

Table 8-5 – Comparison Maintenance Volumes Totals for 50 Years (WRRDA 2014 and TSP)

Channel Reach	Begin Station	End Station	2012 Feasibility Report Maintenance Plan		Revised Maintenance Plan with TSP quantities	
			Volume (CY)	PA	Volume (CY)	PA
Channel Extension and Jetty Channel	470+00	78+52	159,416,960	ODMDS 1A	9,733,297	ODMDS 1A
Lower Turning Basin to Brazosport Turning Basin	78+52	123+40	7,529,640	PA 1 (1,817,240) PA 8 (5,712,400)	7,529,640	ODMDS 1A
Brazosport TB to Stauffer Channel	123+40	260+00	8,993,130	PA 9	11,613,930	ODMDS 1A
		TOTALS	**175,939,730**		**178,560,530**	

A 50-year maintenance cost comparison of offshore placement (with use of a hopper dredge) versus upland placement (with use of pipeline dredge) was performed to determine the least cost plan for placement of material. As shown in Table 7 of Engineering Appendix, the relatively small volume of maintenance material for the channel will result in smaller bank heights of material required for dredging. When smaller bank heights (less than two feet) are encountered, hopper dredges are better suited to handle this configuration as opposed to large pipeline dredges that require deeper bank heights for improved efficiency. In addition, pipeline dredges generally incur higher mobilization/demobilization costs when compared to hopper dredges due to their slower speed of travel and larger size of crew required. Because of the factors mentioned, preliminary cost estimates indicate upland placement of material would be 42 percent more expensive when compared to offshore placement.

8.12 Views of non-Federal Sponsor and Others

The non-Federal sponsor, Port Freeport for the existing project has actively participated in the entire planning process, including development as WIK for the Engineering Appendix and NEPA products. Their primary concern has been to provide modifications to allow for transit of the Panamax vessel to and from the Velasco Container Terminal and realize the benefits intended by Congress.

8.13 TSP and Recent USACE Initiatives

These initiatives were developed to ensure USACE success in the future by improving the current practices and decision-making processes of the USACE organization. The goals and objectives outlined in the refreshed Campaign Plan (FY15-19, May 2015) include: 1) Support National Security; 2) Transform Civil Works; 3) Reduce Disaster Risks; and 4) Prepare for Tomorrow. This project is in support of two of the four goals for USACE contained in the latest (FY15-19, updated May 2015) USACE Campaign Plan. This plan is available at the following address: http://www.usace.army.mil/about/campaignplan.aspx. Specifically, this project supports Goal 2 (Transform Civil Works) and Goal 4 (Prepare for Tomorrow).

8.13.1 USACE Actions for Change as Reflected in the Campaign Plan

Specifically, this project supports the USACE Campaign Plan Goal 2 (Transform Civil Works) and Goal 4 (Prepare for Tomorrow) in the following actions.

- The study analyzed potential effects over the study area.
- Direct and indirect effects of the project on the environment were avoided to the maximum extent possible.
- Dredged material placement for the GRR features have stayed within the boundaries of the 2012 Feasiblity Report.

- Risk analysis is being conducted throughout the study.
- Project risks will be communicated during the public review of the study findings.

8.13.2 Environmental Operating Principles

The USACE Environmental Operating Principles (EOPs) were developed to ensure our missions include totally integrated sustainable environmental practices. Throughout the study process, these EOPs are considered at the same level as economic issues. Environmental consequences of construction and operation have been considered in developing the TSP, which avoids and minimizes all significant environmental impacts. Sustainability and risk management were integral considerations in developing a plan that will minimize impacts to the existing Freeport HFPP by incorporating the stability wall feature and the proposed relocation of a portion of the existing wave barrier. The TSP has been developed in consultation with stakeholders and resource agencies. Resource agency knowledge and evaluation methods developed for similar projects were applied in the impact analysis. A thorough NEPA and engineering analysis has ensured that we will meet our corporate responsibility and accountability for actions that may impact human and natural environments in the Brazoria regions. This analysis will be transparent and communicated to all individuals and groups interested in USACE activities. The seven re-energized EOP principles (July 2012) are available at the following webpage: http://www.usace.army.mil/Missions/Environmental/Environmental-Operating-Principles/.

9 ECONOMIC UPDATE

9.1 Economics

A separate but related effort to perform an Economic Update for the authorized project is included in the GRR documentation. The Economic Update will focus on the authorized project features and depths from the 2012 Feasibility Report, while the economic analysis for the GRR will focus on the "First Segment of Construction." The economic update will include the selected bend easing, widening & notch (GRR recommendation), and the authorized depths from the 2012 Feasibility Report. The configurations of the Economic Update are provided below in **Figure 9-1** and **Table 9-1**. This approach requires the assumption that the maximum width at the Dow Thumb is determined at the 46-foot MLLW depth, not the 51- foot MLLW in Economic Reach 2.

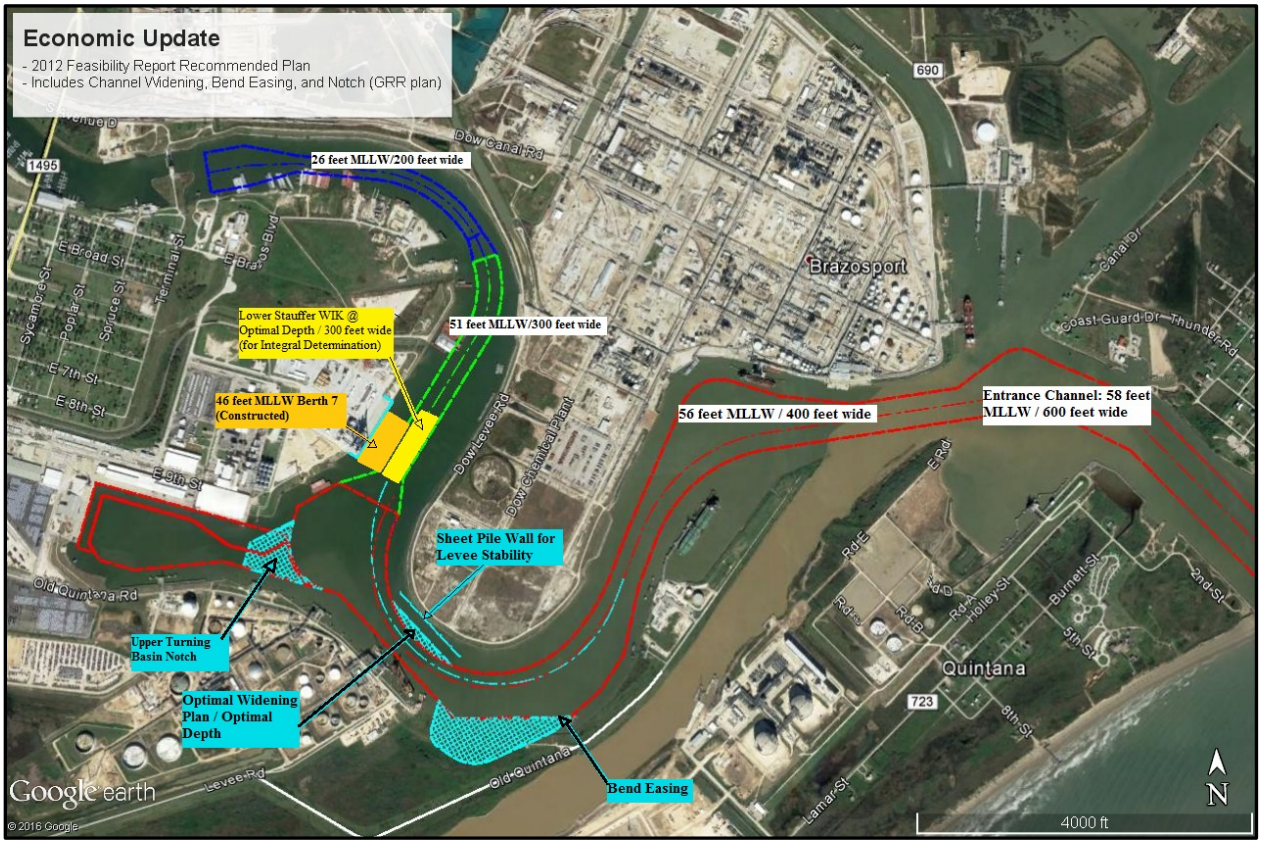

Figure 9-1. Economic Update Evaluation

Table 9-1 - Economic Update Depths and Widths

Economic Reach	Depth (MLLW)	Width (feet)
Reach 1	56	600
Reach 2	51	400
Reach 3	51	300
Reach 4	26	200

Details about the economic update can be found in the economic appendix (Appendix A). In short, containerships and Roll-on Roll-off vessels (RoRos) were included in the TSP calculations, and all deep draft benefitting traffic along the FHC were included in the economic update analysis.

9.2 Total Project First Cost Comparison

Table 9-2 provides the Project First Cost for 1) the WRRDA 2014 authorized cost at October 2013 price levels, 2) the WRRDA 2014 authorized cost updated to current price levels, and 3) the Project First Cost for the WRRDA 2014 updated costs at current prices levels with the TSP costs included.

Table 9-2 – Project First Cost Comparison Summary of WRRDA 2014 Project($000)

Cost Account and Feature	WRRDA 2014 Authorized Project First Cost *(Oct 2013 Price level)*	WRRDA 2014 Authorized Project First Cost *(Oct 2016 Price level)*	Project First Cost (WRRDA 2014 Updated Costs plus GRR TSP) *(Oct 2016 Price level)*
01 Lands & Damages (100% Non-Federal)	1,702	1,653	5,832
06 Fish & Wildlife Facilities	166	246	137
11 Levees & Floodwalls (GRR only)	-	-	20,767
12 Navigation, Ports & Harbors[1]	209,432	182,299	218,730
16 Bank Stabilization (GRR only)	-	-	1,163
30 Preconstruction Engineering & Design (PED)	18,449	18,578	24,012
31 Construction Management (E&D, S&A)	9,567	8,551	10,577
SubTotal Project First Cost	**239,316**	**211,327**[1]	**281,218**
12 Associated Costs (Berthing Areas)[2]	58,878	59,601	59,601
Other Federal Costs (Aids to Navigation) –USCG	1,392	1,352	1,352
Total Project First Cost	**299,586**	**272,280**[2]	**342,171**

[1]Cost decreased due to changes in labor rates, fuel costs, and interest rates.
[2]Associated costs that are not part of the recommended Federal project but are a necessary non-Federal responsibility.

9.2.1 Cost Implications of Additional Features for the WRRDA 2014 Authorization

There are cost implications to modifying the 2012 Feasibility Report. The maximum amount that a project may cost is defined in Section 902 of WRDA 1986. This is often called the 902 Limit or Project Cost Cap. "The maximum project cost limit imposed by Section 902 is a

numerical value specified by law which must be computed in a legal manner (Engineer Regulation 1105-2-100 Appendix G)." The maximum project cost includes 1) the authorized cost (adjusted for inflation), 2) the current cost of any studies, modifications, and action authorized by WRDA 1986 or any later law, and 3) 20 percent of the authorized cost (without adjustment for inflation). The cost of modifications required by law is to be kept separate and added to other allowable costs. The sum of these three components equal the maximum project cost allowed by Section 902.

Subsequent to the TSP advancement after the Agency Decision Milestone, a Class 3 Cost Estimate will be prepared using the MCACES tools and the established developed and certified. At that time, if the additional costs of the modifications that are necessary to allow the Panamax Vessel to transit to and from Velasco Container Terminal result in the Project exceeding the Section 902 Limit, congressional authorization would be required to increase the cost of the authorized project with the modifications.

9.3 Equivalent Annual Costs and Benefits

Table 9-3 provides a summary for this economic analysis in October 2016 dollars. The total average annual benefits of $36,159,000 for the project exceeds the total average annual costs of $26,052,000, yielding net benefits of $10,107,000 and a continued justified project.

Table 9-3 – Equivalent Annual Benefits and Costs ($000)

Equivalent Annual Benefits and Costs (October 2016 Price Level, 50-Year Period of Analysis, 2.875 Percent Discount Rate)	
Investment costs	
Total Project Construction Costs	$342,172
Interest During Construction	$12,852
Total Investment Cost	$355,024
Average Annual Costs	
Construction Average Annual Costs	$13,341
OMRR&R	$12,815
Total Average Annual Costs	$26,156
Average Annual Benefits	$40,019
Net Annual Benefits	$13,863
Benefit-Cost Ratio	1.53

9.4 Cost Sharing Apportionment

The estimated Cost Apportionment for the cost of the TSP at October 2016 price levels is presented in **Table 9-4**. For the TSP a Class 3 cost estimate was developed. For the FIGRR-EA, a Class 4 cost estimate will be developed and certified. The project cost for determining the cost-sharing requirements is based on the Project First Cost. The Project First Cost for all project components is separated into expected non-Federal and Federal cost shares. These costs differ from those in **Table 9-2** due to the inclusion of PED and Construction Management costs across the different channel segments.

Table 9-4 – Cost Apportionment (Authorized Project Costs plus TSP costs)

Project Feature		Project First Cost October 2016 Price Levels		
		Federal	Non-Federal	Total
General Navigation Features[1]				
1	Land & Damages (100% NF)	-	5,832	5,832
6	PA Mitigation-Contract 8 (90/10)	1	0	1
6	PA Mitigation-Contract 8 (75/25)	32	11	42
6	PA Mitigation-Contract 8 (50/50)	116	116	232
11	Levees and Floodwalls (90/10)	10,358	1,151	11,509
11	Levees and Floodwalls (75/25)	7,255	2,418	9,673
11	Levees and Floodwalls (50/50)	956	956	1,912
12[2]	Navigation Ports & Harbors (90/10)	845	94	939
12[2]	Navigation Ports & Harbors (75/25)	24,784	8,261	33,045
12[2]	Navigation Ports & Harbors (50/50)	93,628	93,628	187,256
12[2]	GRR-Navigation Ports & Harbors (90/10)	9,524	1,058	10,852
12[2]	GRR-Navigation Ports & Harbors (75/25)	11,104	3,701	14,806
12[2]	GRR-Navigation Ports & Harbors (50/50)	1,575	1,575	3,150
16	Bank Stabilization (90/10)	522	58	580
16	Bank Stabilization (75/25)	428	143	571
16	Bank Stabilization (50/50)	73	73	145
	Spent Costs	471	471	942
	Sub-Total Project First Cost[3]	**161,671**	**119,546**	**281,218**
	Associated Costs	-	59,601	59,601
	Navigation Aids (USCG)	1,352	-	1,352
	Total Project First Cost[3]	**163,023**	**179,147**	**342,171**

[1] Costs included PED and Construction Management totals.
[2] The Water Infrastructure Improvements for the Nation Act (WIIN Act) dated January 4, 2017, under Section 1111, modifies the cost share percentages for the new work originally stated in WRDA 1986. Once USACE provides Implementation Guidance, cost share percentages will be updated per said guidance.
[3] The total project costs and respective cost share allocations are approximate and contain rounding errors.

10 PUBLIC INVOLVEMENT AND AGENCY COORDINATION*

10.1 Public Involvement Activities

The public will have an opportunity to comment on the TSP during the 30-day public review of the DIGRR-EA. Any comments submitted during that process will be considered and addressed. The DIRGG-EA is very limited in scope and non-controversial.

10.2 Coordination of the DIGRR-EA with Federal and State Agencies

The EA and a Draft Findings of No Significant Impact (FONSI) will be sent to Federal and State agencies including the following:

Environmental Protection Agency Region 6
National Marine Fisheries Service
Texas Commission on Environmental Quality
Texas General Land Office
Texas Historical Commission
Texas Parks and Wildlife Department
U.S. Coast Guard
U.S. Fish and Wildlife Service
Natural Resource Conservation Service
Texas Parks and Wildlife Department
Texas Water Development Board
Texas Office of State-Federal Relations
Texas Department of Transportation

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

The TSP involves widening the channel to 400 feet, and constructing a bend easing, and a turning notch, all to a depth of 46 feet MLLW as the first segment of construction. Widening the channel requires removal of the underwater berm around the Dow Thumb. Prior to removal of the underwater berm, the Old River North Levee would be reinforced in this area with a stability wall inserted into the terrestrial portion of the Dow Thumb at the waterside toe of the levee. Prior to construction of the bend easing the west end of the North Wave Barrier would be re-designated to the elevated Old Quintana Road. Without these modifications to the 2012 Feasibility Report, the Panamax design vessel will not be able to transit efficiently and safety to the Velasco Container Terminal and the benefits associated with Reach 3 would not be accrued as intended by Congress.

As addressed earlier either congressional authorization or a Section 408 approval will be required to modify features belonging to the HFPP. Once this study reaches the Agency Decision Milestone Meeting, a path forward will be determined for the process used to modify the HFPP Old River North Levee and re-designate the North Wave Barrier.

11.2 Recommendation

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 will be advised of any modifications and will be afforded an opportunity to comment further.

_____ _____*

Date

Lars N. Zetterstrom, P.E.
Colonel, U.S. Army
Commanding

* Final Report To be signed

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