Deepwater Port License Application for the

Texas Gulf Terminals Project

Volume II – Environmental Evaluation (Public)

Section 2:
Alternatives Analysis

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ACRONYMS AND ABBREVIATIONS

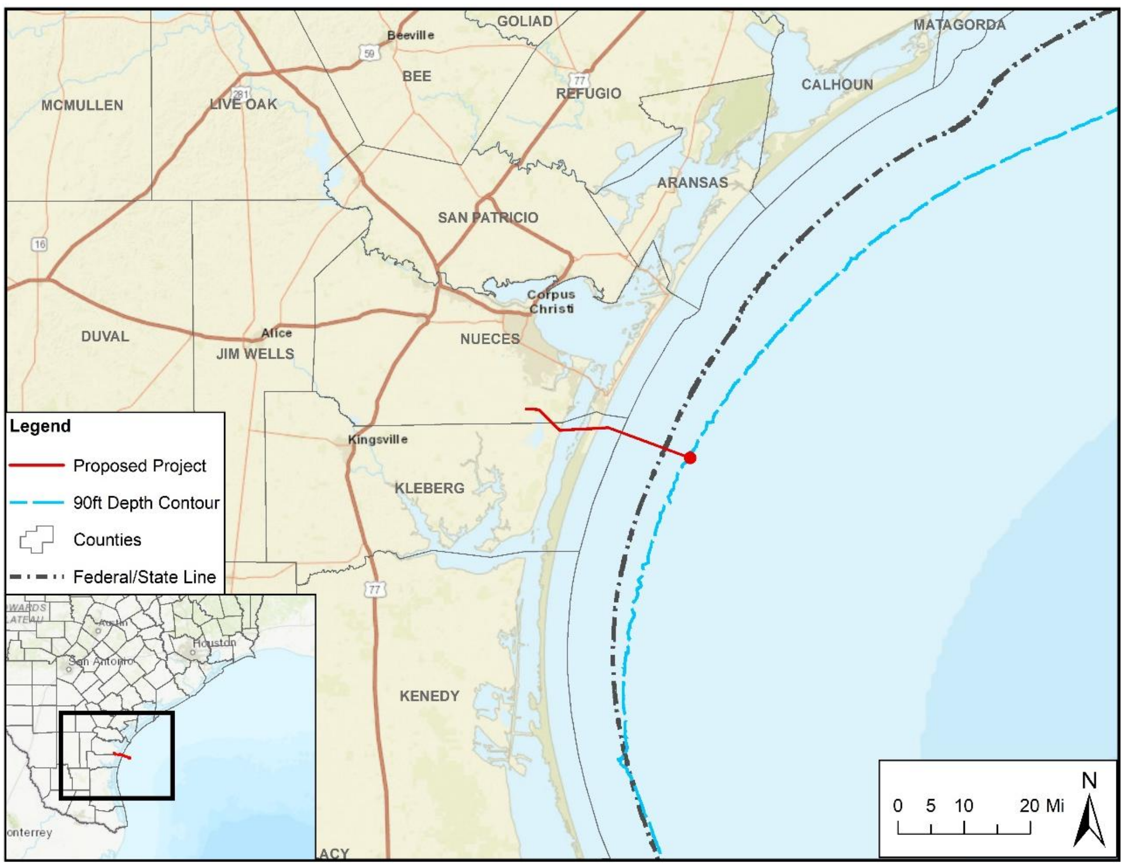
>	greater than
<	less than
AAPA	American Association of Port Authorities
ac.	acres
Applicant	Texas Gulf Terminals Inc.
BOEM	Bureau of Ocean Energy Management
bbl.	barrels
bpd	barrels per day
bph	barrels per hour
CALM	Catenary Anchor Leg Mooring
CCSC	Corpus Christi Ship Channel
CFR	Code of Federal Regulations
DWP	Deepwater Port
DWPL	Deepwater Port License
DWPA	Deepwater Port Act of 1974, as amended
DWT	deadweight tonnage
EFH	essential fish habitat
EIA	environmental impact assessment
ft.	feet
GIWW	Gulf Intracoastal Waterway
GLO	General Land Office
GOM	Gulf of Mexico
ha	hectare
HDD	Horizontal Directional Drilling
HSSE	health safety security environmental
i.e.	Latin id est “that is”
MARAD	Maritime Administration
max.	maximum
MHT	mean high tide
mi.	miles
MLLW	mean lower low water
mmbpd	million barrels per day
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
Nm	nautical miles
NOAA	National Oceanic and Atmospheric Administration
NWI	National Wetlands Inventory
OCS	Outer Continental Shelf
OSTF	onshore storage terminal facility
PADD	Petroleum Administration for Defense District
%	percent
PLEM	Pipeline End Manifold
POCC	Port of Corpus Christi

Project	Texas Gulf Terminals Project
ROW	Right of Way
SPM	single point mooring
sq. ft.	square feet
STS	ship-to-ship
T&E	threatened and endangered
TNRIS	Texas Natural Resources Information System
TPWD	Texas Parks and Wildlife
U.S.	United States of America
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
STS	ship-to-ship
U.S.	United States
U.S.C.	United States Code
Vs.	versus
VLCC	Very Large Crude Carriers
WMA	Wildlife Management Areas
WOUS	Waters of the United States
wt%	weight percent

PROJECT OVERVIEW

Texas Gulf Terminals Inc. (TGTI; also referred to as Applicant) is proposing to construct and operate a deepwater port (DWP), associated pipeline infrastructure, booster station, and an onshore storage terminal facility (OSTF), collectively known as the Texas Gulf Terminals Project (Project), for the safe, efficient and cost-effective export of crude oil to support economic growth in the United States of America (U.S.). The Applicant is filing this Deepwater Port License (DWPL) application to obtain a license to construct, own, and operate the Project pursuant to the Deepwater Port Act of 1974, as amended (DWPA), and in accordance with the U.S. Coast Guard (USCG) and the Maritime Administration's (MARAD) implementing regulations.

The Applicant is proposing to construct and operate the Project to allow direct and full loading of very large crude carriers (VLCC) at the DWP, via a single point mooring (SPM) buoy system. The proposed Project consists of the construction of a DWP, onshore and inshore pipeline infrastructure, offshore pipelines, and an OSTF. The proposed DWP would be positioned outside territorial seas of the Outer Continental Shelf (OCS) Mustang Island Area TX3 (Gulf of Mexico [GOM]), within the Bureau of Ocean Energy Management (BOEM) block number 823. The proposed DWP is positioned at Latitude N27° 28' 42.60" and Longitude W97° 00' 48.43", approximately 12.7 nautical miles (nm) (14.62 statute miles [mi]) off the coast of North Padre Island in Kleberg County, Texas. Refer to the Vicinity Map depicting the location of the proposed Project.



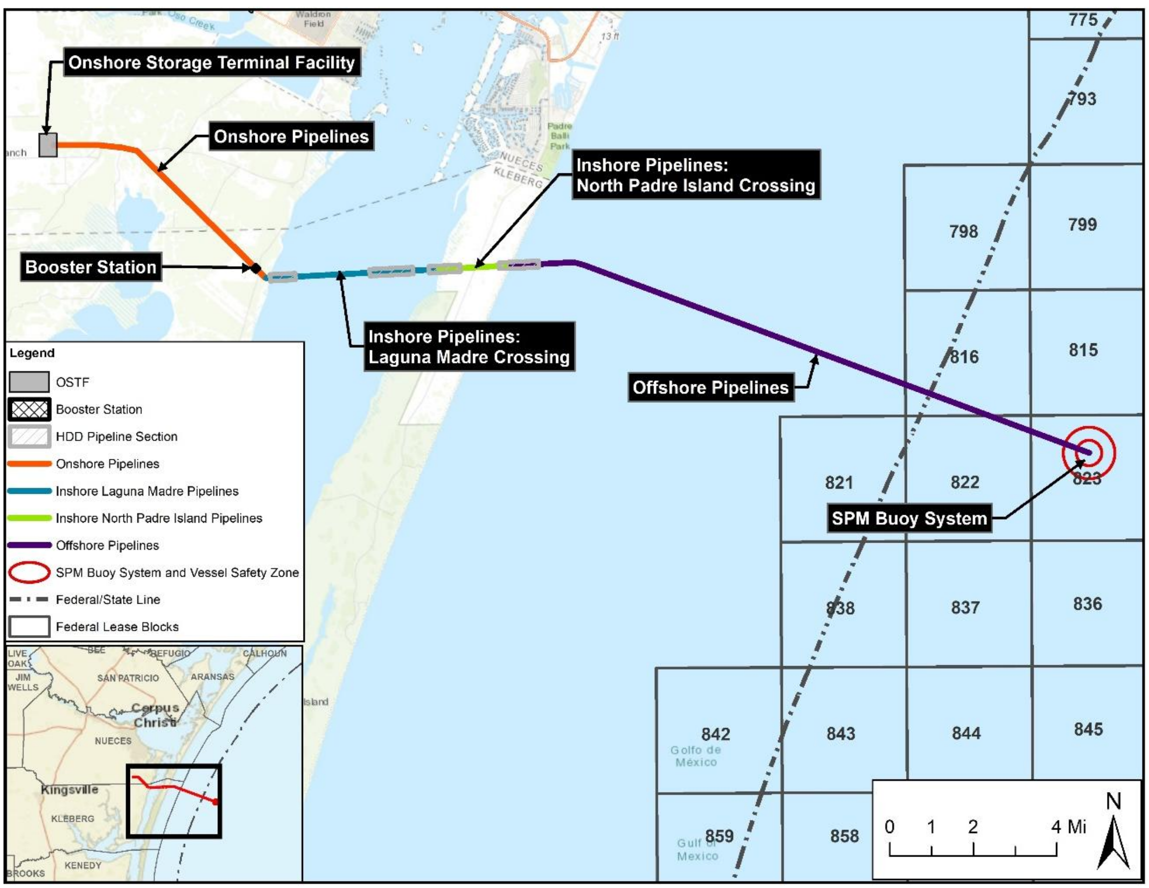
Vicinity Map

The proposed Project involves the design, engineering, and construction of a DWP, 26.81 miles of pipeline infrastructure, booster station, and an OSTF. For the purposes of this DWPL application, the proposed Project is described in three distinguishable segments by locality including "offshore", "inshore", and "onshore".

onshore Project components includes an approximate 150-acre (ac) (60.7 hectares [ha]) OSTF, an 8.25 ac (3.3 ha) booster station, and approximately 6.36 mi of two (2) new 30-inch-diameter crude oil pipelines extending from the OSTF located in Nueces County, to the booster station located in Kleberg County, and continue to the landward side of the mean high tide (MHT) line of the Laguna Madre. The proposed OSTF will serve as the primary collection and storage terminal of crude oil to be directly pumped through the proposed pipeline infrastructure to the DWP. Outbound flow rates from the OSTF to the DWP are anticipated to be approximately 60,000 barrels per hour (bph).

Inshore components associated with the proposed Project are defined as those components located between the western Laguna Madre MHT line and the MHT line located at the interface of North Padre Island and the GOM; this includes approximately 5.74 mi of two (2) new 30-inch-diameter crude oil pipelines and an onshore block valve station located on North Padre Island. The onshore valve station will serve as the primary conjunction between the proposed onshore and offshore pipeline infrastructure.

Offshore components associated with the proposed Project include the DWP and offshore pipelines. Principle structures associated with the proposed DWP includes one SPM buoy system consisting of the SPM buoy, pipeline end manifold (PLEM), sub-marine hoses, mooring hawsers, and floating hoses to allow for the loading of crude oil to vessels moored at the proposed DWP. The proposed SPM buoy system will be of the Catenary Anchor Leg Mooring (CALM) type permanently moored with a symmetrically arranged six-leg anchor chain system extending to pile anchors fixed on the seafloor. Offshore pipeline infrastructure associated with the proposed Project consist of approximately 14.71 mi of two (2) new 30-inch-diameter pipelines extending from MHT line on North Padre Island to the SPM buoy system located at the proposed DWP. Refer to the Project Components Map below for a depiction of the location of the Project components discussed above.



Project Component Map

2.0 ALTERNATIVES ANALYSIS

2.1 Regulatory Requirements of the Alternatives Analysis

An analysis of Project alternatives was undertaken in compliance with the National Environmental Policy Act (NEPA). This section of the NEPA report summarizes the process and outcome of the alternatives analysis. The alternatives analysis is one of nine criteria used to determine a final decision under the DWPA (33 Code of Federal Regulations [CFR] subchapter NN parts 148, 149, 150 AND/OR 33 U.S.C. 1503c). Pursuant to NEPA, governmental decision-makers must consider reasonable alternatives to a proposed action that would result in a significant environmental effect. A reasonable alternative is defined by the below criteria:

- Satisfy the project's purpose and need as defined in Section 1 – Project Purpose and Need;
- Satisfy environmental and project objectives discussed as defined in Section 1 (Purpose and Need and stated below);
- Technically and economically feasible; and,
- Would result in an acceptable return on the investment.

MARAD may approve or deny an application for a license under the DWPA, and in accordance with the implementing regulations in 33 CFR subchapter NN (parts 148, 149, 150). The Applicant understands that a license approval may include enforceable conditions by MARAD as part of the license. MARAD may also consider alternative means to construct and operate the DWP that meet the criteria listed above. Identifying and evaluating alternatives ensures that decisions using the NEPA process regulated under the DWPA are in the best interest of the U.S., and consistent with national security, energy policies, and environmental policies.

As described in Section 1.0 – Project Description, Purpose, and Need, the Applicant identified critical Project objectives required for the fulfillment of the purpose and need of the proposed Project. These Project objectives serve as the basis for consideration throughout the alternatives analysis and are used to compare potential alternatives throughout the tiered analysis. The overall Project objectives are defined as follows:

Project Objectives

- Provides a logistical solution for the safe, efficient, and cost-effective export of crude oil to support U.S. economic growth;
- Minimizes any additional Health, Safety, Security, and Environmental (HSSE) impacts not listed in the Environmental Objectives
- Ability to safely, fully, and directly load a VLCC; and,
- Ability of infrastructure to support loading rates of approximately 60,000 barrels per hour (bph) for the loading of approximately 8 VLCC's per month.

Environmental Objectives

- Minimizes impacts to waters of the U.S. (WOUS), including wetlands, and special aquatic resources;
- Minimizes impacts to threatened and endangered (T&E) species and their associated habitats;
- Minimizes impacts to cultural resources;
- Minimizes impacts to navigation and navigation safety;
- Minimizes impacts to commercial and recreational fisheries and essential fish habitat (EFH);
- Existing land use compatibility, availability, and suitable for the proposed Project;

- Project location within proximity of existing and planned crude oil infrastructure, thereby reducing Project footprint and environmental impacts;
- Project design that allows for the maximization of offsite fabrication in a controlled setting thereby minimizing offshore impact as a result of onsite construction activities.

This alternatives analysis evaluates the reasonable, feasible, and practical alternatives to the proposed action in accordance with NEPA. A variety of practicable and reasonable alternatives were considered by the Applicant. Impractical alternatives are defined as alternatives that are technically or economically unfeasible; therefore, were not considered as part of this alternatives analysis.

The alternatives evaluated have been selected to determine the best means of satisfying the purpose and need of the Project and in accordance with NEPA requirements. As part of the alternatives analysis process, the Applicant identified five tiers which were used to determine the least environmentally damaging practicable alternative which fulfilled the purpose and need of the proposed Project. An overview of the alternatives analysis conducted for the proposed Project is shown in Table 2-1:

Table 2-1: Alternatives Analysis Overview

	Alternatives Analysis
Tier I Screening: No-Action Alternative	
No-Action Alternative	No-Action Alternative
Tier II Screening: Location Alternatives	
U.S. Region Alternatives	East Coast (PADD 1)
	Midwest (PADD 2)
	Gulf Coast (PADD 3)
	Rocky Mountain (PADD 4)
	West Coast (PADD 5)
Gulf Coast (PADD 3) State Alternatives	Alabama
	Arkansas
	Louisiana
	Mississippi
	New Mexico
	Texas
Texas Coast Location Alternatives	Sabine/ Beaumont Area
	Houston Area
	Freeport Area
	Matagorda Area
	Corpus Christi Area
	Brownsville Area
Tier III Screening: Offshore vs. Onshore and Existing Infrastructure Alternatives	
Onshore vs. Offshore Alternatives	Onshore Terminal with Existing Channel Dimensions (-45 ft.)
	Onshore Terminal with Future Authorized Channel Dimensions (-52 ft.)
	Onshore Terminal with Modified Channel Dimensions (-71 ft.)
	Offshore Deepwater Port Terminal
Existing Infrastructure Alternatives	Utilization of Existing Abandoned Offshore Pipelines

	Alternatives Analysis
	Installation of New Offshore Pipeline Infrastructure
Tier IV Screening: Siting Analysis of Required Project Components	
Deepwater Port Location Alternatives	South Region
	Central Region
	North Region
Crude Oil Storage Facility Site Alternatives	Alternative A
	Alternative B
	Alternative C
Pipeline Routing and Deepwater Port Location Alternatives	Alternative 1
	Alternative 2
	Alternative 3
Tier V Screening: Evaluation of Design Alternatives	
Deepwater Port Design Alternatives	Fixed Platform
	Single-Point Mooring Buoy System
SPM Buoy Anchoring Alternatives	Anchor Piles
	Drag Anchors
Pipeline Design Alternatives	Single Pipeline Configuration
	Dual Pipeline Configuration

For each tier of the alternatives analysis, a four-step process was used for the screening of potential alternatives to determine which best fulfilled the Project purpose and need and Project objectives. During this process, alternatives were eliminated to allow for the advancement of the most practicable alternative for further consideration and analysis in subsequent tiers. The four-step process followed for each tier includes:

1. Identification and description of reasonable alternatives for analysis
2. Development of selection criteria for evaluating reasonable alternatives
3. Evaluation and comparison of reasonable alternatives based on selection criteria
4. Identification of most-suitable alternatives for advancement and evaluation in subsequent tiers

The development of selection criteria during step 2 for the evaluation of alternatives conducted during step 3 is based upon the Environmental and Project objectives described above. Section 2.2 provides a summary of the alternatives analysis framework and details the basis for which the identified tiers used for analysis were developed.

2.2 Framework of the Alternatives Analysis

As previously described, the alternatives analysis conducted for the proposed Project follows a tiered screening approach to identify and analyze potential alternatives and their ability to meet the Project purpose and need and Project objectives. As a result of the alternatives analysis, a total of five tiers were identified.

Tier I consisted of the evaluation of the no action alternative. Based on the results of Tier I, the need for action was determined. As such an analysis of potential location alternatives was conducted (Tier II), followed by offshore vs. onshore and system alternatives (Tier III), siting analysis of required Project components (Tier IV), and evaluation of design alternatives (Tier V). The following sections detail the basis for which each of the identified tiers were developed based on preceding determinations.

2.2.1 Tier I – Evaluation of No Action Alternative

Tier I of the alternatives analysis process evaluated the no action alternative. The no action alternative refers to the continuation of existing conditions without implementation of the proposed Project. Based on the results of the Tier I screening, the overall need for the proposed Project was determined with respect to existing market conditions and future crude oil production.

2.2.2 Tier II – Location Alternatives

Based on the results of the Tier I screening analysis, a Tier II screening was conducted consisting of an evaluation of locations within the U.S. that is most suited for meeting the Project purpose and need. As part of Tier II of the alternatives analysis, forecast of crude oil production was analyzed to determine the most suitable setting for the Project. The most suitable setting is further refined through the analysis of navigation and navigational safety needs, existing land use and infrastructure, and presence of sensitive cultural and ecological resources. Completion of the Tier II screening results in the selection of a regional setting for the proposed Project. As such, the identification of a regional setting allows for the analysis of offshore and onshore alternatives.

2.2.3 Tier III – Offshore vs. Onshore and System Alternatives

Based on the regional location determined as a result of the Tier II screening analysis, a Tier III screening was conducted to evaluate the utilization/development of an onshore port, or an offshore port to fulfill the Project purpose and need. The construction of new infrastructure as well as the utilization of existing infrastructure was investigated as part of the Tier III screening. The Tier III screening resulted in the determination of the most suitable conceptual project configuration and the required components. As such, the completion of the Tier III screening allows for a more specific siting analysis of the necessary components to be conducted during the Tier IV screening.

2.2.4 Tier IV – Siting Analysis of Required Project Components

The Tier III screening resulted in the development of a conceptual design and understanding of the required Project components which is determined to be the most suitable to fulfill the Project purposes and need. This understanding of the required infrastructure allows for a detailed siting analysis to be conducted for each of the necessary Project components to determine the most optimal location with regards to various siting criteria. The results of the Tier IV siting analysis allow for the further refinement of the conceptual project design and more detailed engineering of the various components associated with the proposed Project to be completed during the Tier V screening.

2.2.5 Tier V – Evaluation of Design Alternatives

The Tier V screening consisted of the analysis of the potential alternative project designs for the various components associated with the proposed Project. As part of this screening, each of the required Project components was analyzed to determine which allowed for the necessary throughput capacities and fulfillment of Project goals and objectives, while minimizing impacts and overall Project footprint to the maximum extent practicable.

2.2.6 Alternatives Analysis Screening Summary

Based on the results of the five-tiered screening process detailed above, the proposed project location and design was determined based on its ability to fulfill the Project purpose and need while minimizing environmental impacts to the maximum extent practicable. The preferred Project design and location as presented within this DWPL application is based on the results of the described screening process and serves as the basis for the determination of potential impacts to environmental resources as presented in Volume II as a result of the construction, operation, and decommissioning of the proposed Project.

2.3 Tier I – Evaluation of No-Action Alternative

The no action alternative refers to the continuation of existing conditions without implementation of the proposed Project. The U.S. crude oil production forecast indicate a 3.8 million barrel per day (MMbpd) increase of U.S. crude oil production over the next 5 years. Forecasts from Turner Mason & Company predict that U.S. crude oil production could surpass 13.0 MMbpd by 2022. Currently, the U.S. is exporting 2.4 MMbpd of crude oil.

The increase in U.S crude oil production consists of grades of crude oil classified as light, low sulfur crude oil. Light, low sulfur crude oil can typically be defined as greater than 25 American Petroleum Institute (API) gravity and 0.5wt% sulfur. Refineries are a complex series of processing units designed to convert a specific type of crude oil into refined products, such as gasoline and diesel. Existing U.S. refineries are either designed to process heavy, high sulfur crude oils or their ability to process light, low sulfur crude oil is currently at maximum capacity.

The additional production of light, low sulfur crude oil will ultimately be exported from the U.S. Forecasted production volumes of light, low sulfur crude oil within the U.S. equates to the export of 675 VLCC's per year. Currently, no inland port currently can fully and directly load a VLCC due to the draft and dock limitations. As such, VLCC's are currently being loaded via ship-to-ship (STS) operations, also referred to as lightering and/or reverse lightering. STS operations involve the use of smaller vessel(s) requiring lesser draft depths to fully load a VLCC. The VLCC stays positioned in water depths of greater than 71 feet during the STS operation. The smaller vessels load at an inland port, transit to the VLCC, transfer their cargo to the VLCC via an STS operation, and transit back to the inland port. This process is repeated until the VLCC is fully loaded. As such, STS operations create several HSSE concerns including multiple discharge operations at the VLCC, multiple navigations in and out of the inland ports, multiple emission sources, and multiple exposures to workforce hazards.

The international market demand for crude oil will continue to grow. The development of a safe, efficient, and cost-effective logistical solution for the export of crude oil would result in significant benefits on a local, regional, national, and global scale and support the continued economic growth of the U.S. The natural gas and oil industry is a critical part of the U.S. economy. In 2015 these energy resources supported 10.3 million jobs and contributed more than $1.3 trillion to the U.S. economy. Under the no-action alternative, the export of crude oil from the U.S. would be limited due to existing logistical constraints, thereby likely limiting crude oil production, and exploration of new wells.

Failure to develop a safe, efficient, and cost-effective logistical solution for the export of U.S. crude oil would result in the forfeiture of opportunities for the U.S. capitalization on international market demands and economic growth.

Table 2-2: Evaluation of the No Action Alternative Decision Matrix

Objective Type	Objectives	No Action Alternative	Action
Project Objectives	Provides a logistical solution for the safe, efficient, and cost-effective export of crude oil to support U.S. economic growth	X	✓
	Minimizes any additional HSSE impacts not listed in the Environmental Objectives	X	✓
	Ability to safely, fully, and directly load a VLCC	X	✓
	Ability of infrastructure to support loading rates of approximately 60,000 barrels per hour (bph) for the loading of approximately 8 VLCC's per month	X	✓
	TOTAL	**0**	**4**

Tier I – No Action Alternatives Analysis Conclusion

Based on the results of the Tier I analysis, as presented in Table 2-2, the no-action alternative was not considered feasible and not considered for further review.

2.4 Tier II – Location Alternatives

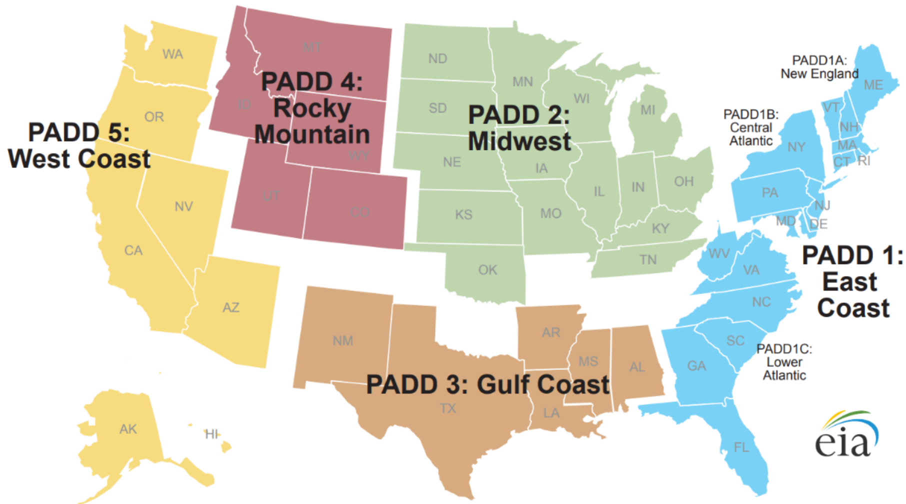
As determined by the result of the Tier I screening analysis, the Applicant determined the need for the development of a logistical solution for the safe, efficient and cost-effective export of crude oil to support the U.S. economy. As such, Tier II of the alternatives analysis was conducted consisting of an evaluation of locations within the U.S. most suited for meeting the Project purpose and need. Tier II consisted of screening potential location alternatives at the U.S. Regional level, state level, and local area level. The following sections describe the results of the Tier II screening analysis.

2.4.1 U.S. Region Alternatives

The U.S. is divided into five regions called Petroleum Administration for Defense Districts (PADDs) (Figure 2-1). PADDs are geographic aggregations which were established during World War II to help organize and ration petroleum products being used as fuel such as gasoline and diesel. Today PADDs are used to analyze patterns of crude oil and petroleum product movements throughout the U.S. (EIA 2018c). The five PADDs are:

- East Coast (PADD 1)
- Midwest (PADD 2)
- Gulf Coast (PADD 3)
- Rocky Mountain (PADD 4)
- West Coast (PADD 5)

Figure 2-1: Petroleum Administration for Defense Districts



Source: EIA 2018c

The analysis of U.S. Regional location alternatives was based upon three screening criteria consisting of the following:

1. High Crude Oil Production: Establishment of a crude oil export solution within the regional location of the highest crude oil production.
2. Amount of Existing Crude Oil Transport Infrastructure: Establishment of a crude oil export solution within the regional location with existing crude oil transport infrastructure (i.e. pipelines) allows for connectivity and utilization of existing infrastructure. Thereby is cost-effective, promotes operational efficiencies, and minimizes the need for additional infrastructure.
3. Regional Coastal Boundary: The most efficient form of global export of crude oil is conducted via waterborne commerce. As such, access to coastal waters is required for the loading of vessels for the export.

The following sections detail the analysis conducted for the U.S. Regional location alternatives.

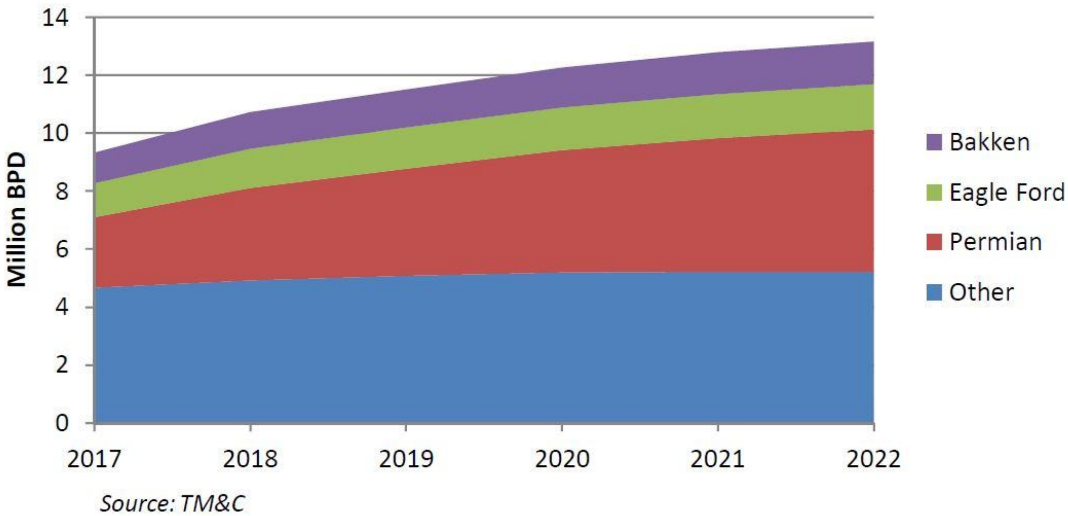
High Crude Oil Production

As shown in Table 2-3, 2016 crude oil production volume within the Gulf Coast (PADD 3) was greater than all other PADDs combined, with volumes greater than three times that of any other PADD. When looking at each of the five PADDs, the Gulf Coast region (PADD 3), currently stands out as the region of greatest potential for the Project based on the projected surge in oil production over the next 5 years as discussed in Section 1 – Project Description, Purpose, and Need. Of the forecasted increase of U.S. crude oil production, approximately 75% is forecasted to come from the Permian Basin and Eagle Ford Shale located within PADD 3: Gulf Coast (Table 2-3 and Figure 2-2). Additionally, this region is also expected to have the highest growth rate (Turner, Mason and Company, 2018).

Table 2-3: Crude oil production in the U.S. in 2016 by PADD

Crude oil production in the U.S. in 2016 by PADD	
East Coast (PADD 1)	15,956 thousand bpd
Midwest (PADD 2)	614,396 thousand bpd
Gulf Coast (PADD 3)	1,997,201 thousand bpd
Rocky Mountain (PADD 4)	242,365 thousand bpd
West Coast (PADD 5)	371,673 thousand bpd
Source: Statista 2018	

Figure 2-2: Forecasted Increase of U.S. Crude Production Sources



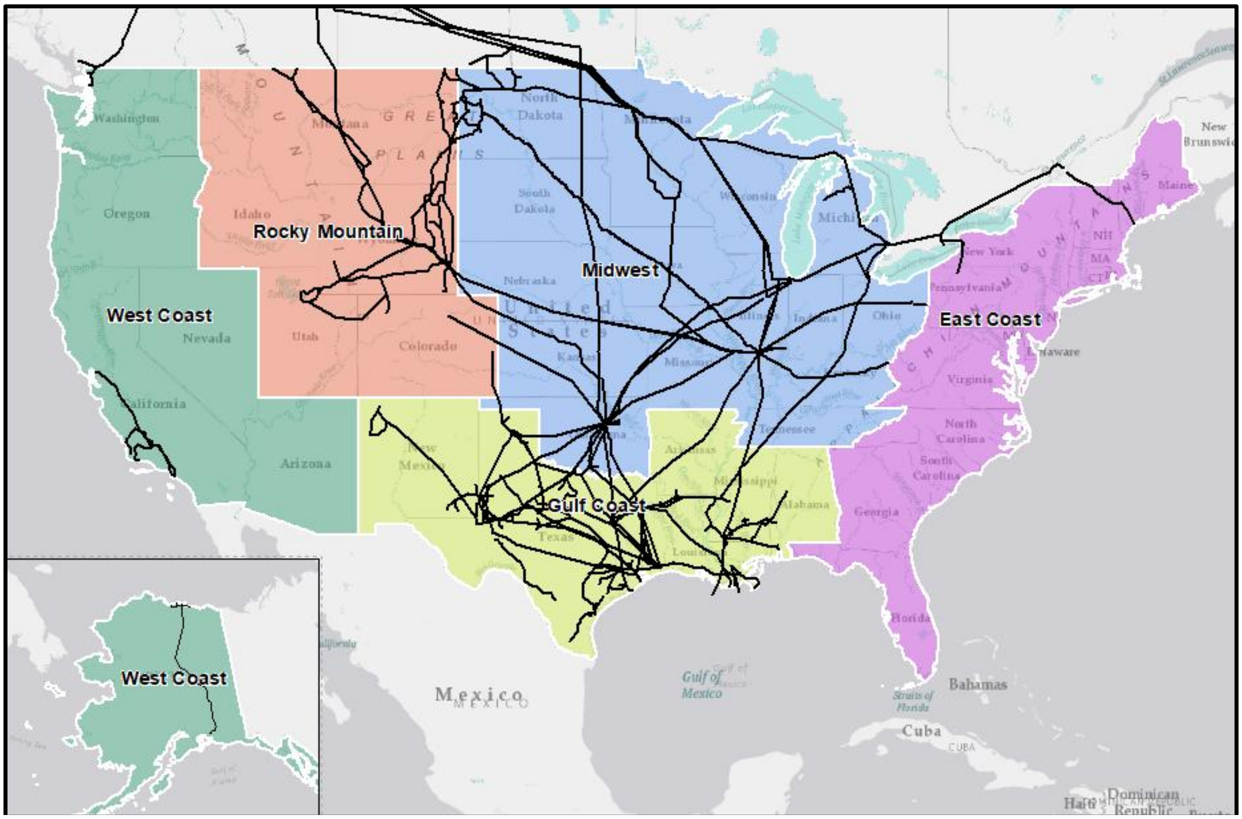
<u>Amount of Existing Crude Oil Transport Infrastructure</u>

As expected in areas of high crude production, the Gulf Coast region (PADD 3) and the Midwest region (PADD 2) are rich in crude oil infrastructure including major crude oil pipelines (Table 2-4 and Figure 2-3). Establishment of a crude oil export solution within the regional location with existing crude oil transport infrastructure (i.e. pipelines) allows for connectivity and utilization of existing infrastructure. Thereby, is cost-effective, promotes the utilization of existing operational efficiencies, and minimizes the need for additional infrastructure.

Table 2-4: Number of Existing Major Crude Oil Pipelines in the U.S. by PADD

Existing Major Crude Oil Pipelines in the U.S. by PADD	
East Coast (PADD 1)	7
Midwest (PADD 2)	62
Gulf Coast (PADD 3)	102
Rocky Mountain (PADD 4)	32
West Coast (PADD 5)	19
Source: EIA 2018g	

Figure 2-3: Existing Major Crude Oil Pipeline Infrastructure in the U.S. by PADD



Source: EIA 2018g

<u>Regional Coastal Boundary</u>

One of the most efficient forms of global export of crude oil is via waterborne operations. Access to offshore coastal waters is required for the loading of vessels. The East Coast (PADD 1) has the highest mileage of regional coastal boundary followed by the Gulf Coast (Table 2-5).

Table 2-5: U.S. Regional Coastal Boundary Mileage

Area	Mileage of Regional Coastal Boundary
East Coast (PADD 1)	27,370
Midwest (PADD 2)	0
Gulf Coast (PADD 3)	12,046
Rocky Mountain (PADD 4)	0
West Coast (PADD 5) *	7,863
**not including Alaska*	
Source: NOAA 2016	

An analysis of the five regional locations (PADD 1-PADD 5) was conducted based on the screening criteria listed above. The results of the U.S. region location screening are presented in Table 2-6.

Table 2-6: U.S. Region Location Alternatives Decision Matrix

U.S Region Alternatives	**East Coast (PADD 1)**	**Midwest (PADD 2)**	**Gulf Coast (PADD 3)**	**Rocky Mountain (PADD 4)**	**West Coast (PADD 5)**
High Crude Oil Production	X 15,956 thousand bpd	X 614,396 thousand bpd	✓ 1,997,201 thousand bpd	X 242,365 thousand bpd	X 371,673 thousand bpd
Existing Crude Oil Transport Infrastructure: Number of Existing Major Crude Oil Pipelines	X 7	✓ 62	✓ 102	X 32	X 19
Regional Coastal Boundary: Mileage Coastal Boundary	✓ 27,370	X 0	✓ 12,046	X 0	✓ 7,863
Evaluation Score	1	1	3	0	1
Retained for Further Consideration	No	No	**Yes**	No	No

U.S. Regional Alternatives Analysis Conclusion

Based on the results of the U.S. regional location alternatives analysis, as presented in Table 2-6, the Gulf Coast (PADD 3) is the most practicable U.S. regional alternative to be carried forward.

2.4.2 State Alternatives

Based on the results of the U.S. regional screening, the Gulf Coast (PADD 3) was determined to be the best suited for the establishment of a crude oil export solution. A state alternatives screening was conducted for the six states located within the Gulf Coast (PADD 3) to further refine the most optimal location and determine the most suitable state for the proposed Project. The six states include:

- Alabama
- Arkansas
- Louisiana
- Mississippi
- New Mexico
- Texas

The analysis of state alternatives was based on three screening criteria consisting of:

1. High Crude Oil Production: Establishment of a crude oil export solution within a state of the highest crude oil production.
2. Amount of Existing Crude Oil Transport Infrastructure: Establishment of a crude oil export solution within a state with existing crude oil transport infrastructure (i.e. pipelines) allows for connectivity thought the utilization of existing infrastructure; thereby, is cost-effective, promotes of operational efficiencies, and minimizes the need for additional infrastructure.

3. State Coastal Boundary: Access to coastal waters is required for the loading of vessels.

The following sections detail the analysis conducted for the state alternatives.

<u>High Crude Oil Production</u>

Texas is the leader of crude oil production within the Gulf Coast region. In 2017, Texas produced more than seven times the amount of crude oil than any other Gulf Coast state. New Mexico was the second most productive Gulf Coast state, followed by Louisiana in third (Table 2-7).

Table 2-7: Crude Oil Production January 2017

Crude Oil Production January 2017		
Area	**State**	**Thousand bpd Annually**
Gulf Coast (PAD District 3)	Alabama	18
	Arkansas	14
	Louisiana	137
	Mississippi	50
	New Mexico	473
	Texas	3,514
Source: EIA 2018e		

<u>Amount of Existing Crude Oil Transport Infrastructure</u>

As a reflection of its annual crude oil production, Texas houses more than two times the number of major crude oil pipelines than any other state in the Gulf Coast (Table 2-8). Establishment of a crude oil export solution within a state consisting of existing crude oil transport infrastructure (i.e. pipelines) allows for optimal connectivity through the utilization of existing infrastructure and would thereby be cost-effective, promote use of existing operational efficiencies, and minimize the need for additional infrastructure.

Table 2-8: Number of Existing Major Crude Oil Pipeline Infrastructure by State

Number of Existing Major Crude Oil Pipelines by State		
Area	**State**	**No.**
Gulf Coast (PADD 3)	Alabama	5
	Arkansas	2
	Louisiana	24
	Mississippi	18
	New Mexico	8
	Texas	63
Source: EIA 2018d		

State Coastal Boundary

Access to offshore coastal waters is required for the loading of vessels. Louisiana and Texas have the highest mileage of regional coastal boundary (Table 2-9).

Table 2-9: State Coastal Boundary Mileage

Area	Mileage of State Coastal Boundary
Alabama	53
Arkansas	0
Louisiana	397
Mississippi	44
New Mexico	0
Texas	367
Source: Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service.	

An analysis of the six states within the Gulf Coast was conducted based on the screening criteria listed above. The results of the state alternatives screening are presented in Table 2-10.

Table 2-10: State Alternatives Decision Matrix

U.S Region Alternatives	Alabama	Arkansas	Louisiana	Mississippi	New Mexico	Texas
High Crude Oil Production	X 18,000 bpd	X 14,000 bpd	X 134,00 bpd	X 50,000 bpd	X 473,000 bpd	✓ 3,514,000 bpd
Existing Crude Oil Transport Infrastructure: Number of Existing Major Crude Oil Pipelines	X 5	X 2	X 24	X 18	X 8	✓ 63
State Coastal Boundary: Mileage Coastal Boundary	X 53	X 0	✓ 397	X 44	X 0	✓ 367
Evaluation Score	0	0	1	0	0	3
Retained for Further Consideration	No	No	No	No	No	**Yes**

State Alternatives Analysis Conclusion

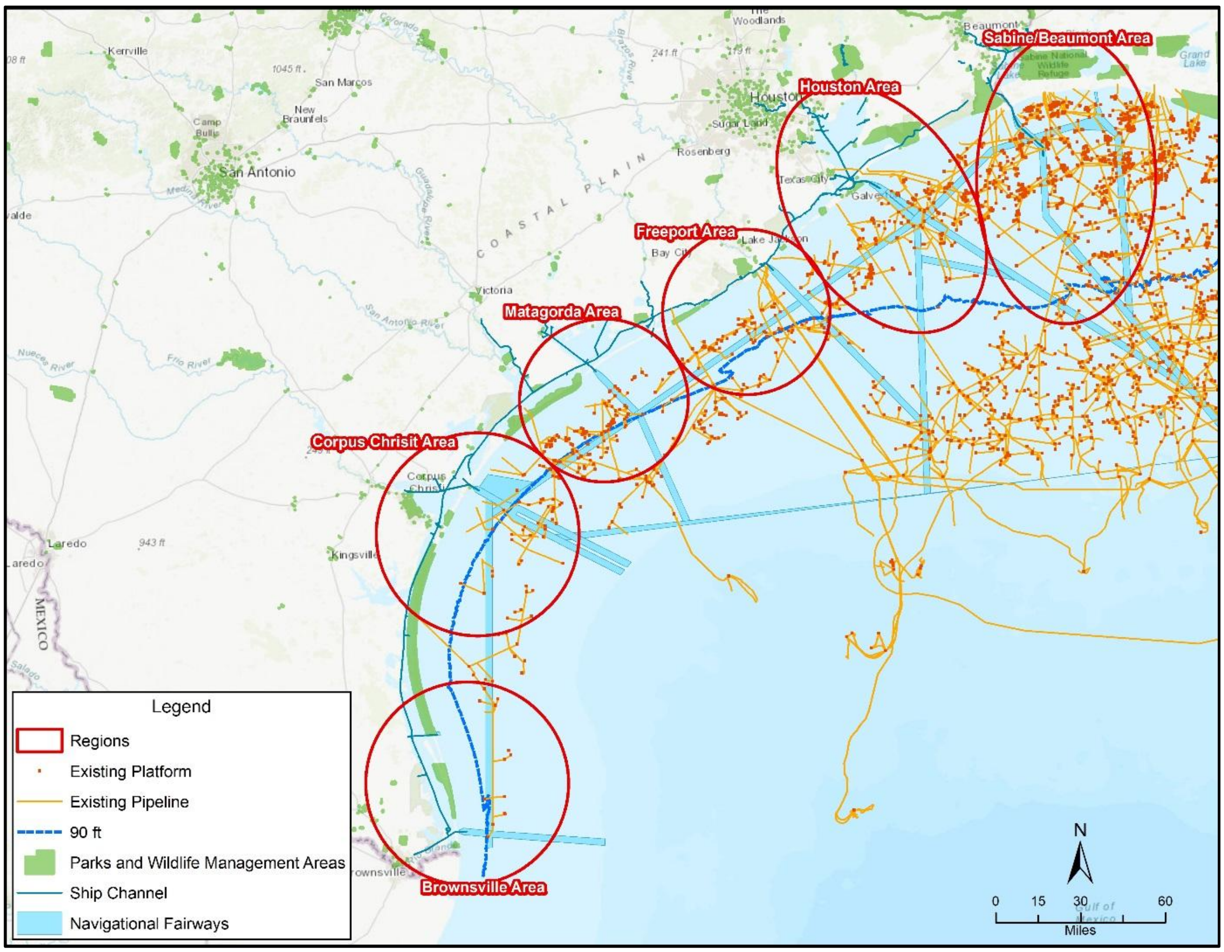
Based on the results of state alternatives analysis, as presented in Table 2-10, Texas is the most practicable state alternative to be carried forward.

2.4.3 Local Area Alternatives

Based on the results of the state alternative screening, Texas was determined to be the best suited state for the establishment of a crude oil export solution. A location alternative analysis along the coast of Texas was conducted to further refine the most optimal location and determine the most suitable area for the proposed Project. The Texas coast was categorized for analysis into six areas based on the major ports and nearby existing oil and gas related infrastructure (Figure 2-4). The six areas analyzed consist of:

- Sabine/Beaumont
- Houston
- Freeport
- Matagorda
- Corpus Christi
- Brownsville

Figure 2-4: Local Area Alternatives



Sources: BOEM, 2018; TNRIS, 2018

To identify the most suitable Texas coast location for the development of a crude export solution, several Project objectives needed to be further refined to narrow down the most optimal location. The primary criteria used for determining the most optimal Texas coast location can be categorized as navigation and navigational safety, sensitive ecological resources, and existing and future crude oil infrastructure. The following sections describe specifics used during the analysis of Texas coast location alternatives.

Navigation and Navigation Safety

As detailed within Section 1 – Project Description, Purpose, and Need, the purpose of the proposed project is to provide a safe, efficient and cost-effective logistical solution for the export of crude oil. A VLCC is one of the largest operating cargo vessels in the world carrying approximately 2,000,000 barrels. VLCC's measure approximately 1,540 feet (ft.) in length and 200 ft in width. Given this significant scale advantage versus the rest of the tanker fleet, a VLCC is the most economical form of waterborne crude oil transportation used globally. However, this scale also means that VLCCs require draft depths of approximately 71 ft. and require the necessary infrastructure to support loading operations. As such, the loading of a VLCC presents potential navigation and navigational safety concerns. The optimal location of the loading of VLCCs for crude oil export would be one that minimizes impacts to existing navigation and navigational safety. The following navigation and navigation safety criteria were used for analysis of the Texas coast location alternatives.

- Navigation Criteria 1: Minimizes potential for interference with existing offshore structures and activities: The optimal Texas coast location would be one that has limited existing offshore structures potentially interfering with vessel navigation (i.e. platforms).
- Navigation Criteria 2: Minimizes extensive dredging or removal of natural obstacles: VLCCs require draft depths of approximately 71 ft. and therefore the optimal Texas coast location would be one that allows for the full and direct loading of a VLCC at an inland port.
- Navigation Criteria 3: Minimizes danger posed to safe navigation by surrounding water depths: VLCCs require draft depths of approximately 71 ft. or greater and therefore the optimal Texas coast location would be one that limits the distance to areas of sufficient water depths for offshore loading operations (approximately 90 ft.).
- Navigation Criteria 4: Minimizes impacts to areas of existing congested vessel traffic: The optimal Texas coast location would be one that minimizes interference with existing incoming and outgoing vessel traffic and navigation fairways.

Sensitive Ecological Resources

Potential for impacts to sensitive ecological resources was used for the analysis of Texas coast location alternatives to identify the most suitable location. The following criteria were used for analysis of the Texas coast location alternatives with regards to potential impacts to sensitive ecological resources.

- Sensitive Ecological Resources Criteria 1: Minimizes impacts to threatened or endangered species: The optimal location would be one that has limited T&E species critical habitat within the area.
- Sensitive Ecological Resources Criteria 2: Minimizes impacts to areas of lesser air quality: The optimal location would be one that is located within an area, and consists of surrounding areas, that meet the National Ambient Air Quality Standards (NAAQS), and thereby are classified as attainment areas.

Existing and Future Crude Oil Infrastructure

As detailed within Section 1 – Project Description, Purpose, and Need, the purpose of the proposed project is to provide a safe, efficient and cost-effective logistical solution for the export of crude oil. Areas with existing crude oil infrastructure allows for greater connectivity and transport capabilities. Existing crude oil transport infrastructure allows for greater efficiencies for transporting the crude oil from the wellhead to export facilities. However, considerations should also be made to the destinations of future crude oil pipeline infrastructure being constructed in response to the forecasted increases of U.S. crude oil production. The following criteria were used for analysis of the Texas coast location alternatives with regards to existing and future crude oil infrastructure.

- Existing and Future Crude Oil Infrastructure Criteria 1: Texas coast location with regards to existing crude oil pipeline infrastructure.
- Existing and Future Crude Oil Infrastructure Criteria 2: Texas coast location with regards to future crude oil pipeline infrastructure.

The following three sections consist of the analysis of the navigation and navigation safety, sensitive ecological resources, and existing crude oil infrastructure criteria for the local area alternatives.

Navigation and Navigation Safety Analysis

The Gulf of Mexico is a major source of oil and natural gas in the U.S. As such, the Gulf of Mexico has significant numbers of offshore infrastructure. Understanding that the direct and full loading of VLCC's offshore may be required to fulfill the Project objectives and purpose and need, considerations were made as to the number and density of existing offshore platforms potentially interfering with vessel navigation (Table 2-11).

Table 2-11: Number of Existing Offshore Platforms

Texas Coast Location	Number of Existing Offshore Platforms
Sabine/Beaumont Area	781
Houston Area	188
Freeport Area	98
Matagorda Area	140
Corpus Christi Area	55
Brownsville Area	15

Source: BOEM, 2018

Currently, Texas Gulf Coast inland ports have limited draft depths within existing navigation channels, none of which exhibit the approximate minimum depth of 71 ft. required to allow a fully laden VLCC to transport its cargo safely (Table 2-12).

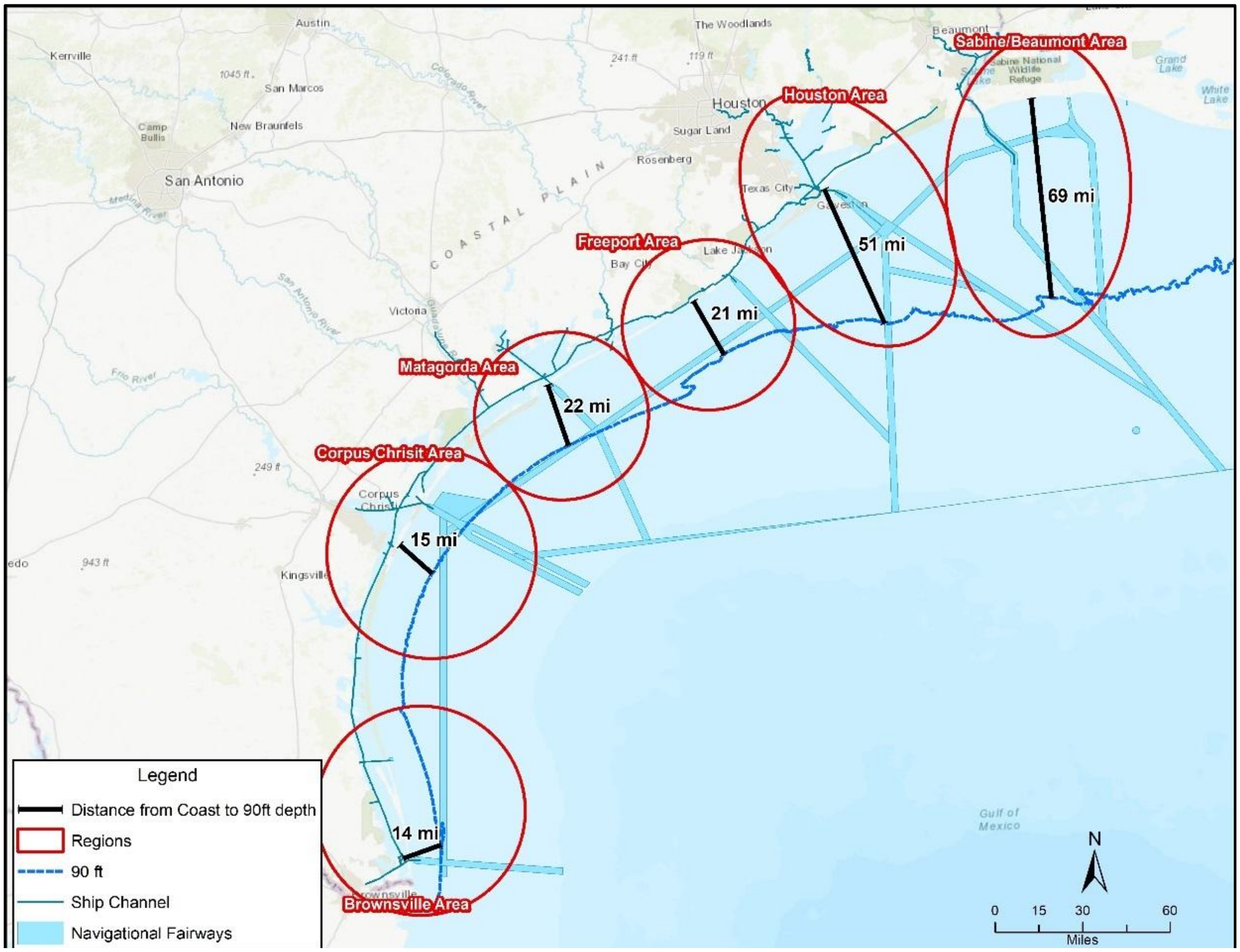
Table 2-12: Existing Gulf Coast Inland Port Draft Restrictions

GULF COAST PORT DRAFT RESTRICTIONS	
Port Name	**Max Draft (feet)**
Brownsville Area	35.8
Corpus Christi Area	45.0
Matagorda Area	35.1
Freeport Area	42.0
Houston Area	44.9
Sabine/Beaumont Area	40.0

Source: USACE, 2018a

Understanding that current Texas Gulf Coast inland ports have limited depths within existing navigation channels, considerations must be made to identify suitable areas along the Texas Gulf Coast which limit the distance from the coastline to the water depths required to support the loading of VLCC's offshore (approximately 90 ft.). Figure 2-5 depicts the 90 ft. water depth contour line with relation to the Texas Gulf Coast location alternatives. The distance from the coastline to sufficient water depths to support the full and direct loading of a VLCC varies based on location along the Texas coast (Table 2-13). Based on this measurement, the Brownsville area requires the minimal distance to obtain 90 ft. water depths followed by the Corpus Christ area.

Figure 2-5: Texas Coast Location Distances to 90-foot Water Depths



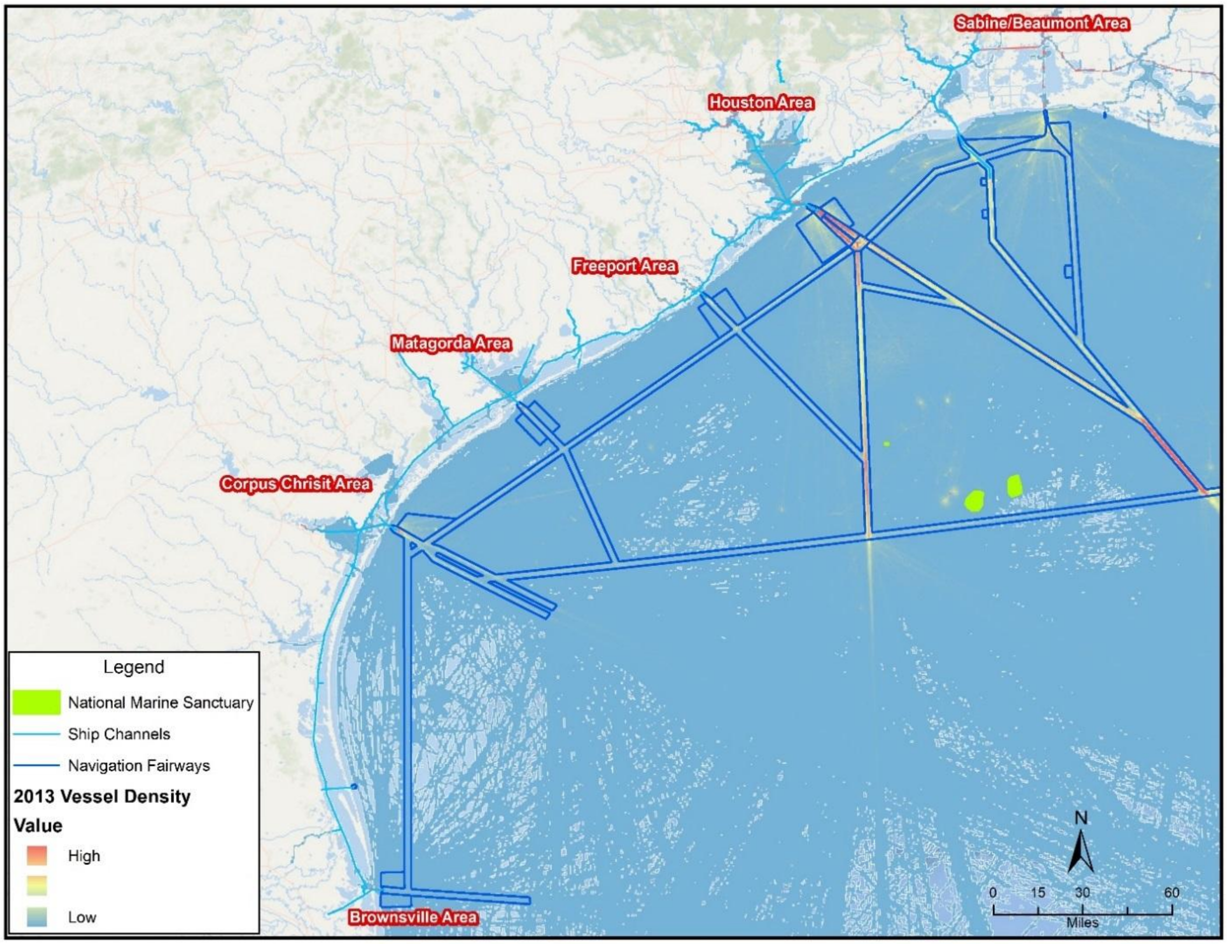
Sources: BOEM, 2018; TNRIS, 2018

Table 2-13: Existing Gulf Coast Port Draft Restrictions

Texas Coast Location	Approximate Distance to 90 ft. Water Depth
Sabine/Beaumont Area	69 miles
Houston Area	51 miles
Freeport Area	21 miles
Matagorda Area	22 miles
Corpus Christi Area	15 miles
Brownsville Area	14 miles

The export of crude oil from the U.S. as a result of increased production will likely result in greater increases of vessel traffic and congestion within existing navigation fairways. When considering Texas Gulf Coast location alternatives, the navigation and navigational safety for VLCC's with regards to existing vessel traffic densities and congestion was taken into consideration (Figure 2-6). Based on a review of this information, the Houston and Sabine/Beaumont areas currently have the highest vessel traffic densities and congestion within fairways.

Figure 2-6: Existing Navigation Fairways and Vessel Densities



Sources: BOEM, 2018; Marine Cadastre, 2018

Sensitive Ecological Resources Analysis

Potential for impacts to sensitive ecological resources was used for the analysis of Texas Gulf Coast location alternatives to identify the most suitable location. A review of threatened or endangered species and critical habitats was conducted to determine which of the Texas Gulf Coast location alternative would result in the minimal amount of impacts to T&E species critical habitats (Table 2-14). Additionally, a review was also conducted to determine the classification status of Texas Gulf Coast location alternatives with regards to NAAQS (Table 2-15).

Table 2-14: Texas Coast Location Alternatives T&E Species Critical Habitats

Texas Coast Location	Acreage of T&E Critical Habitat	T&E Critical Habitat Species
Sabine/Beaumont Area	4,796 acres	Piping Plover
Houston Area	3,757 acres	Piping Plover
Freeport Area	3,497 acres	Piping Plover
Matagorda Area	94,029 acres	Piping Plover and Whooping Crane
Corpus Christi Area	19,488 acres	Piping Plover
Brownsville Area	101,873 acres	Piping Plover

Source: USFWS, 2018a

Table 2-15: Texas Coast Location Alternatives National Ambient Air Quality Standards Status

Texas Coast Location	Counties	2018 NAQQS Status
Sabine/Beaumont Area	Jefferson County	Attainment
	Orange County	Attainment
Houston Area	Chambers County	Nonattainment
	Galveston County	Nonattainment
Freeport Area	Brazoria County	Nonattainment
Matagorda Area	Matagorda County	Attainment
	Calhoun County	Attainment
Corpus Christi Area	San Patricio County	Attainment
	Nueces County	Attainment
	Kleberg County	Attainment
Brownsville Area	Cameron County	Attainment

Source: EPA, 2018

Existing and Future Crude Oil Infrastructure Analysis

Understanding that the efficient export of U.S. crude oil requires connectivity to transport facilities (i.e. pipelines), considerations of Texas Gulf Coast location alternatives were made based crude oil pipeline infrastructure. Existing crude oil transport infrastructure allows for greater efficiencies for transporting the crude oil from the wellhead to export facilities. However, considerations should also be made to the destinations of future crude oil pipeline infrastructure being constructed in response to the forecasted increases of U.S. crude oil production. Based on a review of both existing crude oil pipeline infrastructure (Table 2-16) and future crude oil pipeline infrastructure (Table 2-17 and Figure 2-7), the Corpus Christi area will have the greatest connectivity to crude oil pipeline infrastructure.

Table 2-16: Number of Existing Major Crude Oil Pipelines by Texas Coast Location

Texas Coast Location	Number of Existing Major Crude Oil Pipelines

Texas Coast Location	Number of Existing Major Crude Oil Pipelines
Sabine/Beaumont Area	8
Houston Area	7
Freeport Area	1
Matagorda Area	0
Corpus Christi Area	4
Brownsville Area	0

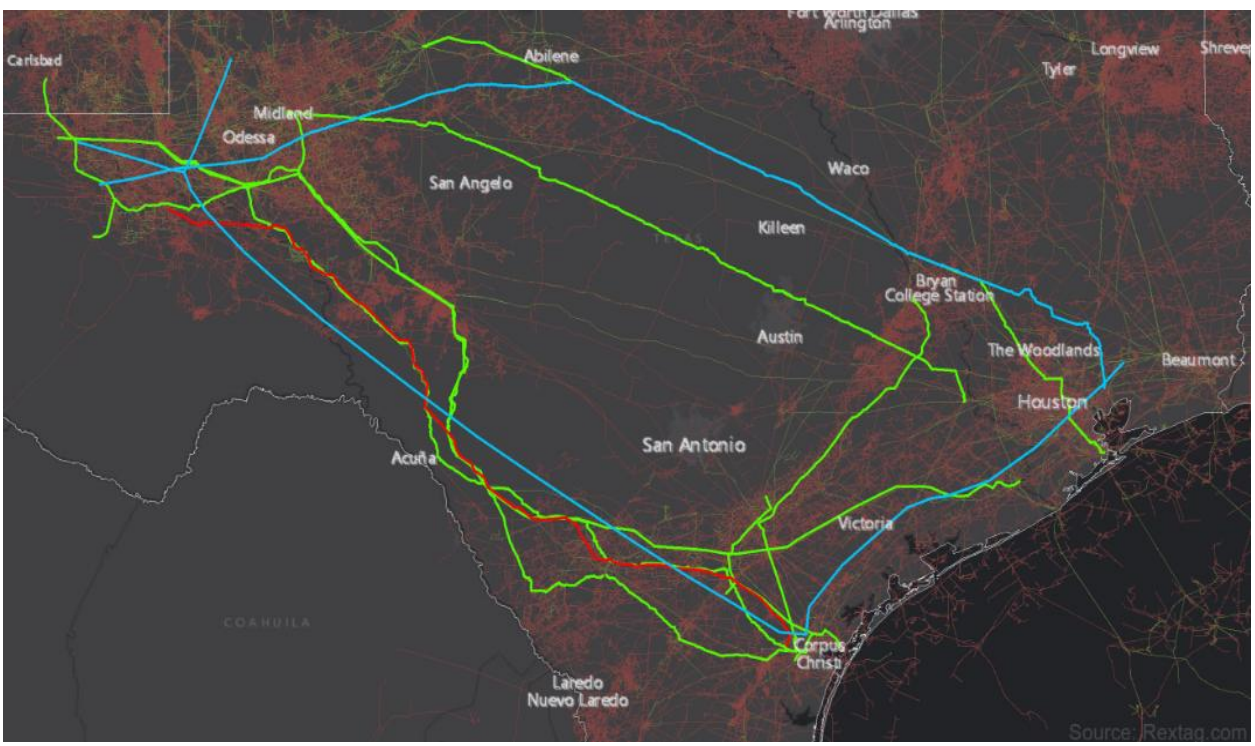
Source: EIA, 2018

Table 2-17: Number of Future Major Crude Oil Pipelines by Texas Coast Location

Texas Coast Location	Number of Future Major Crude Oil Pipelines
Sabine/Beaumont Area	0
Houston Area	3
Freeport Area	1
Matagorda Area	0
Corpus Christi Area	6
Brownsville Area	0

Source: EIA, 2018

Figure 2-7: Future Major Crude Oil Pipelines



Source: Rextag, 2018

An analysis of the six Texas Gulf Coast location alternatives was conducted based on the navigation and navigational safety, sensitive ecological resources, and existing and future crude oil infrastructure screening criteria previously listed. The results of the state alternatives screening are presented in Table 2-18.

Table 2-18: Local Area Location Alternatives Decision Matrix

Local Area Location Alternatives	Sabine/ Beaumont Area	Houston Area	Freeport Area	Matagorda Area	Corpus Christi Area	Brownsville Area
Navigation Criteria 1: Limited Existing Offshore Platforms (<100)	X 781 platforms	X 188 platforms	✓ 98 platforms	X 140 platforms	✓ 55 platforms	✓ 15 platforms
Navigation Criteria 2: Inland Port Draft Depth of 71 ft.	X 40 ft.	X 44.9 ft.	X 42 ft.	X 35 ft.	X 45 ft.	X 35 ft.
Navigation Criteria 3: Distance to 90 ft. Water Depth (<20 miles)	X ~ 69 miles	X ~ 51 miles	X ~ 21 miles	X ~ 22 miles	✓ ~ 15 miles	✓ ~ 14 miles
Navigation Criteria 4: Existing Vessel Traffic and Congestion	X High	X High	✓ Low	✓ Low	✓ Low	✓ Low
Ecological Resources Criteria 1: Acreage of Critical Habitat (<5,000 acres)	✓ 4,795 acres	✓ 3,757 acres	✓ 3,497 acres	X 94,029 acres	X 19,488 acres	X 101,873 acres
Ecological Resources Criteria 2: NAAQS Classification	✓ Attainment	X Nonattainment	X Nonattainment	✓ Attainment	✓ Attainment	✓ Attainment
Crude Oil Infrastructure Criteria 1: Existing Major Crude Oil Pipelines (>3 pipelines)	✓ 8	✓ 7	X 1	X 0	✓ 4	X 0
Crude Oil Infrastructure Criteria 2: Future Major Crude Oil Pipelines (>3 pipelines)	X 0	✓ 3	X 1	X 0	✓ 6	X 0
Evaluation Score	3	3	3	2	6	4
Retained for Further Consideration	**No**	**No**	**No**	**No**	**Yes**	**No**

Local Area Location Alternatives Analysis

Based on the results of the Texas Gulf Coast location alternatives analysis, as presented in Table 2-18, the Corpus Christi area is the most practicable local area alternative to be carried forward.

2.5 Tier III – Offshore vs. Onshore and Existing Infrastructure Alternatives

2.5.1 Offshore vs. Onshore Alternatives

As determined during the Tier II screening analysis, the Corpus Christi, Texas area was determined to be the best suited location for the establishment of a logistical solution for the safe, efficient and cost-effective export of crude oil to support growth of the U.S. economy. As such, Tier III of the alternatives analysis was conducted to determine which system alternatives best fulfilled the overall Project objectives and purpose and need. Tier III consisted of a screening of potential offshore, onshore, and a combination of onshore and offshore alternatives for the export of crude oil to support growth of the U.S. economy.

The ability to export crude oil safely, efficiently, and in a cost-effective manner requires the loading of VLCC's, the most economical and globally used form of waterborne transport for the export of crude oil. The onshore and offshore alternatives used for analysis includes:

1. Onshore Terminal with Existing Channel Dimensions (-45 ft.)
2. Onshore Terminal with Future Authorized Channel Dimensions (-52 ft.)
3. Onshore Terminal with Modified Channel Dimensions (-71 ft.)
4. Offshore Deepwater Port Terminal (-90 ft.)

The following sections describe the onshore and offshore alternatives and their associated components.

<u>Onshore Terminal with Existing Channel Dimensions (-45 ft.)</u>

The use of an onshore terminal with existing Corpus Christi Ship Channel dimensions would be the same as existing conditions and/or the no-action alterative. As described during the Tier I analysis, the Applicant does not consider adoption of the no-action alternative to be a viable alternative because it does not meet the objectives of the Project. Potential impacts associated with the proposed Project would be avoided under the no-action alternative. However, selection of the no-action alternative would not provide a safe, efficient, and cost-effective logistical solution for the export of U.S. crude oil support continued growth of the U.S. economy; thereby does not fulfill the Project purpose and need.

The use of an onshore terminal with existing channel dimensions would not fulfill the purpose and need and therefore was not considered for further review.

<u>Onshore Terminal with Future Authorized Channel Dimensions (-54 ft.)</u>

Per the Port of Corpus Christi Winter 2018 Stakeholder Partnering Forum presentation, the Corpus Christi Ship Channel is authorized to be dredged from its existing depth (-45 ft.) to -54 ft. However, the use of an onshore terminal with future authorized channel dimensions does not allow for the navigation of a fully loaded VLCC. As such the use of an onshore terminal with future authorized channel dimension would be the same as existing conditions and/or the no-action alterative. As described during the Tier I analysis, the Applicant does not consider adoption of the no-action alternative to be a viable alternative because it does not meet the objectives of the Project. Potential impacts associated with the proposed Project would be avoided under the no-action alternative. However, selection of the no-action alternative would not provide a safe, efficient, and cost-effective logistical solution for the export of U.S. crude oil support continued growth of the U.S. economy; thereby does not fulfill the Project purpose and need.

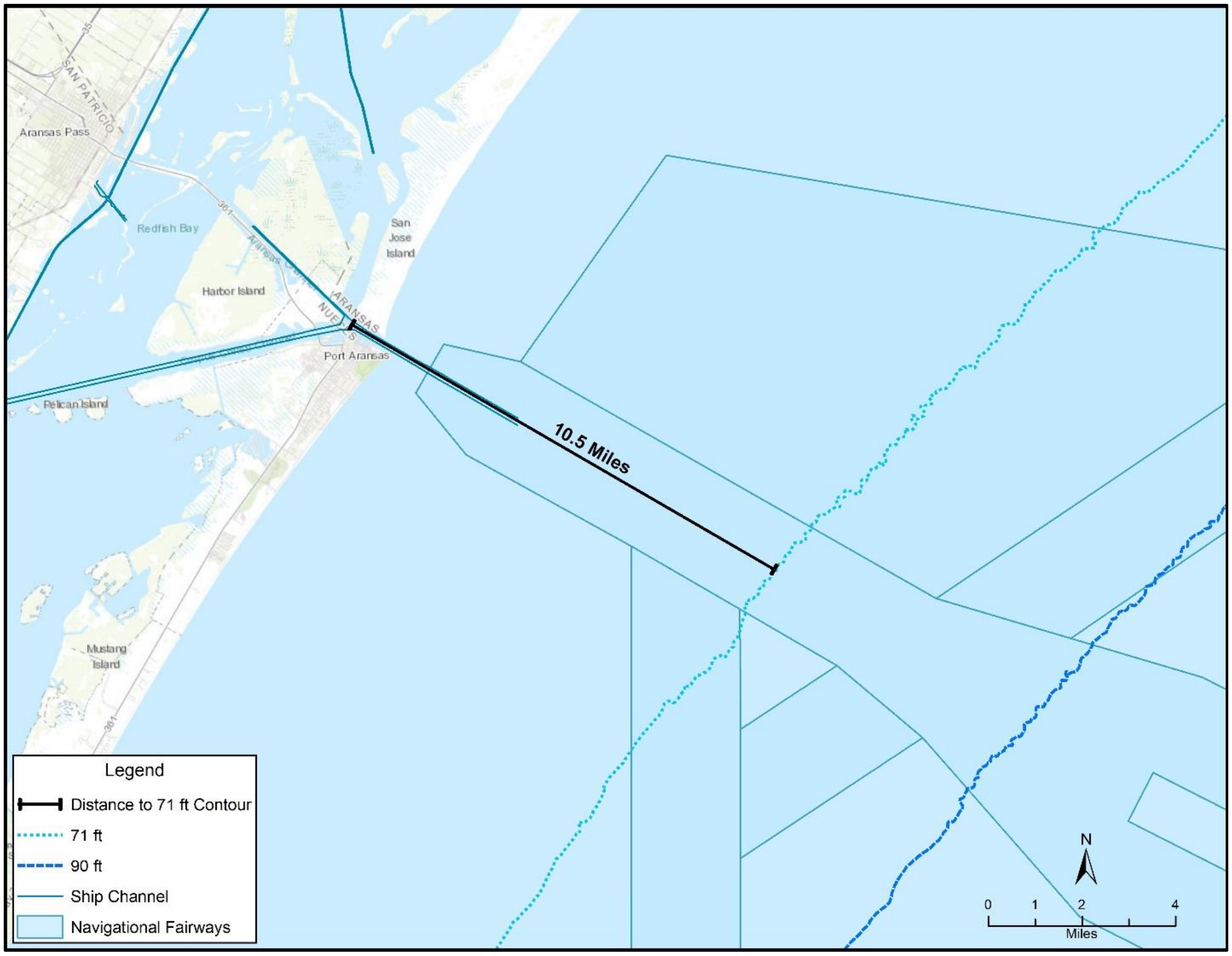
The use of an onshore terminal with future authorized channel dimensions would not fulfill the purpose and need and therefore was not considered for further review.

<u>Onshore Terminal with Modified Channel Dimensions (-71 ft.)</u>

The use of an onshore terminal for the direct and full loading of VLCC's requires the vessels to navigate to the onshore terminal, moor, undergo loading operations, and depart from the onshore storage terminal. Significant modifications to existing Corpus Christi Ship Channel dimensions and offshore approaches would be required (in addition to future authorized channel dimensions [-54 ft.]) for the navigation of vessels to an onshore terminal. Currently, the Corpus Christi Ship Channel has water depths of approximately 45 ft. The direct and fully loading of a VLCC's at an inland terminal facility requires approximately 71 ft of water depth. As such, a minimum of 26 feet of material would be required to be dredged from the onshore terminal to the 71-foot water depth contour located approximately 10.5 miles offshore (Figure 2-8). Preliminary estimates approximate that over 10 million cubic yards of material would be required to be removed and relocated to establish 71 ft. water depths through dredging activities along a 10.5-mile corridor from the existing 71 ft. depths to the nearest location within the Port of Corpus Christi (Figure 2-8).

Additionally, the use of the onshore terminal alternative for the direct and full loading of VLCC's at the necessary rates and frequencies to fulfill Project objectives (60,000 bbls per hour and approximately 8 VLCC's per month) would require storage capacities of approximately 6,000,000 bbls, mooring structures, and terminal supporting infrastructure; the use of an onshore terminal would require the development of approximately 200 acres located adjacent to a navigable waterway, such as the Corpus Christi Ship Channel.

Figure 2-8: Onshore Terminal Alternative Required Channel Modifications to 71 ft. Water Depth



Offshore Deepwater Port

The use of an offshore deepwater port (DWP) for the direct and full loading of VLCC's would require the installation of the necessary components for the loading of vessels offshore. These components include a DWP terminal for the loading of vessels, pipeline infrastructure, valve and booster stations, and storage facilities. The transport of crude oil for export from an offshore facility would require the installation of pipeline infrastructure from onshore crude oil storage facilities to the offshore DWP. Within the Corpus Christi area, a minimum of 15 miles of offshore pipeline infrastructure (i.e. pipeline infrastructure extending seaward from the shoreline of the Gulf of Mexico) is required to obtain the necessary depths for the loading of VLCCs in an offshore environment (90 ft.). To support the necessary rates and frequencies to fulfill Project objectives (60,000 bbls per hour and approximately 8 VLCC's per month), the onshore storage facility would require storage capacities of approximately 6,000,000 bbls. The development of approximately 150 acres would be required to provide the necessary crude oil storage facilities and DWP supporting infrastructure for the efficient operation and loading of VLCC's offshore at a DWP.

Offshore vs. Onshore Alternatives Analysis

The onshore terminal with existing channel dimensions (-45 ft.) and the onshore terminal with future authorized channel dimensions (-52 ft.) would not fulfill the purpose and need of the proposed Project, and therefore were not carried forward for further consideration. The offshore DWP port alternative and onshore terminal with modified channel dimensions (-71 ft.) alternative were carried forward for further analysis.

Potential Environmental Impacts for Offshore and Onshore Alternatives

Potential environmental impacts were assessed for offshore and onshore alternatives to determine which best fulfills the overall Project objectives. However, both the onshore and offshore alternatives have the capability to fulfill the previously identified Project objectives including:

- Provides a logistical solution for the safe, efficient, and cost-effective export of crude oil to support U.S. economic growth;
- Minimizes any additional Health, Safety, Security, and Environmental (HSSE) impacts not listed in the Environmental Objectives;
- Ability to safely, fully, and directly load a VLCC; and,
- Ability of infrastructure to support loading rates of approximately 60,000 barrels per hour (bph) for the loading of approximately 8 VLCC's per month.

To further refine potential alternatives, an analysis of offshore and onshore alternatives was analyzed with regards to the environmental Project objectives to determine the least environmentally damaging practicable alternative that provides a logistical solution for the safe, efficient, and cost-effective export of crude oil. The environmental Project objectives analyzed included:

- Minimizes impacts to waters of the U.S. (WOUS), including wetlands, and special aquatic resources;
- Minimizes impacts to threatened and endangered (T&E) species and their associated habitats;

- Minimizes impacts to cultural resources;
- Minimizes impacts to navigation and navigation safety;
- Minimizes impacts to commercial and recreational fisheries and essential fish habitat (EFH);
- Existing land use is compatible, available, and suitable for the proposed Project;
- Project location is within proximity of existing and planned crude oil infrastructure, thereby reducing Project footprint and environmental impacts;
- Project design allows for the maximization of offsite fabrication in a controlled setting thereby minimizing offshore impact as a result of onsite construction activities.

<u>Environmental Project Objectives Analysis – Onshore Terminal with Modified Channel Dimensions (-71 ft.)</u>

The onshore terminal with modified channel dimensions alternative would result in environmental impacts due to the required dredging and placement of material to obtain the necessary water depths for full and direct loading of a VLCC. To obtain sufficient depths from offshore approaches, it is estimated that the initial dredging and placement of 10 million cubic yards of material would be required for the safe navigation of a VLCC to the inland portion of the Corpus Christi Ship Channel. The following sections detail how each environmental Project objective is fulfilled or not fulfilled by the onshore terminal with modified channel dimensions (-71 ft) alternative.

Minimizes impacts to waters of the U.S. (WOUS), including wetlands, and special aquatic resources:

The dredging and placement of the estimated 10 million cubic yards of material would likely result in significant temporary and permanent impacts to waters of the U.S., including wetlands, and coastal habitats utilized by a variety of wildlife species. Additionally, routine maintenance dredging activities would be required to maintain the necessary water depths to support the navigation and full loading of VLCCs at an onshore terminal. Therefore, this alternative does not fulfill this Project objective.

Minimizes impacts to threatened and endangered (T&E) species and their associated habitats:

Depending on the exact placement of dredged material, impacts to T&E species and their associated habitats may occur. Due to the required volume of dredge material, impacts to coastal environments would occur as a result of the placement of material or disturbance of coastal sediments during dredging activities which would likely impact T&E species habitat. Therefore, this alternative does not fulfill this Project objective.

Minimizes impacts to cultural resources:

Impacts to cultural resources would be determined based on the results of surveys conducted prior to dredging and terminal construction activities. Therefore, the determination of impacts to cultural resources as a result of the onshore terminal with modified channel dimensions is currently unknown.

Minimizes impacts to navigation and navigation safety:

Temporary but significant impacts to navigation and navigation safety would occur during initial dredging activities and subsequent maintenance dredging activities which would disrupt normal navigation patterns within the Corpus Christi Ship Channel. The navigation of VLCC's within the Corpus Christi Ship Channel during operation of the onshore terminal would present significant safety and navigation concerns with regards to existing vessel traffic meaning permanent impacts to navigation and navigation safety would occur due to the operation of the onshore terminal alternative. Therefore, this alternative does not fulfill this Project objective.

Minimizes impacts to commercial and recreational fisheries and essential fish habitat (EFH):

Impacts to commercial and recreational fisheries and EFH would occur during initial dredging and material placement and subsequent maintenance dredging events. Depending on the exact placement of dredged material, permanent impacts to EFH would occur in the likely event that dredged material is placed within an aquatic environment. Impacts to EFH would be temporary for each dredge material placement term due to increased turbidity and vessel activity in EFH areas; however, routine maintenance dredging would occur for the foreseeable future of the Project which would cause long-term impacts. Therefore, this alternative does not fulfill this Project objective.

Existing land use is compatible, available, and suitable for the proposed Project:

The operation of an onshore terminal facility requires that the facility be located adjacent to a navigable waterway. The majority of the Corpus Christi Ship Channel is an industrialized corridor. As such, the development of an onshore terminal facility in this area would be consistent with existing land use. This alternative fulfills this Project objective.

Project location is within proximity of existing and planned crude oil infrastructure, thereby reducing Project footprint and environmental impacts:

As discussed in Tier II, the Corpus Christi area is located nearby existing crude oil infrastructure therefore allowing for connectivity between existing and future crude oil infrastructure and the onshore terminal. Thus, this alternative fulfills this Project objective.

Project design allows for the maximization of offsite fabrication in a controlled setting thereby minimizing offshore impact as a result of onsite construction activities:

The construction of the onshore terminal facility requires onsite fabrication of the necessary crude oil storage facilities, terminal supporting infrastructure, and vessel engagement infrastructure. An onshore storage terminal facility allows for minimal offsite fabrication due to the required infrastructure and site area necessary for the efficient fabrication, installation, and operation of such facilities. Thus, this alternative fulfills this Project objective.

<u>Environmental Project Objectives Analysis – Offshore Deepwater Port</u>

The offshore DWP alternative would result in temporary environmental impacts as a result of the construction and installation of the necessary project components to support the direct and full loading of VLCC’s located offshore. The following sections detail how each environmental Project objective is fulfilled or not fulfilled by the offshore deepwater port alternative.

Minimizes impacts to waters of the U.S. (WOUS), including wetlands, and special aquatic resources:

Impacts to waters of the U.S. would occur as a result of the construction and installation of the necessary pipeline infrastructure extending from crude oil storage facilities to the DWP for the loading of VLCCs. Due to the nature of the offshore DWP alternative, onshore crude oil storage facilities can be strategically positioned within areas resulting in minimal impacts to waters of the U.S., including wetlands. Depending on the exact location and routing of the necessary pipeline infrastructure, temporary impacts to waters of the U.S., including wetlands, and special aquatic resources would occur. Following the completion of installation of the necessary pipeline infrastructure, areas temporarily disturbed can be returned to preconstruction conditions and allowed to revert to previous land use. Advances in technology allows for the installation of pipeline infrastructure via horizontal directional drilling (HDD) methods resulting the avoidance of impacts to critical areas. Therefore, this alternative does fulfill this Project objective.

Minimizes impacts to threatened and endangered (T&E) species and their associated habitats:

Depending on the exact routing of the necessary pipeline infrastructure, temporary impacts to T&E species and their associated habitats may be required. However, impacts to critical T&E habitats can be avoided through the use of HDD pipeline installation methods where determined necessary. Following the completion of the installation of the pipeline infrastructure, areas temporarily disturbed would revert to previous land use. Due to the available technology, the offshore DWP alternative is not anticipated to adversely affect T&E species and/or their associated habitats. Therefore, this alternative does fulfill this Project objective.

Minimizes impacts to cultural resources:

Impacts to cultural resources would be determined based on the results of surveys conducted prior to the construction of the necessary components. Therefore, the determination of impacts to cultural resources as a result of the offshore DWP is unknown. However, should cultural resources be identified as a result of field surveys, the necessary components of the offshore DWP alternative can be either repositioned and/or installed in a manner to avoid impacts to identified cultural resources.

Minimizes impacts to navigation and navigation safety

Temporary impacts to navigation and navigation safety would occur during construction and installation of the necessary pipeline infrastructure extending to a DWP. However, the design of the offshore DWP alternative can be completed in a manner that avoids high vessel traffic areas to minimize navigation and navigation safety impacts during construction activities. Additionally, the use of HDD installation methods would be used, as required, under navigable channels and waterways to avoid impeding vessel traffic during construction methods. The DWP used for the loading of VLCCs would be strategically positioned within the necessary water depths to ensure the navigation, mooring, and loading of vessels at the DWP. Therefore, this alternative does fulfill this Project objective.

Minimizes impacts to commercial and recreational fisheries and essential fish habitat (EFH):

Temporary impacts to commercial and recreational fisheries and EFH would occur as a result of construction activities. However, impacts to commercial and recreational fisheries and EFH can be minimized and/or avoided to the maximum extent practicable. Following the completion of construction and installation activities, areas temporarily impacted as a result of the installation of the pipeline infrastructure would revert to pre-construction uses. Therefore, this alternative does fulfill this Project objective.

Project location is within proximity of existing and planned crude oil infrastructure, thereby reducing Project footprint and environmental impacts:

The operation of an offshore DWP would result in minimal impacts to existing land use due to primary loading operations being completed in an offshore environment. The offshore DWP allows for the versatility in the placement of structures which minimizes impacts to existing land uses and allows for the continued use of the land following the completion of construction activities. Additionally, as discussed in Tier II, the Corpus Christi area is located nearby existing crude oil infrastructure therefore allowing for connectivity between existing and future crude oil infrastructure and the crude oil storage facilities servicing the DWP. Therefore, this alternative does fulfill this Project objective.

Project design allows for the maximization of offsite fabrication in a controlled setting thereby minimizing offshore impact as a result of onsite construction activities:

The construction of the offshore DWP alternative has the potential for the offsite fabrication of necessary components. Onsite fabrication of the crude oil storage facilities servicing the DWP would be required. However, depending on the exact type and style of the DWP to be used for the loading of VLCCs offshore, these components can be fabricated and assembled in a controlled environment, thereby limiting the amount of onsite construction activities. Therefore, this alternative does fulfill this Project objective.

An analysis of the onshore vs. offshore alternatives was conducted based on their ability to fulfill the overall Project objectives. As previously stated, the onshore terminal with existing channel dimensions (-

45 ft.) alternative and the onshore terminal with future authorized channel dimensions (-54 ft.) is that of the no action alterative analyzed as part of the Tier I analysis. The onshore terminal with existing channel dimensions alternative would not fulfill the purpose and need and therefore was not considered for further review. The results of the analysis conducted for the onshore terminal facility with modified channel dimensions (-71 ft) and the offshore DWP alternative are presented in Table 2-19.

Table 2-19: Offshore vs. Onshore Alternatives Decision Matrix

Objective Type	Objectives	Onshore Terminal with Modified Channel Depths (-71 ft.)	Offshore Deepwater Port
Project Objectives	Provides a logistical solution for the safe, efficient, and cost-effective export of crude oil to support U.S. economic growth	✓	✓
	Minimizes any additional HSSE impacts not listed in the Environmental Objectives	✓	✓
	Ability to safely, fully, and directly load a VLCC	✓	✓
	Ability of infrastructure to support loading rates of approximately 60,000 barrels per hour (bph) for the loading of approximately 8 VLCC's per month	✓	✓
Environmental Objectives	Minimizes impacts to waters of the U.S. (WOUS), including wetlands, and special aquatic resources	X	✓
	Minimizes impacts to T&E species and their associated habitats	X	✓
	Minimizes impacts to cultural resources	**Unknown**	**Unknown**
	Minimizes impacts to navigation and navigation safety	X	✓
	Minimizes impacts to commercial and recreational fisheries and EFH	X	✓
	Existing land use compatibility, availability, and suitable for the proposed Project	✓	✓
	Project location within proximity of existing and planned crude oil infrastructure, thereby reducing Project footprint and environmental impacts	✓	✓
	Project design that allows for the maximization of offsite fabrication in a controlled setting thereby minimizing offshore impact as a result of onsite construction activities	X	✓
	Avoids extensive dredging or removal of natural obstacles: 33 CFR Part §148.715(b)(g)	X	✓
TOTAL		**7**	**13**

Onshore vs. Offshore Alternatives Analysis

Based on the results of the onshore vs offshore alternatives analysis, as presented in Table 2-19, the offshore DWP is the least environmentally damaging practicable alternative fulfilling Project objectives to be carried forward.

2.5.2 Existing Infrastructure Alternatives

The results of the offshore vs. onshore alternatives analysis indicated the use of an offshore DWP is the least environmentally damaging practicable alternative to fulfill the purpose and need of the proposed Project. As determined during the Tier II screening analysis, the Corpus Christi, Texas area was determined to be the best suited location for the establishment of a logistical solution for the safe, efficient and cost-effective export of crude oil to support U.S. economic growth. As such, an analysis of existing abandoned offshore pipelines within the Corpus Christi area was conducted to determine the feasibility for the use of existing offshore infrastructure. As part of this analysis, two alternatives were analyzed for the utilization of existing offshore pipeline infrastructure including:

- Utilization of Existing Abandoned Offshore Pipelines: Consists of the use of existing abandoned offshore pipeline infrastructure for the transport of crude oil to a DWP location.
- Installation of New Offshore Pipeline Infrastructure: Consists of the installation of new offshore pipeline infrastructure for the transport of crude oil to a DWP location.

The analysis of potential existing infrastructure alternatives was conducted in order to determine the technical feasibility for the use of existing offshore pipeline infrastructure for the directly and fully loading a VLCC at a DWP, and fulfillment of Project objectives consisting of:

- Pipeline infrastructure located in water depths of 90 ft. to allow for the safe navigation and loading of VLCCs in an offshore environment
- Ability of infrastructure to support loading rates of approximately 60,000 barrels per hour (bph) for the loading of approximately 8 VLCC's per month.

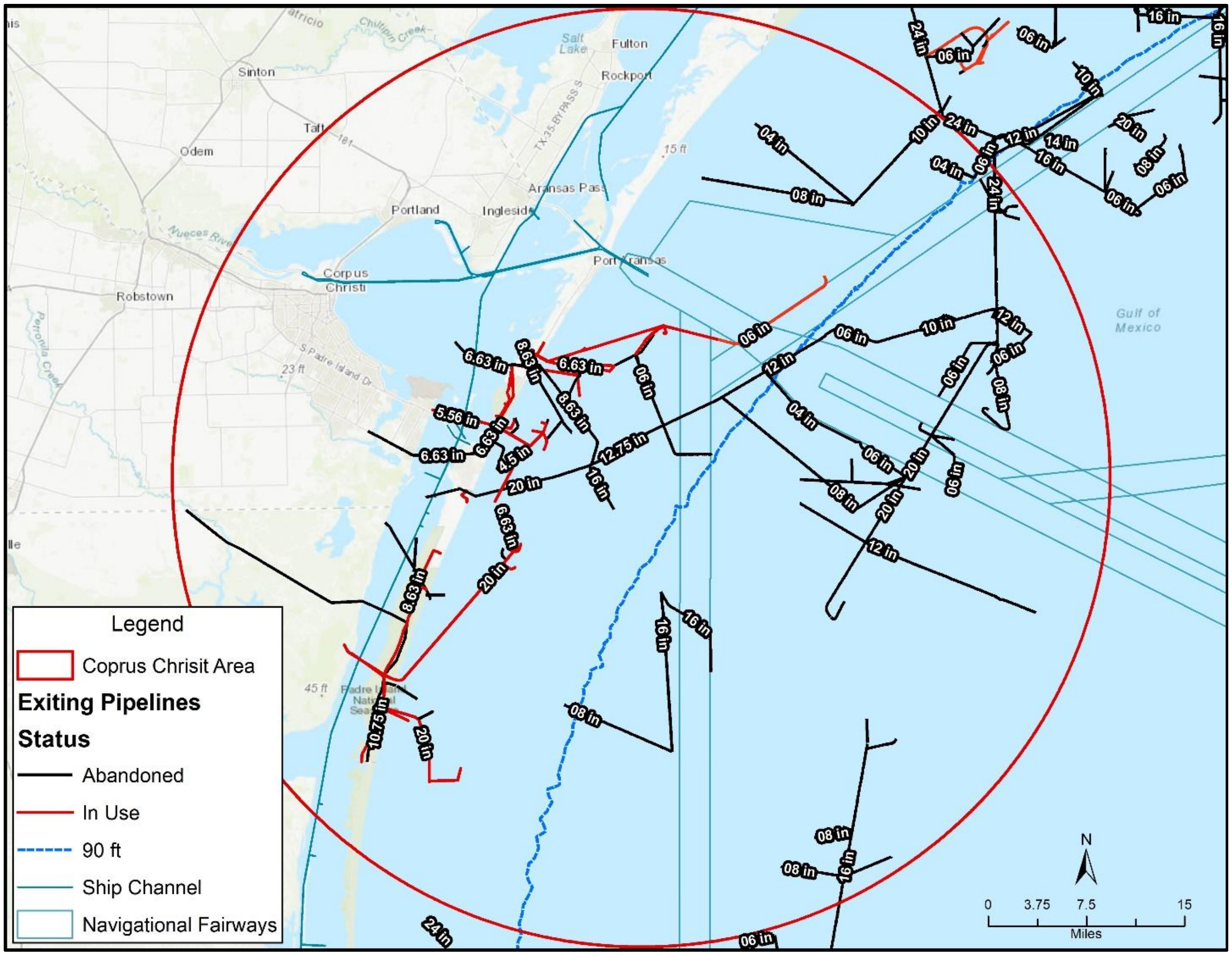
The following section discuss each of the alternatives and their ability to fulfill the siting criteria listed above.

<u>Utilization of Existing Abandoned Offshore Pipelines</u>

An analysis of existing abandoned offshore pipeline infrastructure located within the Corpus Christi area was conducted to determine the feasibility for the use for the full loading of VLCC at a DWP location. To support the safe and direct full loading of a VLCC in an offshore environment, approximately 90 ft. of water depth is required. As such, it is required that existing abandoned offshore pipeline infrastructure extend from onshore to offshore depths of a minimum of 90 ft. To meet the capacity needs for the Project, existing offshore pipeline infrastructure would need to be capable of supporting loading rates of approximately 60,000 bph. Such loading rates require the use of either one 42-inch-diameter pipeline or two 30-inch-diameter pipelines.

An analysis of existing abandoned offshore pipeline infrastructure was conducted within a 35-mile radius area that was previously discussed as the Corpus Christi Area from the Tier II analysis (Figure 2-9). Based on this analysis, the existing pipeline infrastructure within the Corpus Christi area are natural gas gathering pipelines ranging in sizes from 6 to 24-inch-diameter. One 24-inch line is present within the area, but does not extend to an onshore location. Based on the results of this analysis, there are no existing abandoned pipelines of sufficient size extending from the shore to 90 ft. water depths.

Figure 2-9: Existing Offshore Pipeline Infrastructure



Source: BOEM, 2018; RRC, 2018

<u>Installation of New Offshore Pipeline Infrastructure</u>

The installation of new offshore pipeline infrastructure would be conducted in a manner to allow for the safe and efficient, full loading of VLCCs in an offshore environment in water depths of 90 ft. Additionally, the installation of new pipeline infrastructure to service a DWP would be of sufficient size to meet the capacity needs for the Project and loading rates of approximately 60,000 bph.

An analysis of existing infrastructure alternatives was conducted to determine the feasibility for the use of existing abandoned offshore pipeline infrastructure for the fulfillment of the Project purpose and need. The results of the analysis conducted for the existing infrastructure alternatives are presented in Table 2-20.

Table 2-20 Existing Infrastructure Alternatives Decision Matrix

Siting Criteria	Utilization of Existing Abandoned Offshore Pipelines	Installation of New Offshore Pipeline Infrastructure
Pipeline infrastructure located in water depths of 90 ft. to allow for the safe navigation and loading of VLCCs in an offshore environment	X No	✓ Yes
Ability of infrastructure to support loading rates of approximately 60,000 barrels per hour (bph) for the loading of approximately 8 VLCC's per month.	X No	✓ Yes
Evaluation Score	0	2
Selected as Preferred Area for DWP	No	**Yes**

<u>Existing Infrastructure Alternatives Analysis</u>

Based on the results of the existing infrastructure alternatives analysis, as presented in Table 2-20, the installation of new offshore pipeline infrastructure is the most practicable alternative to be carried forward.

2.6 Tier IV – Siting Analysis of Required Project Components

During the Tier III screening analysis, the Applicant determined that the utilization of an offshore DWP is the least environmentally damaging practicable solution for the safe, efficient and cost-effective export of crude oil. As such, Tier IV of the alternatives analysis was conducted consisting of a siting analysis for the location of the necessary components associated with the offshore DWP. Tier IV consists of the screening of location alternatives for the general DWP siting, location alternatives for the crude oil storage facilities, and pipeline infrastructure route alternatives.

Tier IV consists of the following sections:

1. Deepwater Port Site Alternatives
2. Crude Oil Storage Facility Site Alternatives
3. Pipeline Routing Alternatives

The general location alternatives for the siting of the DWP were analyzed first to narrow down the scope of further analysis to the local area that best fulfills the Project purpose and need and the siting criteria listed below. Following the siting alternatives analysis, the local area selected was screened for potential onshore storage terminal location alternatives. Three crude oil storage facility alternatives were analyzed to determine the most ideal location for the onshore storage facility based on the siting criteria discussed in the following sections. Lastly, three pipeline route alternatives were analyzed based on the siting criteria discussed in the following section. The pipeline route was selected by considering which route from the onshore storage facility location to a DWP location in the selected local area best fulfilled the stinging criteria. All three of these analyses make up the Tier IV Siting Analysis.

Potential locations for the siting of the necessary components associated with the Project were evaluated in accordance with 33 CFR Part §148.715(b) siting criteria, as applicable, including:

- (a) Optimizes location to prevent or minimize detrimental environmental effects
- (b) Minimizes space needed for safe and efficient operation
- (c) Locates offshore components in areas with stable sea bottom characteristics
- (d) locates onshore components where stable foundations can be developed
- (e) Minimizes the potential for interference with its safe operations form existing offshore structures and activities
- (f) Minimizes danger posed to safe navigation by surrounding water depths and currents
- (g) Avoids extensive dredging or removal of natural obstacles such as reefs
- (h) Minimizes the danger to the port, its components, and tankers calling at the port from storms, earthquakes, or other natural hazards
- (i) Maximizes the permitted use of existing work areas, facilities, and access routes
- (j) Minimizes the environmental impact of temporary work areas, facilities, and access routes
- (k) Maximizes the distance between the port, its components, and critical habitats including commercial and sport fisheries, threatened or endangered species habitats, wetlands, flood plains, coastal resources, marine management areas, and essential fish habitats
- (l) Minimizes the displacement of existing or potential mining, oil, or gas exploration and production or transportation uses;
- (m) Takes advantage of areas already allocated for similar use, without overusing such areas
- (n) Avoids permanent interference with natural processes or features that are important to natural currents and wave patterns
- (o) Avoids dredging in areas where sediments contain high levels of heavy metals, biocides, oil or other pollutants or hazardous materials, and in areas designated wetlands or other protected coastal resources.

2.6.1 Deepwater Port Site Alternatives

The Applicant evaluated three DWP region alternatives to determine a location that best fulfills the purpose and need of the Project and the Project objectives. Three DWP regions were considered during analysis including:

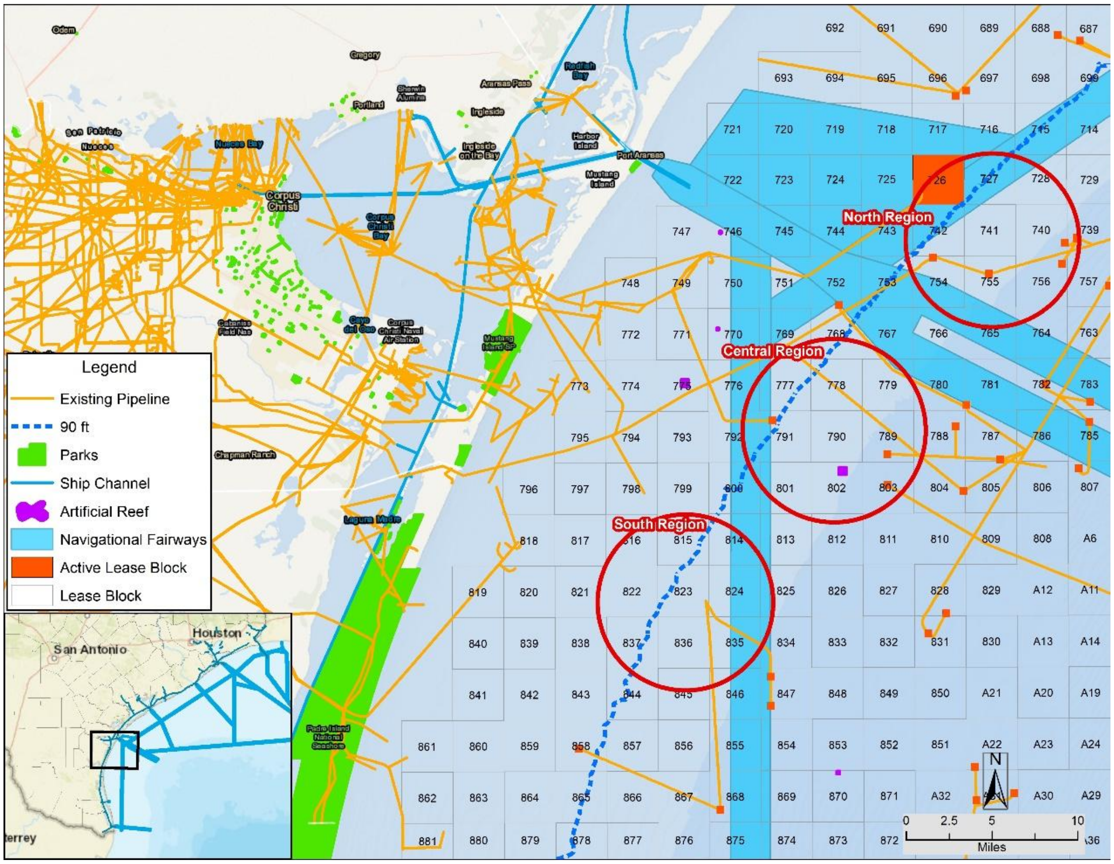
- North Region Alternative: Located north of the main navigation fairway within the Corpus Christi Area
- Central Region Alternative: Located just south of the main navigation fairway, centrally within the Corpus Christi Area
- South Region Alternative: Located just west of the main navigation fairway on the south side of the Corpus Christi Area

The analysis of potential DWP sites was based upon the necessary siting criteria for the DWP to be capable of directly and fully loading a VLCC including:

- Located in water depths of 90 ft. to allow for the safe navigation and loading of VLCCs in an offshore environment
- Minimizes the distance from the shoreline, thereby minimizing the required offshore pipeline infrastructure to be installed to service the DWP
- Siting of the DWP in a location that minimizes the number of crossings of existing offshore pipelines as a result of the installation of the offshore pipeline infrastructure to service the DWP
- Located in an area that would reduce the inshore and onshore pipeline crossing state and federally owned protected land
- Located within an area that minimizes the installation of offshore pipelines across existing fairways and anchorage areas

The above described siting criteria for the analysis of DWP site alternatives are consistent with 33 CFR Part §148.715(b): Siting criteria (b), (e), (f), and (l). Figure 2-10 depicts the three regions evaluated for the siting of a DWP. The following section discuss each of the three regions and their ability to fulfill the siting criteria listed above.

Figure 2-10: Evaluated Deepwater Port Locations



Sources: BOEM, 2018; RRC, 2018; TPWD, 2018

Each of the three regions reviewed were consisted of water depths of sufficient for the loading of VLCCs in an offshore environment (i.e. 90 ft.).

<u>North Region Siting Analysis</u>

The siting of a DWP within the north region would require the installation of offshore pipeline infrastructure across multiple fairways, inland navigable waterways, and anchorage areas. One active lease block, multiple existing platforms, and pipeline infrastructure are located within the north region. As such, the siting of a DWP within the north region has the potential for the displacement of many oil and gas exploration, production, or transportation facilities. While the north region would have access from multiple fairways it would also require a longer pipeline route and therefore an overall larger footprint. The siting of the DWP in the north region location would require pipeline infrastructure to cross a minimum of one inland navigable waterway. The north region has the potential to require a pipeline crossing on federal or state-owned land near the Corpus Christi Ship Channel depending on the specific location of the DWP and routing of the pipeline which would be subsequently be determined, if this region were to be selected.

<u>Central Region Siting Analysis</u>

The siting of a DWP within the central region would require the installation of offshore pipeline infrastructure across one existing fairway and potentially multiple existing pipelines. The siting of the DWP in the central region location would require pipeline infrastructure to cross a minimum of one inland navigable waterway. It is estimated that approximately 16 miles of offshore pipeline infrastructure would be required to site a DWP within the central region. The offshore pipeline would likely have to be located within the vicinity of two artificial reefs managed by TPWD. The central region consists of multiple existing platforms, and offshore pipeline infrastructure. While the central region would have access from multiple fairways it would also require a longer pipeline route and therefore an overall larger footprint.

South Region Siting Analysis

The siting of a DWP within the south region would not require the installation of a pipeline across existing fairways, anchorage areas, and would limit the required crossing of existing pipelines to one. The siting of the DWP in the southern location would require pipeline infrastructure to cross one inland navigable waterway. It is estimated that approximately 15 miles of offshore pipeline infrastructure would be required for the siting of the DWP in the south region. The southern region has limited amounts of existing platforms, offshore pipeline infrastructure and does not consist of any active lease blocks. As such, the siting of a DWP within the south region minimizes the potential for the displacement of any oil and gas exploration, production, or transportation facilities. The south region has the potential to require a pipeline crossing on federal or state-owned land inshore depending on the specific location of the DWP and routing of the pipeline.

An analysis of the DWP site alternatives was conducted based on their ability to fulfill the Project purpose and need, the necessary siting criteria for the direct and full loading a VLCC, and minimization environmental impacts to the maximum extent practicable. The results of the analysis conducted for the DWP site alternatives are presented in Table 2-21.

Table 2-21 Deepwater Port Site Alternatives Decision Matrix

Siting Criteria	Southern Region	Central Region	Northern Region
Located in greater the 90 ft. of water to allow access for VLCC ships	✓	✓	✓
Minimizes the distance from the shoreline, thereby minimizing the required offshore pipeline infrastructure to be installed to service the DWP	✓ ~ 15 miles	X ~ 16 miles	X ~ 18 miles
Siting of the DWP in a location that minimizes the number of crossings of existing offshore pipelines as a result of the installation of the offshore pipeline infrastructure to service the DWP	✓ 1	X 2+	X 2+
Located in an area that would reduce the inshore and onshore pipeline crossing state and federally owned protected land	X	✓	X
Located within an area that minimizes the installation of offshore pipelines across existing fairways and anchorage areas	✓ 0	X 1	X 1+
Evaluation Score	4	2	1
Selected as Preferred Area for DWP	**Yes**	No	No

Deepwater Port Site Alternatives Analysis

Based on the results of the DWP site alternatives analysis, as presented in Table 2-21, the southern region alternative was determined to be the most practicable DWP site location alternative to be carried forward.

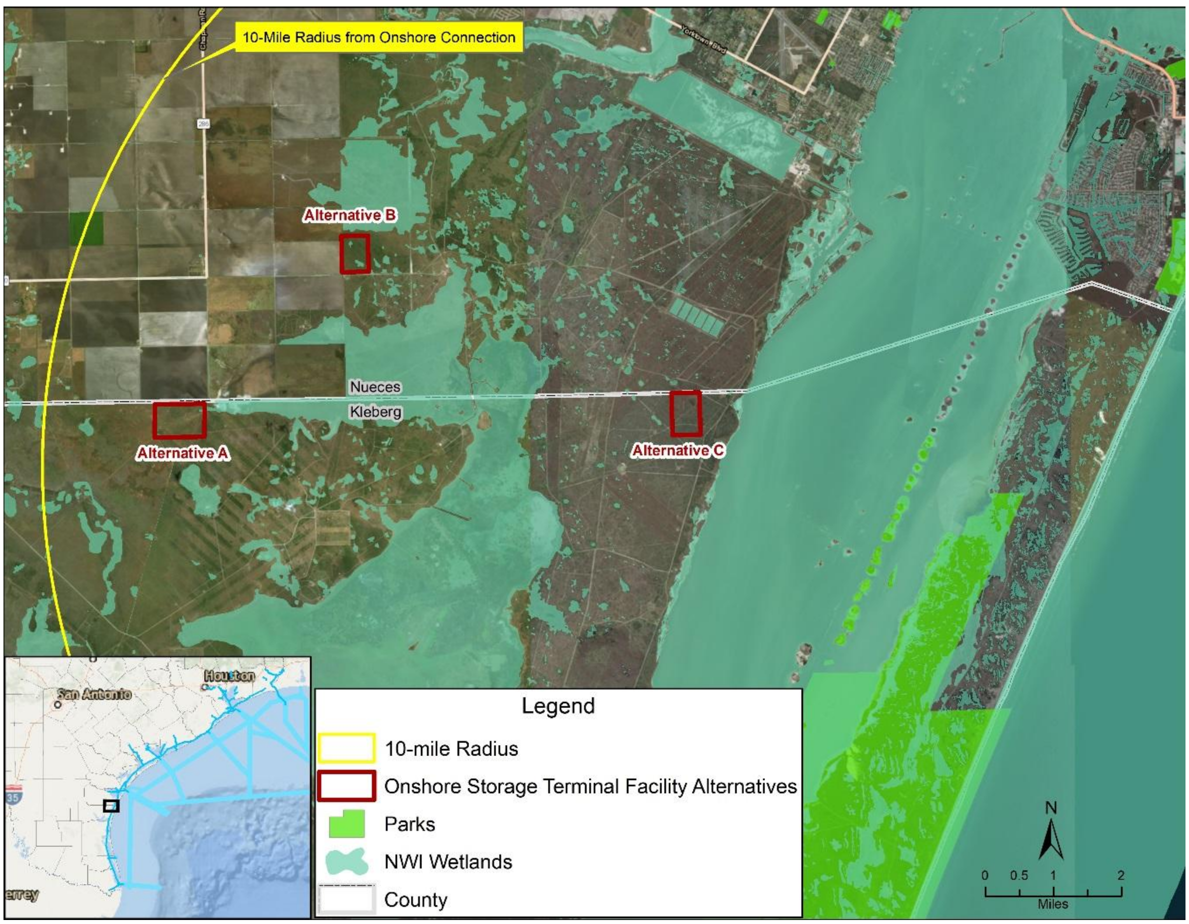
2.6.2 Onshore Crude Oil Storage Terminal Facility Site Alternatives

Three locations were evaluated for the siting of a crude oil onshore storage terminal facility (OSTF) criteria to service the DWP for the direct and full loading of VLCCs. The OSTF would serve as a storage facility for crude oil to serve the DWP and is a necessary project component. The OSTF locations analyzed include:

- Alternative A Location: 150-acre tract of land located 7.5 miles from the shoreline of Laguna Madre
- Alternative B Location: 150-acre tract of land located 6.0 miles from the shoreline of Laguna Madre
- Alternative C Location: 174-acre tract of land located less than 1 mile from the shoreline of Laguna Madre

Figure 2-11 provides an overview of the crude oil storage facility location alternatives considered as part of this analysis.

Figure 2-11: Onshore Storage Terminal Facility Alternatives



Source: USFWS, 2018b

The analysis of potential crude oil storage facility site alternatives was based upon the following siting criteria:

- Area available is at least 150 acres
- Access to existing electrical supply
- Maximizes the use of existing roads

- Ability to use existing pipeline corridors
- Minimizes required onshore pipeline infrastructure
- Minimizes impacts to multiple properties
- Minimizes interference with existing landowner operations
- Minimizes landowner construction restrictions
- Minimizes potential for wetland crossings as a result of installation of onshore pipeline infrastructure
- Location is above 100-year floodplain base elevation
- Avoids permanent impacts to waters of the U.S., including wetlands
- Avoids impacts to T&E species and critical habitats
- Located within an area where stable foundations can be developed
- Minimizes pipeline materials and installation cost

The above described siting criteria for the analysis crude oil storage facility site alternatives are consistent with 33 CFR Part §148.715(b): Siting criteria (a), (d), (i), (j), (m), and (n). Figure 2-11 depicts the three crude oil storage facility locations analyzed. The results of the analysis conducted for the crude oil storage facility alternatives are presented in Table 2-22. The following sections discuss each of the siting criteria and how each alternate location fulfills, or does not fulfill, the criteria.

Area Available is at Least 150 Acres

Alternative A, Alternative B, and Alternative C are all located such that the site allows for at least 150 acres of developable area. Thus, all alternatives would fulfill this criterion.

Access to Existing Electrical Supply

Alternative A is located approximately 0.5 miles to the nearest power supply, which would be a tie-in to existing electricity infrastructure located along an existing road. Alternative B is located approximately 0.5 miles to the nearest power supply, which would be a tie-in to existing electricity infrastructure located along an existing road. Alternative C is not located near any existing electricity infrastructure with the capabilities of powering a storage facility; selection of this location would require improvement of existing power lines and construction of new infrastructure. Thus, Alternative A or B would fulfill this criterion, while Alternative C would not.

Maximizes the Use of Existing Roads and Minimizes the Need for Improvement of Existing Roads

Alternative A is not located adjacent to any existing roads. New roads would have to be constructed for access to Alternative A if selected and existing roads in the vicinity of Alternative A would also have to be improved in order to be safely utilized by construction vehicles if Alternative A was selected. Alternative B is located directly adjacent to an existing road that could be utilized for access to the site if Alternative B was selected; the existing road is well-maintained and would be able to be safely utilized by all vehicles to and from the site. Alternative C is not adjacent to any existing roads and not located near any roads that have the capability of handling construction vehicles. Selection of this location would require improvement of some existing roads and construction of new roads to access this location. Thus, Alternative B would fulfill these criteria, while Alternative A or C would not.

Ability to Use Existing Pipeline Corridors and Minimizes Required Onshore Pipeline Infrastructure

Alternative A is located near some existing pipeline corridors and would require approximately 7.5 miles of onshore pipeline to reach the Laguna Madres. Existing pipeline corridors would be able to be utilized for an estimated 50% of the pipeline length. Alternative B is located near a major existing pipeline corridor and would require approximately 6.5 miles of pipeline infrastructure to Laguna Madres. An estimated 80% of the pipeline from Alternative B could be in exiting corridors. Alternative C would require approximately

1.2 miles of onshore pipeline infrastructure, of which, an estimated 90% could be in existing pipeline corridors. Thus, Alternative C would best fulfill these criteria.

Minimizes Impacts to Multiple Properties, Interference with Existing Landowner Operations, and Landowner Construction Restrictions

Alternative A is located within a single property; however, the access roads that would need to be constructed in order to gain access to the site would need to cross through multiple properties of different land owners. Alternative A would not interfere with existing landowner operations and would not have any construction limitations by the landowner. Alternative B is located within a single property and would not have any impacts to other properties, as the access road is existing. Alternative B would not interfere with existing landowner operations and would not have any construction limitations by the landowner. Alternative C is located within a single property and would not have any impacts to other properties, as the access road is existing. Alternative C would interfere with some landowner operations due to the location of the site and proximity to exiting operation areas and would also have constructed limitations enforced by the landowner if this site was selected. Thus, Alternative B would best fulfill these criteria.

Minimizes Potential for Wetland Crossings as a Result of Installation of Onshore Pipeline Infrastructure

Alternative A is located on the west side of Laguna Larga. Laguna Larga is large wetland complex that contains intermittent coastal marsh and a season freshwater pond and is shown on National Wetland Inventory map as a contiguous wetland area. Crossing of Laguna Larga would be required by a pipeline originating at Alternative A. A pipeline originating at Alternative B would not require a crossing of Laguna Larga and could be routed to avoid any other major crossings of wetlands. An onshore pipeline originating at Alternative C would not require a crossing of any wetlands. Thus, Alternative B or C would best fulfill these criteria, while Alternative A would not.

Location Is Above 100-Year Floodplain Base Elevation

Alternative A, Alternative B, and Alternative C are all located at elevations higher than the 100-year base flood elevation of the area. Alternative A is located approximately 18-20 ft above mean sea level and is not within a 100-yr flood plain. Alternative B is located approximately 18-20 ft above mean sea level and is not within a 100-yr flood plain. Alternative C is located approximately 20-25 ft above mean sea level and is not within a 100-yr flood plain. Thus, all alternatives would fulfill this criterion.

Avoids Permanent Impacts to Waters of The U.S., Including Wetlands

Based on a desktop review of National Wetland Inventory data and existing conditions of each alternative site, it is believed that Alternative A, Alternative B, and Alternative C would not result in permanent impact to any jurisdictional WOUS including wetlands. Thus, all alternatives would fulfill this criterion.

Avoids Impacts to T&E Species and Critical Habitats

Based on a desktop review, Alternative A, Alternative B, and Alternative C are not located in any critical habitat areas of T&E species. Thus, all alternatives would fulfill this criterion.

Located Within an Area Where Stable Foundations can be Developed

Based on a desktop review of soils and geological formations in the area, Alternative A, Alternative B, and Alternative C are sited appropriately where stable foundations can be developed. Thus, all alternatives would fulfill this criterion.

An analysis of the crude oil storage facility alternatives was conducted based on their ability to fulfill the above described criteria. The results of the analysis conducted for the crude oil storage facility alternatives are presented in Table 2-22.

Table 2-22: Onshore Crude Oil Storage Facility Alternatives Decision Matrix

Selection Criteria	Alternative A Location	Alternative B Location	Alternative C Location
Area Available is at least 150 acres	✓ 150 ac	✓ 150 ac	✓ 174 ac
Access to existing electricity supply	✓ Yes - 0.5 mi from power	✓ Yes - 0.5 mi from power	X No –Improvement of existing power access required
Maximizes use of existing roads	X No	✓ Yes	X No
Ability to Use Existing Pipeline Corridors	X Estimated 50% in existing corridors	✓ Estimated 80% in existing corridors	✓ Estimated 90% in existing corridors
Minimizes Required Onshore Pipeline	X 7.5-mile pipeline required	X 6.5-mile pipeline required	✓ 1.2-mile pipeline required
Minimizes impacts to multiple properties	X No, required road improvements across multiple properties	✓ Yes	✓ Yes
Minimizes interference with existing Landowner Operations	✓ Yes	✓ Yes	X No
Minimizes Landowner Construction Restrictions	✓ Yes	✓ Yes	X No
Minimizes potential for wetland crossings as a result of installation of onshore pipeline infrastructure	X No	✓ Yes	✓ Yes
Location is above 100-year floodplain base elevation	✓ 18 – 20 ft.	✓ 18- 20 ft.	✓ 20 – 25 ft.
Avoids permanent impacts to waters of the U.S., including wetlands	✓ Yes	✓ Yes	✓ Yes
Avoids/minimizes T&E species and critical habitat impacts	✓ No critical habitat impacts	✓ No critical habitat impacts	✓ No critical habitat impacts
Located within an area where stable foundations can be developed	✓ Yes	✓ Yes	✓ Yes
Evaluation Score	8	**12**	9
Selected as Preferred Alternative	No	**Yes**	No

<u>Crude Oil Storage Facility Alternatives Analysis</u>

Based on the results of the crude oil storage facility alternatives analysis, as presented in Table 2-22, Alternative B was determined to be the most practicable crude oil storage facility alternative to be carried forward.

2.6.3 Pipeline Routing and Deepwater Port Location Alternatives

The Applicant evaluated pipeline routing and DWP location alternatives to determine which best fulfilled the Project purpose and need. Three alternatives were considered during the analysis including:

- Alternative 1: requires 21.3 miles of offshore pipeline to a northern DWP location
- Alternative 2: requires 20.4 miles of offshore pipeline to a southern DWP location
- Alternative 3: requires 20.1 miles of offshore pipeline to a southern DWP location

Development of Alternative Pipeline Routes and Deepwater Port Location Alternatives

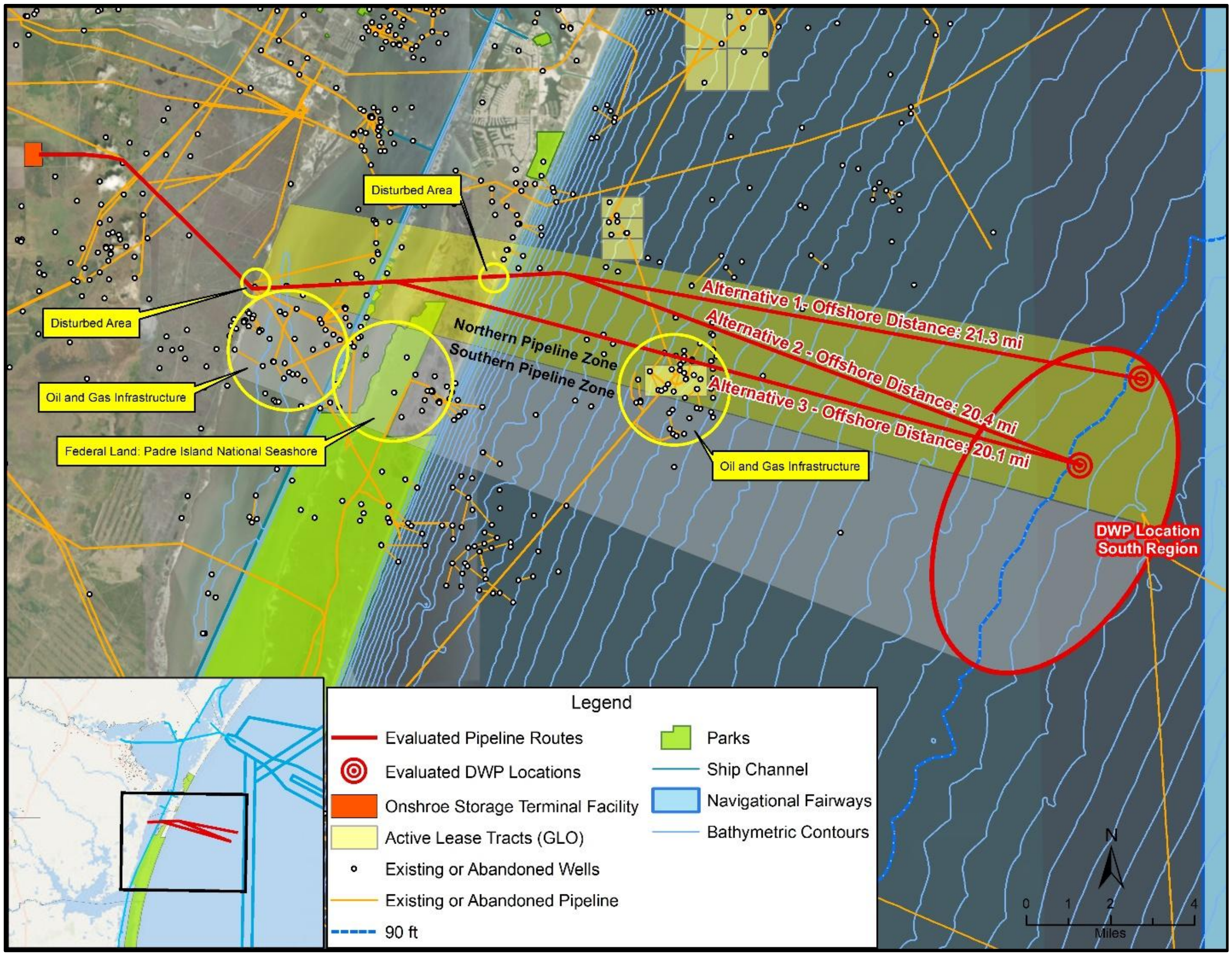
Alternatives 1, 2, and 3 consist of different combinations of pipeline routes and DWP locations. Alternatives 1, 2, 3 were developed to maximize the utilization of existing pipeline corridors and disturbed areas to the maximum extent practicable. Onshore portions of the required pipeline infrastructure (i.e. portions of the pipeline infrastructure extending from the OSTF to the western Laguna Madre MHT line) follows an existing pipeline corridor and utilizes previously disturbed areas located at the interface with Laguna Madres. The onshore pipeline route was established based on the selection of Alternative B as the OSTF location and the objective of utilizing existing pipeline corridor and previously disturbed areas. The onshore pipeline route is common to all alternatives discussed in this section and is shown in Figure 2-12.

Initially, pipeline routes and deepwater port location alternatives were developed to avoid impacts to a national park, the Padre Island National Seashore. As shown within Figure 2-12, a northern and southern pipeline zone extend from the onshore pipeline terminus to the south region DWP location, as previously determined as the most feasible DWP site alternative. The utilization of the southern pipeline zone for pipeline infrastructure to connect the onshore pipeline to a DWP location in the South Region requires crossing through a portion of a Padre Island National Seashore, which is the longest remaining undeveloped stretch of barrier island in the world and is of national importance for nesting sea turtles. To avoid such critical impacts, only pipeline routes within the Northern Pipeline Zone were considered for further analysis. A comprehensive approach was used for the precise siting of the DWP in a manner that was conducive for the avoidance of impacts as a result of the installation of the required pipeline infrastructure servicing the DWP. The analysis of pipeline routing and DWP location alternatives was based upon the following criteria:

- Minimizes required offshore pipeline infrastructure
- Utilizes existing pipeline corridors and disturbed areas to the maximum extent practicable
- Minimizes the number of crossings of existing offshore pipelines
- Minimizes the potential for interference with its safe operations from existing offshore structures and activities
- Located within an area that avoids pipeline crossings of state and federally owned protected land
- Minimizes the displacement of existing or potential mining, oil, or gas exploration and production or transportation uses
- Optimizes location to prevent or minimize project footprint resulting in environmental effects

The above described siting criteria for the development and analysis of pipeline routes and DWP location alternatives are consistent with 33 CFR Part §148.715(b): Siting criteria (a), (b), (c), (e), (f), (i), (j), (k), and (m). Figure 2-12 depicts the three alternatives considered during analysis, Alternative 1, 2 and 3. The following section discuss each of the three alternatives and their ability to fulfill the siting criteria listed above.

Figure 2-12: Evaluated Pipeline Routes



Sources: BOEM 2018; RRC 2018; USFWS 2018a

Minimizes Required Offshore Pipeline Infrastructure

Alternative 1 requires 21.3 miles of offshore pipeline infrastructure to connect the onshore pipeline to the proposed DWP location. Alternative 2 requires 20.4 miles of offshore pipeline infrastructure to connect the onshore pipeline to the proposed DWP location. Alternative 3 requires 20.1 miles of offshore pipeline infrastructure to connect the onshore pipeline to the proposed DWP location. Thus, Alternative 1 does not fulfill the criterion, where Alternatives 2 and 3 do fulfill the criterion.

Utilizes Existing Pipeline Corridors and Disturbed Areas to The Maximum Extent Practicable

All alternatives utilize existing pipeline corridor and disturbed areas onshore to the maximum extent practicable, and thus share the same route for onshore pipeline infrastructure. Alternative 1 and 2 utilize an area in Nueces County, located adjacent to the shore of the Gulf of Mexico that is a previously disturbed area of sand dunes. Locating the pipeline route through this area maximizes the use of disturbed areas. Alternative 3 does not utilize the disturbed area adjacent to the Gulf of Mexico because this alternative route is the most direct route to the proposed DWP location while still avoiding impacts to Padre Island National Seashore. Alternative 3 does not fulfill the criterion, while Alternatives 1 and 2 do fulfill the criterion.

Minimizes the Number of Crossings of Existing Offshore Pipelines

Alternative 1 requires one (1) offshore pipeline crossing. Alternative 2 requires one (1) offshore pipeline crossing. Alternative 3 requires more than 6 offshore pipeline crossings. Thus, Alternative 3 does not fulfill the criterion, where Alternatives 1 and 2 do fulfill the criterion.

Minimizes the Potential for Interference with its Safe Operations from Existing Offshore Structures and Activities

Alternative 1 is not located near any existing offshore structures and would not interfere with any safe operations of other facilities. Alternative 2 is also not located near any existing offshore structures or activities and would not interfere with any safe operations of other facilities. Alternative 3 requires the offshore pipeline to pass through an area of dense oil and gas infrastructure which contains active gas wells, gathering lines, and platforms. Construction and installation of the pipeline could interfere with the safe operations of these offshore activities. Thus, Alternative 3 does not fulfill the criterion, where Alternatives 1 and 2 do fulfill the criterion.

Located Within an Area That Avoids Pipeline Crossings of State and Federally Owned Protected Land

All alternatives were selected for further analysis due to the fact that they do not cross the Padre Island National Seashore. Additionally, all pipeline alternatives utilize the same route across Laguna Madres which requires the pipeline crossing of the Gulf Intracoastal Waterway, GIWW, which is a federally maintained navigational channel in state-owned submerged land. Thus, all alternative fulfill the criterion equally.

Minimizes the Displacement of Existing or Potential Mining, Oil, or Gas Exploration and Production or Transportation Uses

Alternative 1 is not located near any active oil and gas exploration leases or activity. Alternative 2 is also not located near any active oil and gas exploration leases or activity. Alternative 3 requires the offshore pipeline to pass through an area of dense oil and gas infrastructure which lies within an active lease tract leased by the Texas General Land Office (GLO). Construction and installation of the pipeline would temporarily or permanently affect the existing and potential exploration and production wells within this lease tract. Thus, Alternative 3 does not fulfill the criterion, where Alternatives 1 and 2 do fulfill the criterion.

Optimizes Location to Prevent or Minimize Project Footprint Resulting in Environmental Effects

The pipeline route crossing Laguna Madre is common to all alternatives and was selected to minimize the impact to Padre Island National Seashore. The pipeline route from the onshore connection point is located such that the pipeline emerges on North Padre Island north of the national park. This point is further referred to as the onshore connection point as it is the common point of diversion for all pipeline and DWP location alternatives. Alternative 1 requires 21.3 miles of offshore pipeline infrastructure to connect the onshore pipeline to the proposed DWP location. The proposed DWP location for Alternative 1 is located at the northernmost limit of the Northern Pipeline Zone which creates an alternative that maximizes the distance from proposed pipeline infrastructure to nearby oil and gas infrastructure. The DWP must also be in waters at least 90 ft deep and is therefore located as close to the 90 ft. depth contour line as possible. Alternative 2 requires 20.4 miles of offshore pipeline infrastructure to connect the onshore pipeline to the proposed DWP location. The proposed DWP location for Alternative 2 is located at the nearest point to the onshore pipeline connection point at North Padre Island that is at least 90 ft. deep, while still allowing for the pipeline route to avoid significant oil and gas infrastructure. The DWP is located such that a pipeline originating at the North Padre Island onshore connection can extend past the area of dense oil and gas infrastructure and optimize the length of pipeline running perpendicular to the

90 ft. contour so that the total pipeline distance is minimal. Alternative 3 requires 20.1 miles of offshore pipeline infrastructure to connect the onshore pipeline to the proposed DWP location, which is located at the nearest point to the onshore pipeline connection on North Padre Island that is at least 90 ft. deep. The DWP is located such that a pipeline running perpendicular to the 90 ft. contour, directly from the connection point, would be optimized for the shortest length possible. Alternative 3 would result in the smallest footprint because it utilizes the shortest pipeline length the reach the DWP location. Based on offshore pipeline footprint, Alternative 1 would result in the largest footprint and cause more environmental effects due to bottom disturbance from the installation of the pipeline than compared to Alternative 2 and 3. Thus, Alternative 1 does not fulfill the criterion, where Alternatives 2 and 3 do fulfill the criterion.

An analysis of the pipeline route and DWP location alternatives was conducted based on their ability to fulfill the above described criteria. Figure 2-12 provides an overview of the pipeline routing and DWP location alternatives considered as part of this analysis. The results of the analysis conducted for pipeline routing and DWP location alternatives are presented in Table 2-23.

Table 2-23 Alternative Pipeline Routes and Deepwater Port Location Alternatives Decision Matrix

Siting Criteria	Alternative 1	Alternative 2	Alternative 3
Minimizes required offshore pipeline infrastructure	X 21.3 miles	✓ 20.4 miles	✓ 20.1 miles
Utilizes existing pipeline corridors and disturbed areas to the maximum extent practicable	✓	✓	X
Minimizes the number of crossings of existing offshore pipelines	✓ 1	✓ 1	X 6+
Minimizes the Displacement of Existing or Potential Mining, Oil, or Gas Exploration and Production or Transportation Uses	✓	✓	X
Located in an area that avoids pipeline crossings of state and federally owned protected land	✓	✓	✓
Minimizes the displacement of existing or potential mining, oil, or gas exploration and production or transportation uses	✓	✓	X
Optimizes location to prevent or minimize project footprint resulting in environmental effects	X	✓	✓
Evaluation Score	5	7	3
Selected as Preferred Area for DWP	No	**Yes**	No

<u>Pipeline Routes and Deepwater Port Location Alternatives Analysis</u>

Based on the results of the pipeline routes and DWP location alternatives analysis, as presented in Table 2-23, Alternative 2 was determined to be the most practicable pipeline route and DWP location.

2.7 Tier V – Evaluation of Design Alternatives

During the Tier IV screening analysis, the Applicant determined the best region for the DWP, the location of the crude oil onshore storage terminal facility, and the associated pipeline route and specific DWP location. As such, Tier V of the alternatives analysis was conducted to evaluate design alternatives to determine the most practicable design of the necessary components to allow for the for the safe, efficient, and cost-effective export of crude oil, while minimizing environmental impacts to the maximum extent practicable. Tier V consists of the screening of alternative designs including:

- Deepwater Port Design Alternatives
- SPM Buoy Anchoring Alternatives
- Pipeline Design Alternatives
- Pipeline Construction and Installation Design Alternatives

The following sections detail the design alternatives analysis conducted analysis conducted for the above described components.

2.7.1 Deepwater Port Design Alternatives

The Applicant evaluated potential DWP design alternatives to determine the DWP design that best fulfills the purpose and need of the Project while minimizing environmental impacts to the maximum extent practicable. As defined by the DWPA, the term "deepwater port" is any fixed or floating manmade structure other than a vessel, or any group of such structures, that are located beyond State seaward boundaries and that are used or intended for use as a port or terminal for the transportation, storage, or further handling of oil or natural gas for transportation to or from any State.

Two DWP designs were considered during analysis including a fixed platform and a single point mooring (SPM) buoy system. The following sections describe the fixed platform and SPM buoy system alternatives.

<u>Fixed Platform</u>

The design and functionality of a fixed platform for the offshore loading of vessels is similar to that of a fixed dock or terminal used at inland port facilities. The use of an offshore fixed platform for the loading of VLCCs would require an approximate 25,000 square ft. platform equipped with marine loading arms and dock supporting infrastructure, mooring dolphins, and catwalks. The offshore fixed platform would be connected to shore-based facilities using sub-sea/offshore pipeline infrastructure for the loading of vessels.

The fixed offshore platform would be supported by multiple large-diameter pile arrangements installed on the seafloor and installed to sufficient depths to ensure structural integrity. Additionally, the mooring of vessels at a fixed platform requires the installation of mooring dolphins and catwalks to safely secure vessels during loading operations. Below is a general overview of the processes required for the loading of vessels at an offshore fixed platform.

- Vessels would approach the offshore fixed platform,
- Support vessels are used to safely navigate vessels for mooring at the fixed platform,
- A combination of platform personnel and support vessels aid in the mooring of the vessel,
- Marine loading arms are connected to the vessel manifold,
- Fixed platform personnel operate valves for the transfer of crude oil to the vessel,
- Once the vessel is fully loaded, marine loading is disconnected from the vessel,
- A combination of platform personnel and support vessels aid in the unmooring of the vessel,
- Support vessels are used to safely navigate vessels away from the fixed platform.

The fixed offshore platform is a manned system requiring the use of onsite personnel for operations. Additionally, a fixed platform requires the use of support vessels which are required for vessel approach, mooring/unmooring, and departure product hose connection and disconnection. As such, the use of a fixed platform requires the transport of onsite personnel to and from the location of the offshore fixed platform and the necessary facilities to support the health and safety of onsite personnel.

The onsite construction of a fixed platform is estimated to require 3 months. This includes the transport of the prefabricated materials to the designated location, installation of platform supporting piles, mooring dolphins, installation marine loading arms, and connection to sub-sea pipeline infrastructure.

Single Point Mooring Buoy System

A SPM buoy is a floating buoy anchored offshore to allow for the handling of liquid cargo, such as crude oil, for the loading and/or unloading of vessels. SPM buoys are connected to shore-based facilities using sub-sea/offshore pipeline infrastructure for the loading and/or unloading of liquid cargo from vessels of massive capacity, such as a VLCC.

SPM buoys are moored to the seabed using a mooring arrangement which includes anchors and anchor chains. Mooring arrangements are such that it allows the buoy to move freely within a defined limit with consideration to vessel conditions, wind, waves, and currents. The body of the SPM buoy system floats above the water surface and consists of a rotating gale which connects to the vessels through a hawser arrangement. The cargo transfer from the SPM buoy system and the vessel begins with a pipeline end manifold (PLEM) located on the seabed directly under the SPM buoy. The PLEM serves as the connection point between offshore pipelines and the SPM buoy. A series of floating hose strings connect the SPM buoy to the vessel allowing for the transfer of liquid cargo.

SPM buoy systems are capable of operating efficiently in rough seas and are not sensitive to directional changes of wind, waves, and currents. Due to vessels being moored to the SPM buoy via bow lines, vessels are free to “weather-vane” around the buoy to stay head-on to during various weather, wind, wave, and current forces. The ability to load vessels during various offshore conditions allows for greater terminal utilization and operational efficiencies.

Below is a general overview of how a SPM buoy system works.

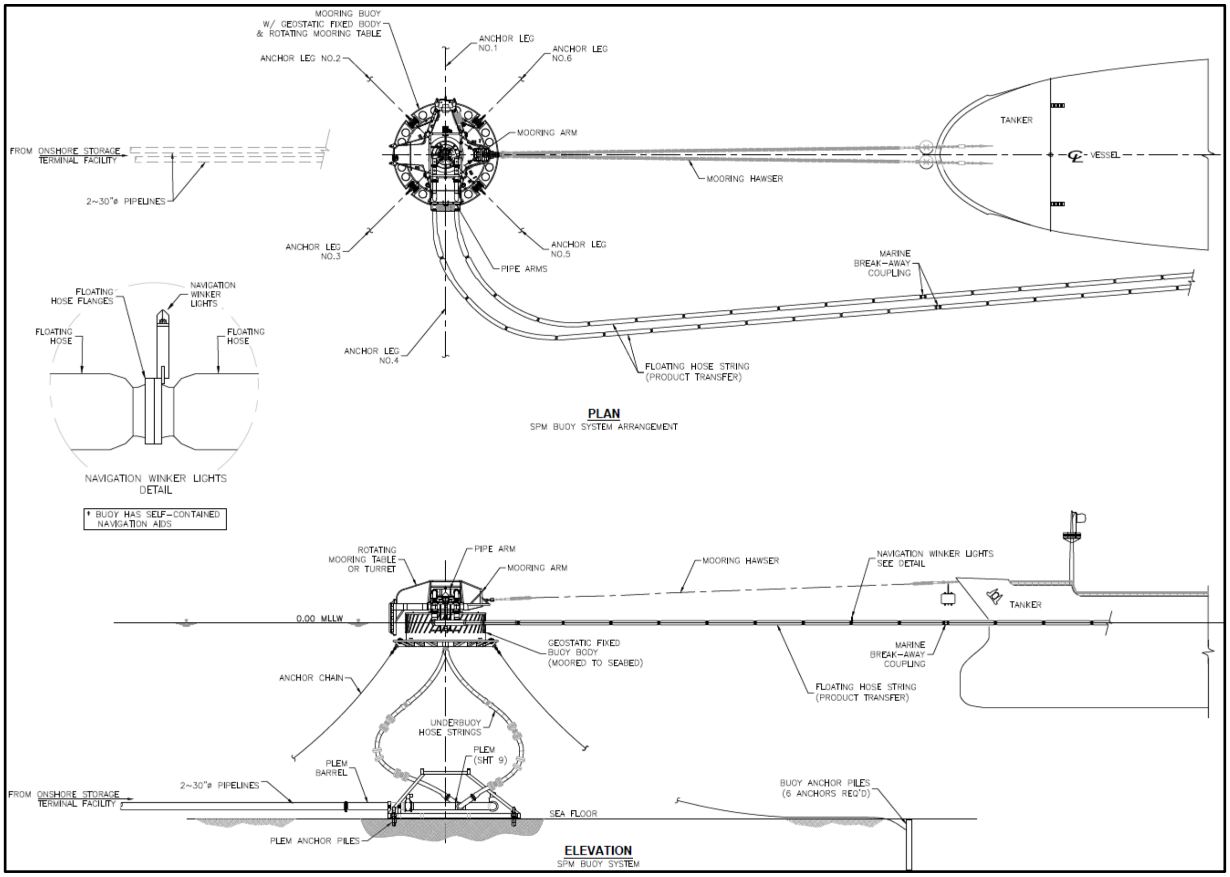
- Vessels are moored to the buoy for the loading of cargo,
- A landing space on the SPM buoy provides access to the buoy for the setup of connections to secure vessels,
- Cranes located on the vessel are used to lift floating product transfer hoses for connection to the vessel manifold,
- Once connections are made, valves are operated from shore-based facilities to initiate the transfer of cargo to the vessel,
- Once vessel loading is complete, floating product transfer lines are disconnected from the vessel manifold and lowered using cranes fixed on the vessel.

An SPM buoy system is an unmanned system remotely operated from a land-based facility. The use of support vessels for the SPM buoy operations is limited to the mooring/unmooring and product hose connection and disconnection. As such, the use of an SPM buoy system for the loading of vessels reduces operational dependency of onsite personnel and support vessels.

The onsite construction and installation of an SPM buoy system is estimated to require 1 month. This includes the transport of the prefabricated SPM to the designated location, installation of anchoring systems, installation of the PLEM, and connection to sub-sea pipeline infrastructure.

Refer to Figure 2-13 for a depiction of the general arrangement of an SPM buoy system. Refer to Figure 2-14 for a depiction of a vessel moored at an SPM buoy system.

Figure 2-13: Single Point Mooring Buoy System General Arrangement



Source: LEI Engineering Drawings

Figure 2-14: Single Point Mooring Buoy System in Operation

Source: TGTI

The analysis of potential DWP design alternatives was based upon seven screening criteria including:

- Minimizes the Potential for Interference with Natural Processes: The optimal DWP design would be one that minimizes the potential for interference with natural offshore processes such as wave patterns and currents.
- Berth Availability: The optimal DWP design would be one that maximizes berth availability to support the loading of vessels in various offshore wind, wave, current, and weather conditions.
- Minimizes Personnel Required for Operation: The optimal DWP design would be one that minimizes potential safety hazards through the minimization of the number of onsite personnel required at the DWP during operations.
- Length of Construction Schedule: The optimal DWP design would be one that minimizes the time required for the installation of the DWP, thereby minimizing environmental impacts offshore.
- Maintenance Requirements: The optimal DWP design would be one that is most efficient and cost-effective thought the minimizes maintenance requirements
- Seabed and Above Water Footprint: The optimal DWP design would be one that minimizes environmental impacts through the minimization of the seabed and above water footprint
- Accidental Collision Damage: The optimal DWP design would be one that results in the least amount of damage and hazard to personnel should an accidental collision occur.

The above described criteria for the analysis of DWP site alternatives are consistent with 33 CFR Part §148.715(b): Siting criteria (b), (j), and (n), The following section discuss each of the DWP alternatives ability to fulfill the criteria listed above.

Minimizes the Potential for Interference with Natural Processes

Natural processes such as wind, waves, and currents exhort forces on and below the water surface. The minimization of the overall structures above and below the water surface results in minimal interference with forces exhorted by natural processes. The SPM buoy system is smaller than that of the fixed offshore platform. Additionally, the SPM buoy system would be supported in location by tension chains designed to allow for movement with natural forces. A rigid fixed dock platform requires the installation of multiple rigid pile structures both above and below the water surface. Additionally, the mooring of vessels to a SPM buoy system not sensitive to directional changes of wind, waves, and currents as the vessel is free to “weather-vane” around the buoy to stay head-on to during various weather, wind, wave, and current forces.

Berth Availability

Berth availability and ability to safely moor a vessel at an offshore DWP is dependent on the environmental conditions such as weather, winds, and waves as well as the DWP’s design capabilities for accommodating for the safe mooring of vessels in such conditions. Variations of wind and currents occur seasonally within the Gulf of Mexico. As such a DWP system that allows for the accommodation for various conditions allows for the safe mooring of vessels, and thereby greater efficiency and utilization of the DWP. The SPM buoy system allows for vessels to “weather-vane” around the buoy to stay head-on to during various weather, wind, wave, and current forces, whereas the fixed dock structure requires the vessels be poisoned in a designated manner to allow for loading operations. The ability of the SPM buoy system to accommodate for the various offshore conditions allows for greater berth availability.

Personnel Required for Operation

An SPM buoy system is an unmanned system remotely operated from a land-based facility. The use of support vessels for the SPM buoy operations is limited to the mooring/unmooring and product hose connection and disconnection. The fixed offshore platform is a manned system requiring the use of onsite personnel for operations. Additionally, a fixed platform requires the use of support vessels for the vessel approach, mooring/unmooring, and departure product hose connection and disconnection. As such, the use of a fixed platform requires the transport of onsite personnel to and from the location of the offshore fixed platform and the necessary facilities to support the health and safety of onsite personnel. The optimal DWP design would be one that minimizes potential safety hazards through the minimization of the number of onsite personnel required at the DWP during operations. As such, the use of an SPM buoy system for the loading of vessels reduces operational dependency of onsite personnel and support vessels, thereby minimizes potential health and safety exposures.

Length of Construction Schedule

A longer onsite construction timeframe results in greater disturbance of the marine environment and impacts to benthic habitats, underwater noise disturbance, and prolonged impacts to water quality. The onsite construction of a fixed platform is estimated to require 3 months whereas the onsite construction of an SPM buoy system is estimated to require 1 month. As such, the construction of the SPM buoy system minimizes the length of onsite construction required for the installation of a DWP.

Maintenance Requirements

The maintenance of a fixed berth will be greater than an SPM as loading arms, valves and controls will be required on the deck of the platform. This work would be carried out in an offshore environment resulting in exposure to potential hazards and safety concerns.

Seabed and Above Water Footprint

The SPM buoy system would provide a smaller footprint on the seabed and above water than a fixed platform which in turn would result in less environmental impacts. The SPM buoy system would consist of multiple components including a PLEM, a floating buoy, mooring hawsers, floating hoses, and sub-marine hoses. The PLEM system would be an approximate 47-foot by 68-foot steel frame structure positioned directly beneath the proposed SPM buoy system and would be anchored directly to the seafloor with four 24-inch-diameter piles. Above the water, the SPM will be approximately 1,000 square ft. and approximately 25 ft. in height. A fixed platform with the ability to load VLCCs would require an approximate 25,000 square ft. platform with mooring dolphins with catwalks connecting each structure. Additionally, a fixed platform would likely require a helipad to transport personnel to and from the structure for maintenance and operations. As such, for the purposes of directly and fully loading a VLCC in an offshore environment, the SPM buoy system requires less surface area, subsurface area, and impacts to the seafloor.

Accidental Collision Damage

Based on conversations between Lloyd Engineering, Inc. and the major SPM buoy vender, SPM buoys under service contracts experience minor, if any, damage as a result of operations. An SPM buoy system is anchored to the seafloor by chains which are set at appropriate tensions to allow for the flexibility and movement of the SPM buoy system with various offshore conditions. A fixed platform is supported by pile structures which are rigid structures. In the situation of an accidental collision, the SPM buoy design allows for the dissipation of forces exhorted by the vessel whereas rigid structures associated with a fixed platform absorb forces. As such, damages as a result of an accidental collision would be less for an SPM buoy than that of a fixed platform.

Since 1958, over 500 SPM buoys have been installed worldwide, indicating that the use of SPM buoys are a globally proven technology.

An analysis of the DWP design alternatives was conducted based on their ability to fulfill the Project purpose and need, while minimizing environmental impacts to the maximum extent practicable. The results of the analysis conducted for the DWP design alternatives are presented in Table 2-24.

Table 2-24 Deepwater Port Design Alternatives Decision Matrix

Siting Criteria	Single Point Mooring Buoy System	Fixed Platform
Minimizes the potential for interference with natural processes	✓ SPM buoy design allows for moored vessels to accommodate for existing natural processes	X Fixed platform design consists of rigid fixed structures incapable of accommodating for various offshore processes once installed
Berth availability	✓ Vessel is allowed to freely weathervane around the SPM buoy	X Vessel remains fixed to platform and mooring structures
Personnel Occupancy Required	✓ Un-manned system (excluding the assist tugs during berthing and de-berthing)	X Requires personnel to be onsite the fixed platform during operations
Length of Construction Schedule	✓ 1-month timeframe of disturbance of the marine environment	X 3-month timeframe and disturbance of the marine environment
Maintenance Requirements	✓ Shorter timeframe of required maintenance	X Longer timeframe of required maintenance
Seabed and Above Water Footprint	✓ Smaller footprint on the seabed and above water	X Larger footprint on the seabed and above water
Accidental Collision Damage	✓ Chains to the seabed will cause less damage	X Rigid dolphins and platform of a fixed dock structure will cause more damage
Evaluation Score	**7**	0
Selected as Preferred Alternative	**Yes**	No

Deepwater Port Design Alternatives

Based on the results of the DWP design alternatives analysis, as presented in Table 2-24, the SPM buoy system alternative was determined to be the most practicable DWP design alternative to be carried forward.

2.7.3 SPM Buoy Anchoring Alternatives

Based on the results of the DWP design alternatives screening, the use of an SPM buoy system was determined to be the best suited DWP design which fulfilled the Project purpose and need while minimizing environmental impacts. Two SPM buoy anchoring alternatives were considered during analysis including:

- Drag Anchors
- Anchor Piles

The analysis of SPM buoy anchoring alternatives was based upon two screening criteria including:

- Seabed Footprint: The optimal DWP design would be one that minimizes the footprint on the seabed.
- Practicality and Safety: The optimal DWP design would be one that is practical for the anchoring of the SPM buoy system.

An evaluation of the two anchoring alternatives was conducted to determine which best fulfilled the screening criteria listed above.

The use of drag anchors for the anchoring of the SPM buoy system minimize environmental impacts as it requires a larger footprint on the seabed than that of anchor piles. Within the Gulf of Mexico the composition of sediments at these water depths primarily consists of loose recent soils. Based on initial geotechnical analysis off offshore sediments at the proposed location of the SPM buoy, the use of drag anchors for the anchoring of the SPM buoy system is not practicable. As such, the practical and safe solution for the anchoring of the SPM buoy system is the use of anchor piles. Discussions of the soils is discussed in Volume II Section 10 geological resources and in Volume I Section 15.

The results of the analysis conducted for SPM buoy anchoring alternatives are presented in Table 2-25.

Table 2-25 SPM Buoy Anchoring Alternatives Decision Matrix

Siting Criteria	Anchor Piles	Drag Anchors
Seabed Footprint	✓ Smaller seabed footprint	X Larger seabed footprint
Practicality and Safety	✓ Initial geotechnical analysis shows that piles would be required to safely hold the SPM buoy system in place	X Initial geotechnical analysis shows that piles would be required to safely hold the SPM buoy system in place
Evaluation Score	2	0
Selected as Preferred Alternative	**Yes**	No

<u>SPM Buoy Anchoring Alternatives Analysis</u>

Based on the results of the SPM buoy anchoring alternatives analysis and geotechnical analysis conducted for the proposed Project, as presented in Table 2-25, the anchor pile system alternative was determined to be the only practicable SPM buoy anchoring alternative to be carried forward.

2.7.4 Pipeline Design Alternatives

An evaluation of pipeline design alternatives was conducted to determine the best suited pipeline design which fulfilled the Project purpose and need and overall Project objectives. As such, in order to allow for the efficiency required, two pipeline design alternatives were considered which allowed for the necessary loading rates of approximately 60,000 barrels per hour (bph) for the loading of approximately 8 VLCC's per month. The two pipeline design alternatives consist of:

- Single Pipeline Configuration: One 42-inch-diameter pipeline
- Dual Pipeline Configuration: Two 30-inch-diameter pipelines

The pipeline design alternatives analysis is based upon four screening criteria including:

- Continued Service During Pipeline Maintenance: The optimal pipeline design would be one that allows for the continuation of operations during routine maintenance and inspection.
- Minimizes Danger to the DWP and Surrounding Environment due to Natural Disasters: The optimal pipeline design would be one that minimizes potential impacts to the DWP, the associated components, and surrounding environment as a result of natural disasters.
- Maximizes Construction and Installation Capabilities: The optimal pipeline design would be one that allows for the safe and efficient installation using the best available technology to minimize impacts as a result of installation activities.
- Seabed Footprint: The optimal pipeline design would be one that minimizes the footprint on the seabed.

The following describes each of the DWP design alternatives.

An evaluation of the two pipeline designs was conducted to determine which design best fulfilled the screening criteria listed above.

Continued Service During Pipeline Maintenance

The single pipeline configuration requires operations to be shut down during routine maintenance and inspection activities. The dual pipeline configuration allows for the continuation of operations using one pipeline while routine maintenance and inspection activities are being conducted on the other pipeline. As such, the dual pipeline system allows for greater efficiency due to its ability for the continuation of operations during maintenance and inspection activities.

Minimizes Potential for Danger to the DWP and Surrounding Environment due to Natural Disasters

In the event of a natural disaster such as a named storm or hurricane, the dual pipeline system allows for the ability to displace crude oil located within the pipeline back to crude oil storage facilities located onshore followed by the filling of the pipeline with water in anticipation of a natural disaster such as a named storm or hurricane. This allows for the minimization of danger to the pipeline infrastructure as well as the surrounding environment should damage occur causing a leak or discharge of the contents located within the pipeline.

Maximizes Construction and Installation Capabilities

The methods which pipelines can be installed is primarily dependent on the size of the pipeline. The installation of larger diameter pipelines limits HDD distances and typically requires larger workspaces for the safe installation using HDD methods. HDD installation methods for smaller diameter pipelines allows for greater HDD distances and lesser workspaces sizes. The use of HDD installation techniques allows for the minimization of environmental impacts and is the least invasive method for the installation of pipelines across navigable waterways. The crossing of the GIWW and Gulf of Mexico surf zone would be required for connection of crude oil storage facilities located onshore and the DWP. The technical feasibility of executing an HDD of a 42-inch-diameter pipeline for the length required under the GIWW and Gulf of Mexico surf zone was not determined achievable.

Seabed Footprint

The single pipeline configuration would result in a lesser construction footprint on the seabed than the dual pipeline configuration.

An analysis of the pipeline design alternatives was conducted based on their ability to fulfill the above described criteria. The results of the analysis conducted for the pipeline design alternatives are presented in Table 2-26.

Table 2-26 Pipeline Design Alternatives Decision Matrix

Siting Criteria	**Single Pipeline Configuration (One 42-inch-diameter pipeline)**	**Dual Pipeline Configuration (Two 30-inch-diameter pipelines)**
Continued Service During Pipeline Maintenance	x Pipeline would have to come out of service for maintenance	✓ Ability to conduct maintenance in one line while keeping the other in service
Minimizes Potential for Danger to the DWP and Surrounding Environment due to Natural Disasters	x	✓
Maximizes construction and installation capabilities	x	✓
Seabed Footprint	✓ Smaller seabed footprint	x Larger seabed footprint
Evaluation Score	1	4
Selected as Preferred Alternative	No	**Yes**

Pipeline Design Alternatives Analysis

Based on the results of the pipeline design alternatives analysis, as presented in Table 2-26, the single dual pipeline configuration (i.e. two 30-inch-diameter pipelines) was considered most practicable alternative to be carried forward.

2.8 Alternatives Analysis Summary

Table 2-27 presents summary of the tiered screening analysis, the alternatives evaluated, and the chosen alternative as a result of the analysis conducted.

Table 2-27 Alternatives Analysis Summary Table

	Alternatives Analysis	Selection
Tier I Screening: No-Action Alternative		
No-Action Alternative	No-Action Alternative	Not considered for further review.
Tier II Screening: Location Alternatives		
U.S. Region Alternatives	East Coast (PADD 1)	Gulf Coast (PADD 3)
	Midwest (PADD 2)	
	Gulf Coast (PADD 3)	
	Rocky Mountain (PADD 4)	
	West Coast (PADD 5)	
Gulf Coast (PADD 3) State Alternatives	Alabama	Texas
	Arkansas	
	Louisiana	
	Mississippi	
	New Mexico	
	Texas	
Texas Coast Location Alternatives	Sabine/ Beaumont Area	Corpus Christi Area
	Houston Area	
	Freeport Area	
	Matagorda Area	
	Corpus Christi Area	
	Brownsville Area	
Tier III Screening: Offshore vs. Onshore and Existing Infrastructure Alternatives		
Onshore vs. Offshore Alternatives	Onshore Terminal with Existing Channel Dimensions (-45 ft.)	Offshore Deepwater Port Terminal
	Onshore Terminal with Future Authorized Channel Dimensions (-52 ft.)	
	Onshore Terminal with Modified Channel Dimensions (-71 ft.)	
	Offshore Deepwater Port Terminal	
Existing Infrastructure Alternatives	Utilization of Existing Abandoned Offshore Pipelines	Installation of New Offshore Pipeline Infrastructure
	Installation of New Offshore Pipeline Infrastructure	
Tier IV Screening: Siting Analysis of Required Project Components		
Deepwater Port Location Alternatives	South Region	South Region
	Central Region	
	North Region	
Crude Oil Storage Facility Site Alternatives	Alternative A	Onshore Storage Terminal Facility Alternative B
	Alternative B	
	Alternative C	

	Alternatives Analysis	Selection
Pipeline Routing and Deepwater Port Location Alternatives	Alternative 1	Alternative 2
	Alternative 2	
	Alternative 3	
Tier V Screening: Evaluation of Design Alternatives		
Deepwater Port Design Alternatives	Fixed Platform	Single-Point Mooring Buoy System
	Single-Point Mooring Buoy System	
SPM Buoy Anchoring Alternatives	Anchor Piles	Anchor Piles
	Drag Anchors	
Pipeline Design Alternatives	Single 42" Pipeline Configuration	Dual 30" Pipelines
	Dual 30" Pipeline Configuration	

Based on the results of the alternatives analysis conducted, the proposed Project location and design was determined to be the most practicable alternative to provide a safe, efficient and cost-effective logistical solution for the export of crude oil to support the continued economic growth of the United States of America (U.S).

2.9 Proposed Project

Based on the alternatives analysis presented in the previous sections, the proposed Project is located and designed in accordance with NEPA and the requirements of the DWPA to meet the Project objectives defined in Section 2.1.

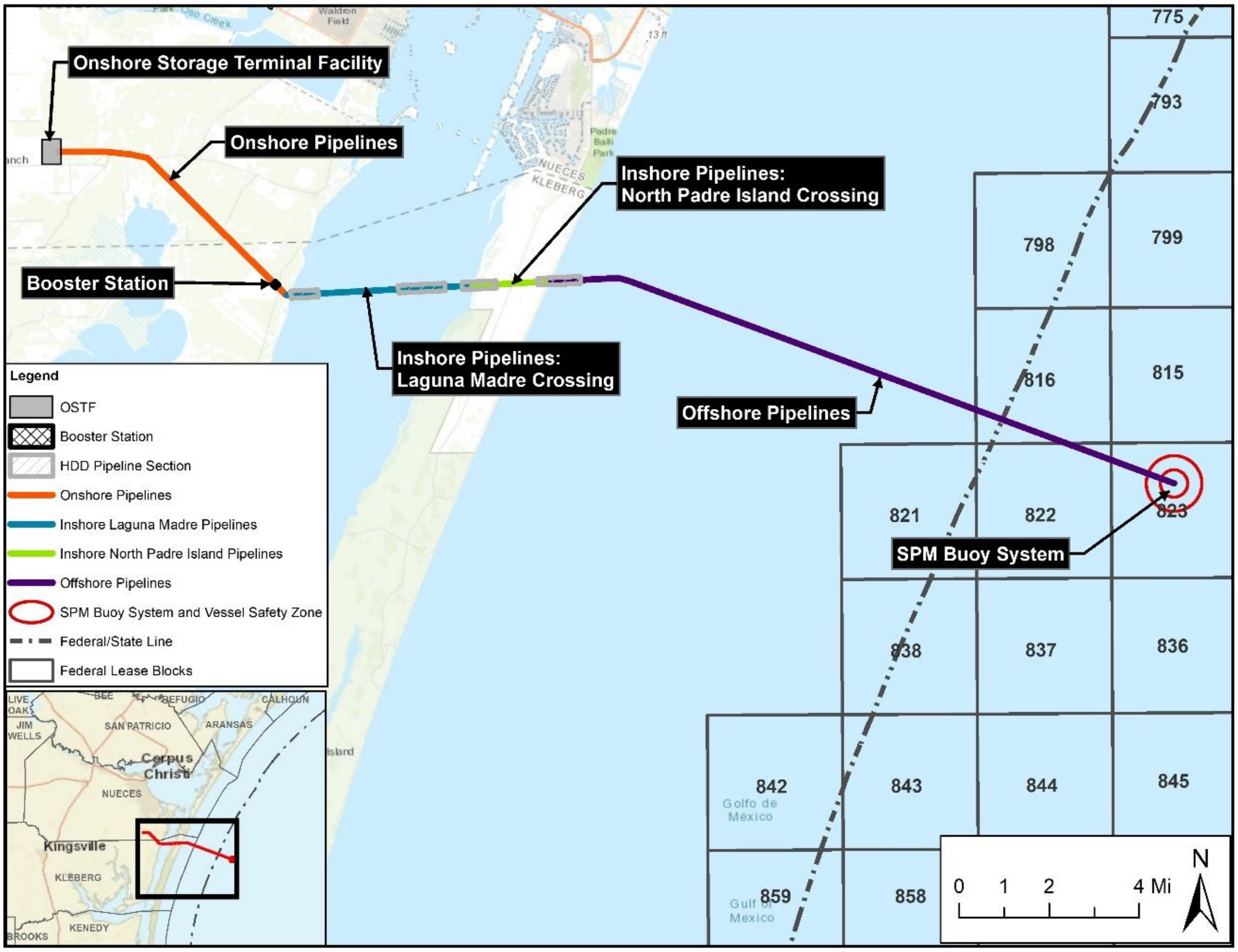
Therefore, the Applicant is proposing to construct and operate the Project to allow direct and full loading of VLCC at the DWP, via a SPM buoy system. The proposed Project consists of the construction of a DWP, onshore and inshore pipeline infrastructure, offshore pipelines, and an OSTF. The proposed DWP would be positioned outside territorial seas of the Outer Continental Shelf (OCS) Mustang Island Area TX3 (Gulf of Mexico), within the Bureau of Ocean Energy Management (BOEM) block number 823. The proposed DWP is positioned at Latitude N27° 28' 42.60" and Longitude W97° 00' 48.43", approximately 12.7 nautical miles (nm) (14.62 statute miles [mi]) off the coast of North Padre Island in Kleberg County, Texas. The proposed Project involves the design, engineering, and construction of a DWP, 26.81 miles of pipeline infrastructure, booster station, and an OSTF. For the purposes of this DWPL application, the proposed Project is described in three distinguishable segments by locality including "offshore", "inshore", and "onshore".

Onshore Project components includes an approximate 150-acre (60.7 hectares [ha]) OSTF, an 8.25 ac (3.3 ha) booster station, and approximately 6.36 mi of two (2) new 30-inch-diameter crude oil pipelines extending from the OSTF located in Nueces County, to the booster station located in Kleberg County, and continue to the landward side of the MHT line of the Laguna Madre. The proposed OSTF will serve as the primary collection and storage terminal of crude oil to be directly pumped through the proposed pipeline infrastructure to the DWP. Outbound flow rates from the OSTF to the DWP are anticipated to be approximately 60,000 bph.

Inshore components associated with the proposed Project are defined as those components located between the western Laguna Madre MHT line and the MHT line located at the interface of North Padre Island and the GOM; this includes approximately 5.74 mi of two (2) new 30-inch-diameter crude oil pipelines and an onshore block valve station located on North Padre Island. The onshore valve station will serve as the primary conjunction between the proposed onshore and offshore pipeline infrastructure.

Offshore components associated with the proposed Project include the DWP and offshore pipelines. Principle structures associated with the proposed DWP includes one SPM buoy system consisting of the SPM buoy, PLEM, sub-marine hoses, mooring hawsers, and floating hoses to allow for the loading of crude oil to vessels moored at the proposed DWP. The proposed SPM buoy system will be of the CALM type permanently moored with a symmetrically arranged six-leg anchor chain system extending to pile anchors fixed on the seafloor. Offshore pipeline infrastructure associated with the proposed Project consist of approximately 14.71 mi of two (2) new 30-inch-diameter pipelines extending from MHT line on North Padre Island to the SPM buoy system located at the proposed DWP. Refer to the Project Components Map below for a depiction of the location of the Project components discussed above.

Figure 2-15: Project Component Map



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