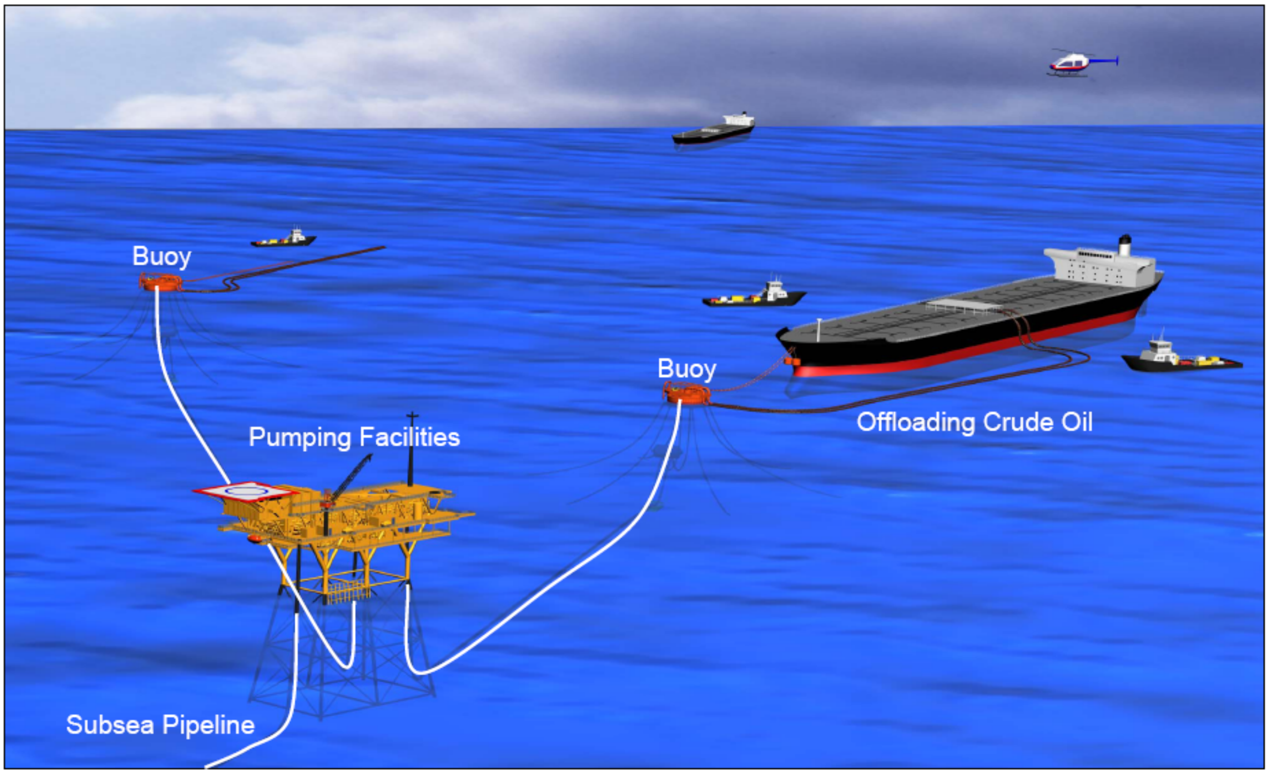

Texas Offshore Port System

Application for a Department of the Army Permit

November 2008

Document No.: 12174-006

Texas Offshore Port System

United States Army Corps of Engineers Permit Application

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Acronyms and Abbreviations

A&R	abandonment and recovery
ANWR	Aransas National Wildlife Refuge
ASBS	Area of Special Biological Significance
bbl	barrel
bbls	barrels
BGEPA	Bald and Golden Eagle Protection Act
BHA	bottom hole assembly
BMP	Best Management Practice
BOPD	barrels of oil per day
BPH	barrels of oil per hour
BR 538	Brazos Area Block 538
CALM	Catenary anchor leg mooring
CFR	Code of Federal Regulations
CHOPS	Cameron Highway Oil Port Pipeline System
CMP	Coastal Management Program
cm/s	centimeters per second
cSt	CentiStokes
CWA	Clean Water Act
DA	Department of the Army
dB	decibel
DP	dynamic positioning
DPA	Deepwater Port Act
DRA	Drag Reducing Agent
DWP	Deepwater Port

DWPA	deepwater port application
DWT	dead weight tons
EFH	Essential Fish Habitat
EIA	Energy Information Administration
ESA	Endangered Species Act
ESPLC	Emergency Shutdown Programmable Logic Control
FBE	fusion-bonded epoxy
FGP	Fuel Gas Pipeline
FM	Farm-to-market
FMP	Fishery Management Plan
FRP	Facility Response Plan
FVS	Freeport Valve Site
GA A56	Galveston Area Block A56
gal	gallons
GIS	Geographic Information System
GIWW	Gulf Intracoastal Waterway
GLO	General Land Office
GMFMC	Gulf of Mexico Fishery Management Council
GOM	Gulf of Mexico
gpm	gallons per minute
H_s	significant wave height
H_{max}	maximum wave height
ha	hectare
HDD	horizontal directional drill
HCA	high consequence area
HMS	highly migratory species

hp	horsepower
ID	inside diameter
IH	Interstate Highway
IMO	International Maritime Organization
IMP	Integrity Management Program
kbbl	thousand barrels
km	kilometers
kW	kilowatts
LNG	liquefied natural gas
LOOP	Louisiana Offshore Oil Port
MAOP	Maximum Allowable Operating Pressure
MARAD	U.S. Maritime Administration
MARPOL	Marine Pollution Convention
MBTA	Migratory Bird Treaty Act
m	meters
m^2	square meters
m^3	cubic meters
µg/l	micrograms per liter
µPa	micropascal
MG	million gallons
MHWM	mean high water mark
MLT	mean low tide
MMA	Marine Managed Area
MMBO	million barrels of oil
MMBOPD	million barrels of oil per day
MP	milepost

msl	mean sea level
MMS	Minerals Management Service
Motiva	Motiva Enterprises, LLC
MSD	Marine Sanitation Device
NCDDC	National Coastal Data Development Center
NDE	non-destructive examination
NEPDG	National Energy Policy Development Group
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMS	National Marine Sanctuaries
NOAA	National Oceanic and Atmospheric Administration
NORM	Naturally Occurring Radioactive Material
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NTL	Notice to Lessees
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
OCS	outer continental shelf
OD	outside diameter
ODMDS	Ocean Dredged Material Disposal Site
OPA	Offshore Pipeline Alternative
OPA 90	Oil Pollution Action of 1990
O&M	operations and maintenance
OSHA	Occupational Safety and Health Act
PACE	Port Arthur Crude Oil Express
PAHs	polycyclic aromatic hydrocarbons

PCV	pressure control valve
PHMSA	Pipeline Hazardous Materials Administration
PLC	Programmable Logic Control
PLEM	pipeline end manifold
PP	Pumping Platform (referring to Platform GA A56-A)
ppm	parts per million
psig	pounds per square inch gauge
QP	Quarters/Control Platform (referring to Platform GA A56-B)
ROW	right-of-way
RRC	Railroad Commission of Texas
SAV	submerged aquatic vegetation
SDV	Shutdown Valve
SH	State Highway
SPM	Single Point Mooring Buoy
SWPPP	Stormwater Pollution Prevention Plan
TBEG	Texas Bureau of Economic Geology
TCEQ	Texas Commission on Environmental Quality
TDS	total dissolved solids
THC	Texas Historical Commission
the Project	Texas Offshore Port System Project
TOPS	Texas Offshore Port System
TPWD	Texas Parks and Wildlife Department
TWDB	Texas Water Development Board
TXDOT	Texas Department of Transportation
ULCC	Ultra Large Crude Carrier
USAs	unusually sensitive areas

U.S.	United States
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USDOT	United States Department of Transportation
USDI	United States Department of the Interior
USEPA	United States Environmental Protection Agency
USFWS	Unites States Fish and Wildlife Service
VAC	volts of alternating current
VDC	volts of direct current
VLCC	Very large Crude Carrier
WMA	Wildlife Management Area

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1.0 Project Overview and Purpose and Need

1.1 Project Overview

Texas Offshore Port System (TOPS) intends to construct, own, and operate a new crude oil deepwater port (DWP) in Federal waters of the United States (U.S.) Gulf of Mexico (GOM) approximately 30 statute miles (approximately 48 kilometers [km]) south of Freeport, Texas. Figure 1.1-1 provides a general project location.

The Texas Offshore Port System Project (the TOPS Project or the Project) consists of the construction and operation of the proposed DWP, which will serve as an offshore crude oil receiving terminal and transmission facility. An average of up to 1,700,000 barrels of oil per day (BOPD) will be offloaded at a new terminal located in Minerals Management Service (MMS) lease block Galveston Area A56 (GA A56), and will be delivered via a new pipeline that will terminate at a newly constructed crude oil storage tank farm to be located in Texas City, Texas.

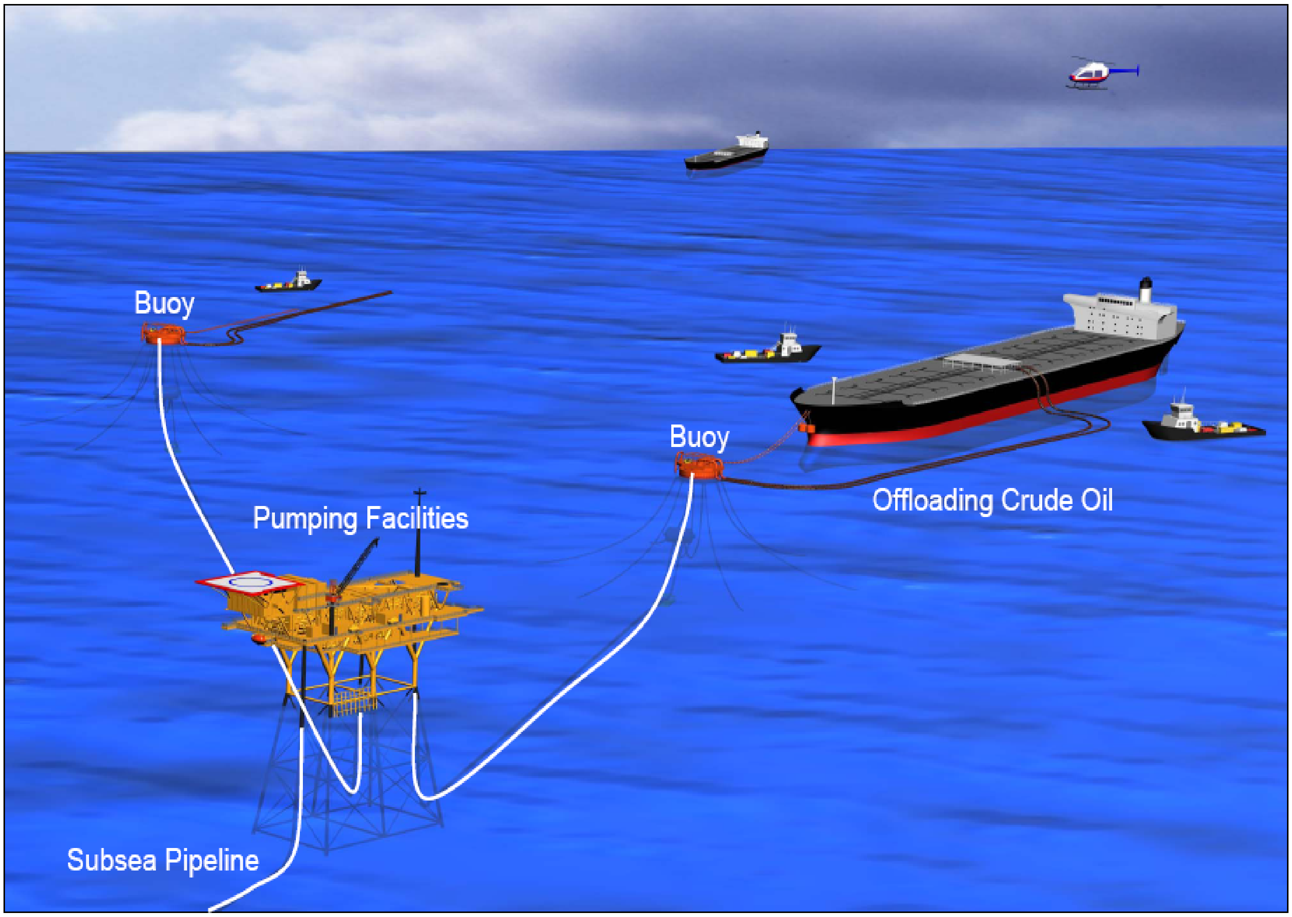
Figure 1.1-1 Project Location

The approximate 120-foot (or 37-meter [m]) mean sea level (msl) water depth in the vicinity of the Project's Offshore Terminal (also referred to as the Port) will allow for the direct unloading of larger, deeper draft Ultra Large Crude Carriers (ULCCs) and Very Large Crude Carriers (VLCCs). As discussed in Section 1.3, these larger crude carriers do not currently have direct access the onshore crude terminals along the upper Texas Gulf Coast and must conduct lightering operations to transport oil to these inland ports. In addition to these larger crude carriers, smaller vessels, including Aframax and Suezmax crude oil carriers, may also be offloaded at the Offshore Terminal.

A visual depiction of the Offshore Terminal is shown in Figure 1.1-2. As shown in Figure 1.1-3, the TOPS Project will include both offshore and onshore components. Offshore components will include two Single Point Mooring Buoys (SPMs), a Pumping Platform (PP), an adjacent Quarters/Control Platform (QP), a pair of subsea Offloading Pipelines running, running approximately 4,000 feet (1,219 m) from each SPM to the Pumping Platform, and a subsea Offshore Pipeline that will run approximately 35 miles from the Pumping Platform to an onshore valve station to be located in Freeport, Texas. Each SPM will be equipped with a pair of floating loading hoses (used to connect to crude carriers) and a pair of subsea hoses that will run from the base of the buoy to a subsea pipeline end manifold (PLEM). The previously noted Offloading Pipeline pair will connect the PLEMs to the Pumping Platform via risers. The Offloading Pipelines and the Offshore Pipeline will be 42-inch outside diameter (OD) crude oil transmission pipelines. The SPMs, Pumping Platform, Quarters/Control Platform and Offloading Pipelines will all be located within MMS Block GA A56. A future third SPM may also be constructed in Block GA A56 within 24 to 36 months after the startup of the deepwater port.

The offshore part of the Project also will include a Fuel Gas Pipeline (FGP) which will route natural gas from gas pipeline systems located to the west-southwest at a platform in MMS lease block Brazos Area 538 (BR 538) a distance of approximately 36 miles (58 km) to the Pumping Platform. The natural gas will be used to power the Pumping Platform's turbine pumps and power generators. The FGP will be an $8^5/_8$-inch OD natural gas transmission pipeline.

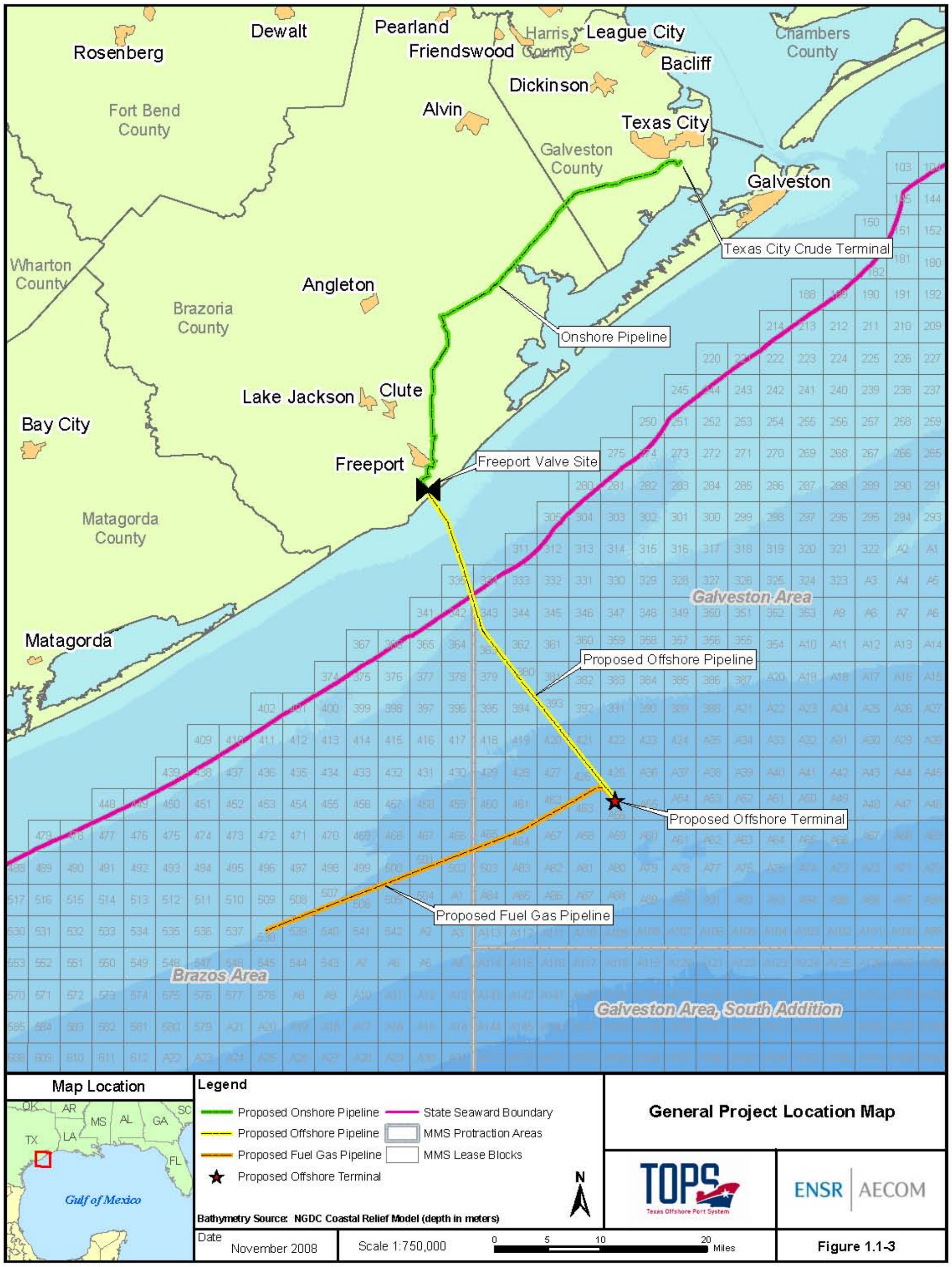
Figure 1.1-2 Visual Depiction of the Offshore Terminal



The onshore Project will begin at an onshore valve station to be located in Freeport, Texas referred to as the Freeport Valve Site (FVS). The FVS will serve as the connection point between the Offshore Pipeline and the Onshore Pipeline. The Onshore Pipeline will be a 42-inch OD crude oil transmission pipeline that will run approximately 47-miles (76 km), from the FVS to the proposed Texas City Crude Terminal. An intermediate crude oil booster pump station, referred to as the Onshore Pump Station, will be constructed at a location yet to be determined along the Onshore Pipeline. The final onshore project component will be the proposed Texas City Crude Terminal, to be constructed in Texas City, Texas. The Texas City Crude Terminal will consist of seven external floating roof tanks, six with a storage capacity of 600,000 barrels (bbls) and one with a storage capacity of 300,000 bbls.

When the Project is operational, pumping equipment on crude carrier vessels will pump crude oil from the ship to the Pumping Platform by means of the loading hoses, SPMs, subsea hoses, PLEMs, Offloading Pipelines and Pumping Platform risers. Turbine pumps on the Pumping Platform will boost the oil pressure and route as much as 100,000 barrels per hour (BPH) of crude oil into the Offshore Pipeline towards shore. Crude oil will flow through the Freeport Valve Site into the Onshore Pipeline and to the Onshore Pump Station. Booster pumps at the Onshore Pump Station will again boost the oil pressure and route as much as 100,000 BPH to the Texas City Crude Terminal, where the oil will be placed into storage for subsequent distribution.

Figure 1.1-3 General Project Location Map



1.2 Project Purpose and Need

Fossil fuels – coal, oil and natural gas – currently provide more than 85% of all the energy consumed in the U.S., nearly two-thirds of our electricity, and virtually all of our transportation fuels. Moreover, it is likely that the nation's reliance on fossil fuels to power an expanding economy will actually increase over at least the next two decades even with aggressive development and deployment of new renewable and nuclear technologies.

The U.S. is the world's largest importer of oil. Over the past few years, the strong growth of the U.S economy has led to the increase in U.S. consumption of oil and petroleum products. The U.S. consumed 20.7 million barrels per day (MMBOPD) of petroleum products during 2007 making us the world's largest petroleum consumer. The Energy Information Administration (EIA) predicts annual U.S. consumption of liquid fuels and other petroleum products to increase from the 20.7 MMBOPD consumed in 2007 to 22.8 MMBOPD in 2030 (an increase of 2.1 MMBOPD) (EIA 2008).

Despite this growth in demand, domestic crude oil production has been in decline. With some domestic crude production increases on the horizon in the Gulf of Mexico, the general decline of existing inland fields will likely offset any potential gains in the longer-term. Consequently, the reliance on imports of crude oil is anticipated to continue in the future.

The U.S. was ranked third in world crude oil production in 2006 at 8.37 MMBOPD, resulting in 12.22 MMBOPD of imported crude oil to meet U.S. demand. As relationships with traditional suppliers such as Venezuela deteriorate, it is anticipated that replacement crude will come from the Arabian Gulf, West Africa or the Mediterranean. Primary suppliers of crude oil to the U.S. are projected to remain Canada, Mexico and Saudi Arabia through 2012.

In response to this growth of U.S. demand for transportation fuels, U.S. Gulf Coast refineries have been evaluating plans to increase capacity. In September of 2007, Motiva Enterprises L.L.C. announced plans to expand its Port Arthur refinery by 325,000 BOPD with completion by 2010. Valero Energy Corporation is in the process of adding approximately 95,000 BOPD of additional capacity to its Port Arthur refinery with completion expected by 2011. These projects, in addition to normal incremental refinery capacity creep are projected to add between 415 and 515 thousand BOPD of incremental crude oil distillation capacity over the next four years to the U.S. Gulf Coast. Given the continued decrease in domestic crude oil production, it is clear that oil imports into the U.S. Gulf are going to increase. Even with plans to build pipelines to transport Canadian oil sand production to meet this need, a significant portion of this U.S. Gulf demand is going to be met through seaborne trade.

The main exporters of crude bound for the U.S. Gulf are countries in West Africa, the Caribbean, the Middle East, and the Mediterranean/United Kingdom. Due to the length of many of these voyages nearly 70% of these imports are transported on Ultra Large Crude Carriers (ULCC – 3 million barrels), Very Large Crude Carriers (VLCC – 2 million barrels) and Suezmax (1 million barrels) vessels to capture economies of scale (the exception is Caribbean exports, where Aframax vessels are preferred – 500 thousand barrels). However, water depths at U.S. Gulf Coast import ports are too shallow for these larger tankers to arrive fully laden at port for discharge. The largest fully loaded tankers, subject to draft restrictions, that can service the majority of the existing inland marine facilities on the Sabine-Neches and Houston/Galveston Waterways of U.S. Gulf Coast ports are around 100,000 DWT (Aframax size). The width and depth of these waterways prevents ULCCs (maximum draft 81.0 feet [24.7 m]) or VLCCs (maximum draft 79.0 feet [24.1 m]) from using the existing facilities.

There are two methods for getting crude from these large tankers into discharge ports on the U.S. Gulf. The first option is to perform a series of lightering operations. A ULCC or VLCC will discharge approximately 500 thousand barrel (kbbl) parcels to Aframax vessels. It may require up to six separate trips utilizing a number of Aframax vessels to shuttle the cargo from the ULCC or VLCC to the ultimate port. The lightering operation typically takes place offshore while both vessels are moving parallel to each other at the same speed. It is also possible when accessing certain ports for a Suezmax to discharge one 500 kbbl parcel to an Aframax and then proceed to a terminal partially laden to discharge the balance of the cargo.

U.S. Gulf Coast port congestion and delay times have significantly increased in the past few years due to the growing amount of ships transporting crude oil, dry bulk, and refined products to and from the region. These factors combined with restrictions by some terminals for daytime transit only, and also refineries' limiting the rate of discharge at their terminals, have contributed to an increase in the duration of the average lightering operation from three days to four or more. Such delays increase the cost per barrel lightering expense for the charterer, and also increase the demand for Aframaxes, driving up freight rates and thus lightering expenses even further. Delays not only increase the lump sum rates the charterer must pay to the lightering company because of higher demurrage payments, but also add to the payment the charterer must make to the VLCC or Suezmax owner for the long haul voyage.

To help develop alternatives to lightering, five U.S. oil companies joined efforts to create deep water ports in the early 1970's. As a result, the DPA, 33 U.S.C. § 1501 et seq., was enacted in order to promote efficiency in transportation and to protect the environment by establishing procedures for the location, construction, and operation of Deepwater ports off the coasts of the U.S. beyond territorial waters.

Cargos that are destined for refineries in Southeast Louisiana, the Midwest or Northeast, and which have access through the right delivery system, can use the DWP known as the Louisiana Offshore Oil Port (LOOP). Cargos entering the US Gulf in a ULCC, VLCC or Suezmax can access the LOOP port and connected systems. However, if the refineries to which a charterer is delivering the crude oil are not tied into the LOOP distribution system, this option is not available.

The TOPS Port is an effort to bring this alternative option to the Texas Refining region and allow this area's refiners to compete more fully with other regions. TOPS will provide refiners with an alterative option that will operate 24 hours per day allowing refiners currently receiving approximately 2.5 MMBOPD of imported crude via tankers that require lightering to reduce potential supply disruptions caused by this increase shipping traffic, operating limitations and weather delays.

The purpose of the DPA was declared by Congress to be:

1. authorize and regulate the location, ownership, construction, and operation of deepwater ports in waters beyond the territorial limits of the U.S.;

2. provide for the protection of the marine and coastal environment to prevent or minimize any adverse impact which might occur as a consequence of the development of such ports;

3. protect the interests of the U.S. and those of adjacent coastal States in the location, construction, and operation of deepwater ports;

4. protect the rights and responsibilities of States and communities to regulate growth, determine land use, and otherwise protect the environment in accordance with law;

5. promote the construction and operation of deepwater ports as a safe and effective means of importing oil or natural gas into the U.S. and transporting oil or natural gas from the outer continental shelf while minimizing tanker traffic and the risks attendant thereto; and

6. promote oil or natural gas production on the outer continental shelf by affording an economic and safe means of transportation of outer continental shelf oil or natural gas to the U.S. mainland.

The primary purpose and objectives of the proposed TOPS Project are in line with the intent of Congress in propagating this act. Specifically, the TOPS Project aims to:

- Enhance the logistics of the overall supply of crude oil supply to Upper Gulf Coast refineries;
- Reduce the number of ULCC and VLCC "lightering" operations in the Gulf of Mexico for crude oil supply to these refineries, thereby decreasing the number of oil handling operations and decreasing the chances for accidents and spills;
- Reduce ship related air emissions by reducing the number lightering operations and duration of ULCC and VLCC off-loading;
- Decrease the amount of crude oil related ship traffic in the upper Texas Gulf Coast Fairways, thereby decreasing the chances for ship collisions and oil supply interruptions due to inclement coastal weather or ship traffic;
- Allow for the anticipated increase in higher quality freight traffic to the local ports by reducing inland crude oil ship traffic; and
- Enhance safety of crude oil transportation by mooring vessels offshore and transporting the crude oil onshore by pipeline.

Because our country's economic health depends on the continued availability of reliable and affordable fossil fuels, we are proposing to construct and operate the TOPS Project which we believe provides refiners in the region with an efficient, reliable and environmentally superior alternative for imported crude oil deliveries.

1.3 Regulatory Jurisdiction and the Contents of This Application

As a proposed DWP, TOPS is applying to the U.S. Department of Transportation's (USDOT's) Maritime Administration (MARAD) for a DWP license under the Deepwater Port Act of 1974 (DPA), as amended by the Maritime Security Act of 2002. MARAD is responsible for issuing a Record of Decision and license for the DWP. Under authority delegated to it by the Secretary of the Department of Homeland Security for license processing functions, the U.S. Coast Guard (USCG) has been delegated the primary responsibility for complying with the National Environmental Policy Act (NEPA) under the DPA. As the lead federal agency, USCG is instrumental in developing the environmental and marine navigation aspects of the decision. TOPS will likewise require a Department of the Army (DA) permit through the U.S. Army Corps of Engineers (USACE). It is anticipated that the USACE will coordinate its permitting process in consultation with USCG as a cooperating agency. A Memorandum of Understanding amongst the agencies relating to the licensing of deepwater ports was signed by the Assistant Secretary of the Army for Civil Works in 2003.

This application package contains requisite application forms, Project description, impacts and alternatives analyses, methods to avoid, minimize and mitigate impacts, and drawings and schematics illustrating the Project components, their locations, and pertinent engineering, construction, operation, maintenance, and decommission details. These materials are being submitted to the USACE, Galveston District, in support of Project's DA permit application. The permit sought is for work and structures in the GOM and other tidal waters under Section 10 of the Rivers and Harbors Act of 1899 and for the discharge of dredged or fill material under Section 404 of the Clean Water Act.

Section 1.0 of this application package contains a Project overview, purpose and need statement, and location description in addition to a list of appendices and acronyms to assist the reader. Section 2.0 describes the features along the Project routes, as well as provides a Project description with greater detail than presented in the Project Overview in Section 1.0, including construction methodology and an analysis of Project alternatives. Section 3.0 contains a description of the existing environmental conditions along the Project route and within the vicinity of permanent Project structures. Impacts to the environment posed by the TOPS Project as well as prevention and mitigation measures are presented in Section 4.0. Section 5.0 contains a statement regarding the Section 401 water quality certification to be obtained for this Project. Section 6.0 contains a statement regarding the Project's compliance with the Texas Coastal Management Program (CMP). Section 7.0 contains a list of references.

Appendices to this submittal also include a DA application form, including a list of adjacent property owners (Appendix A), project drawings and schematics (Appendix B), the DWP License application's Environmental Report, detailing resources within the offshore portion of the Project (Appendix C), the applicant's signed statement and details of the Project's CMP compliance (Appendix D), a delineation of wetlands and waters of the U.S. along the onshore component of the Project area (Appendix E), the Onshore Project Execution Plan, including details of the pipeline installation and mitigation measures (Appendix F), the onshore cultural resource survey (Appendix G), a contingency plan in the event of a fluid release associated with the use of horizontal directional drill technology (Appendix H), a risk assessment and environmental consequence analysis specific to the Project (Appendix I), and Project specific land use/land cover mapping (Appendix J). Likewise, a copy of the complete DWP application, including the Topic Reports and additional supplementary information that detail the various aspects of the project and the resources potentially affected, will be sent to all participating agencies.

As evidenced within this application package, the Project has been designed to avoid and minimize impacts to the environment to the maximum extent practicable. However unavoidable impacts resulting from the pipeline and installation of onshore facilities, as described herein, will require regulatory approval under the Clean Water Act (CWA), Sections 404 and 401 programs, and the Rivers and Harbors Section 10 program. A DA application form (ENG Form 4345) is included in Appendix A.

Table 1.3-1 lists regulatory agencies contacted, potential permits required, and the expected date of receipt of those permits for the construction and operation of TOPS. Although some agencies will not have permitting authority over the proposed TOPS Project, they have been consulted to ensure the participation of all interested parties.

Table 1.3-1 Environmental Approvals and Permitting for the Construction, Operation and Maintenance of the Proposed Texas Offshore Port System

Agency	Permit/Approval	Status	Expected Date of Receipt
Federal			
Maritime Administration (MARAD)	DWP License Record of Decision	Pending	November 2009
U.S. Coast Guard	DWP Environmental Review	Pending	November 2009 (coincident with MARAD approval)
MARAD	DWP License	Pending	November 2009
U.S. Environmental Protection Agency (USEPA)	Individual Permit – National Pollutant Discharge Elimination System (NPDES) for construction (including hydrostatic test water discharges in federal waters) and operation	Pending	November 2009
USEPA	Major Source Construction Permit – Air Emissions	Pending	November 2009
USEPA	Title V Operating Permit – Air Emissions	Pending	December 2010
Minerals Management Service (MMS)	Approval associated with the National Environmental Policy Act (NEPA) as a Cooperating Agency	Pending	November 2009
U.S. Fish and Wildlife Service (USFWS)	Approval associated the National Environmental Policy Act (NEPA) as a Cooperating Agency	Pending	November 2009
National Oceanic and Atmospheric Administration (NOAA)	Approval associated with the National Environmental Policy Act (NEPA) as a Cooperating Agency	Pending	November 2009
NOAA	Determination of no significant impact with respect to Section 7 of the Endangered Species Act (ESA)	Pending	November 2009
NOAA	Determination of no significant impact with respect to the Magnuson-Stevens Fishery Conservation and Management Act	Pending	November 2009
NOAA	Determination of compliance with the Coastal Zone Management Act	Pending	November 2009
U.S. Army Corps of Engineers	Permit to conduct activities in waters of the U.S. in compliance with Sections 401 and 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act of 1899	Pending	November 2009
State – Texas			
Texas Governor's Office	Determination of compliance with the Texas Coastal Management Plan	Pending	November 2009
Texas General Land Office (GLO)	Determination of compliance with the Texas Coastal Management Plan; miscellaneous easement for use of state owned submerged lands	Pending	November 2009

Table 1.3-1 Environmental Approvals and Permitting for the Construction, Operation and Maintenance of the Proposed Texas Offshore Port System

Agency	Permit/Approval	Status	Expected Date of Receipt
Texas Commission on Environmental Quality (TCEQ)	Permit for intake of hydrostatic test water	Application to be submitted Fall 2008	November 2009
Texas Railroad Commission (RRC)	Coastal Zone Consistency Determination; CWA Section 401 water quality determination; TPDES Permit for discharge of hydrostatic test water in Texas waters and for stormwater discharges	Pending	November 2009
Texas Parks and Wildlife Department (TPWD)	Consultation regarding state listed threatened or endangered species	Pending	November 2009
Texas Historical Commission	Determination of no significant impact in Texas waters with respect to Section 106 of the National Historic Preservation Act in state waters and onshore	Pending	November 2009

2.0 Proposed Project

2.1 General Description and Location of Project Components

2.1.1 Description

A schematic diagram of the TOPS Project is provided in Appendix B, including a general site layout and platform details. The Port has been designed to offload an average of up to 1.7 million BOPD of crude oil.

For discussion purposes, the TOPS Project can be divided into three major sections. These include:

- Offshore Terminal (includes the SPMs, Offloading Pipelines, PP GA A56-A, and QP GA A56-B);
- Offshore Pipeline (from PP GA A56-A to the FVS) and Fuel Gas Pipeline (to PP GA A56-A from an existing platform in MMS Block BR 538); and
- Onshore Facilities (includes Freeport Valve Site, Onshore Pipeline, Onshore Pumping Station, and the Texas City Crude Terminal).

2.1.1.1 Offshore Terminal

- Single Point Mooring Buoys (SPMs) - As initially constructed, two SPMs, located in Block GA A56 (local water depth of approximately 120 feet [37 m] msl) will be used to offload crude oil from crude carrier vessels. A third SPM will be constructed at a future time. SPM buoys will be surface Catenary Anchor Leg Mooring (CALM) buoys, anchored to the seafloor by a series of anchor chains. Each SPM will have two 24-inch inside diameter (ID), flexible floating loading hoses, with each hose approximately 1,120 feet (341 m) in length. A crude carrier vessel moored at a given SPM, with the help of an assist boat, will retrieve the SPM’s two loading hoses, bring them onboard, attach them to vessel discharge manifold, and initiate pumping of crude oil from the carrier to the SPM. Crude oil will be routed from each SPM buoy to a subsea PLEM via two 24-inch ID flexible hoses (please refer to Appendix 1.A of the DWP application for the SPM/PLEM configuration). From the PLEM, oil will flow through two parallel 4,000 feet (1,219m) long 42-inch OD Offloading Pipelines to PP GA A56-A. Please refer to Pipeline Plan and Profile Figures located in Appendix B for depictions of the 42-inch OD offloading pipelines. In accordance with a Project consultation meeting with the MMS (described in the DWP environmental report), these offloading pipelines will be buried to the top of pipe;

- PP GA A56-A (Metering and Pumping Platform) - The PP will include metering equipment, seven turbine-driven booster pumps, power generating equipment, and other crude oil transmission system related equipment. Crude oil arriving from the SPMs will be boosted to higher pressure to achieve a flow rate of up to 100,000 BPH into the departing Offshore Pipeline. The PP will be bridge connected via 15 feet (5 m) wide by 150 feet (46 m) long bridge to the new QP GA A56-B. The three-deck PP will be supported by a pile-anchored 8-leg jacket structure (please refer to Appendix 1.A of the DWP license application).; and

- QP GA A56-B (Quarters and Control Platform) – The QP will serve as a support platform for the bridge-connected PP GA A56-A. QP GA A56-B will include a 40-person living quarters, a control room, helicopter deck pad, and survival craft vessel. The platform also will have firewater pumps, fire jockey pumps, and potable water treatment and storage systems, and will provide firewater and potable water across the bridge to PP GA A56-A. The two-deck platform and its helideck will be supported by a pile-anchored 4-leg jacket structure (please refer to Appendix 1.A of the DWP environmental report).

2.1.1.2 Offshore Pipeline and Fuel Gas Pipeline

- Offshore Pipeline – A 35 mile (56 km) of 42-inch OD crude oil transmission pipeline to be installed from PP GA A56-A to the FVS. The south end of the pipeline will connect into the PP via a riser. The pipeline will be buried a minimum of 3.0 feet (0.9 m) below the seafloor, with a minimum burial depth of 10.0 feet (3.0 m) where it crosses the Coastwise Safety Fairway. The shore crossing component of the pipeline will be installed via HDD, approximately 0.9 miles (1.4 km) in length between an onshore HDD entry pit and an offshore HDD exit location. The offshore HDD exit point is expected to be located at a water depth of approximately 18 feet (5.5 m) msl, approximately 0.7 miles (1.1 km) offshore of the Mean High Water Mark (MHWM). For the purpose of this evaluation, the Offshore Pipeline will continue from the MHWM for an additional 0.7 miles (1.1 km) to the FVS.

- Fuel Gas Pipeline (FGP) – Fuel gas to power Pumping Platform turbine pumps and power generators will be supplied by a 36-mile (58 km)-long, $8^{5}/_{8}$-inch OD Fuel Gas Pipeline that will run from gas pipeline systems located at the platform in Block BR 538 to the pumping platform. The FGP will be buried to provide a similar 3-foot (0.9 m) depth of cover as that provided for the Offshore Pipeline.

2.1.1.3 Onshore Facilities

- Onshore Facilities will include 47 miles (77 km) of 42-inch OD pipeline and surface facilities for the metering and pumping of the 42-inch pipeline and storage of the crude oil. These surface facilities include the FVS near the Gulf Intracoastal Waterway (GIWW) south of Freeport, an Onshore Pump Station adjacent to the Onshore Pipeline segment, and the Texas City Crude Terminal in Texas City. The Onshore Pipeline will be placed within a maximum 125-foot-wide (38.1 m) temporary construction right-of-way (ROW) and includes a 30-foot-wide (9.1 m) permanent ROW.

- Freeport Valve Site (FVS) – A proposed valve station that will serve as the connection point between the 42-inch OD Offshore Pipeline and the 42-inch OD Onshore Pipeline, The FVS will be located near the Gulf Intracoastal Waterway (GIWW) south of Freeport and will be equipped with automatic shutoff valves to protect the downstream Onshore Pipeline (designed per ANSI 600 specifications) from the upstream Offshore Pipeline (designed per ANSI 900);

- Onshore Pipeline – An approximately 47-mile (76-km) long, 42-inch OD crude oil transmission pipeline to be installed from the FVS in Freeport, Texas to the proposed Texas City Crude Terminal in Texas City, Texas. An intermediate booster pump station, as noted below, will be located at an as yet not specified point along this Onshore Pipeline;

- Onshore Pump Station – A proposed intermediate crude oil booster pump station to be located on a site approximately 5 acres in size at an as yet not specified point along the

Onshore Pipeline. The Onshore Pump Station will boost the pressure of the flow in the Onshore Pipeline to facilitate the delivery of up to 100,000 BPH to the newly constructed Texas City Crude Terminal; and

- Texas City Crude Terminal - A proposed crude oil storage terminal to be constructed in Texas City, Texas. The Texas City Crude Terminal will consist of seven external floating roof tanks, six with a storage capacity of 600,000 bbls and one with a storage capacity of 300,000 bbls.

Crude oil will be offloaded at the proposed Port from various types of crude carriers. TOPS estimates over 300 vessel offloadings per year. ULCCs, VLCCs, Aframax, and Suezmax carriers will moor at the two offshore SPM buoys (and at the third future SPM) and offload crude oil at a rate of up to 100,000 BPH and at a discharge pressure of approximately 150 psig at the vessel discharge flange.

VLCCs and ULCCs can carry cargos of up to approximately 2.0 to 3.5 million barrels of oil, respectively. It is anticipated that cargos will be offloaded in approximately 21 offloading hours and 28 hours at port (average offloading rate 80,000 BPH, maximum 100,000 BPH). The smaller vessels (Aframax and Suezmax), which can carry cargoes up to approximately 750,000 to 1,000,000 barrels (bbls), respectively, will similarly be offloaded in approximately 24 to 36 hours (average offloading rate 30,000 BPH; maximum 45,000 BPH). Separate crude cargoes and qualities will be segregated through batch delivery operations. The oil then will be boosted to a higher pressure at PP GA A56-A to maintain a flow rate of up to 100,000 BPH in the 42-inch OD pipeline from the PP to the Onshore Pump Station. The Onshore Pump Station will boost the pressure to maintain a flow rate of up to 100,000 BPH in the 42-inch OD pipeline running from the Onshore Pump Station to the newly constructed Texas City Crude Terminal.

Piping, metering and pumping systems on PP GA A56-A will be configured to allow for offloading to occur simultaneously at multiple SPMs. However, TOPS anticipates that simultaneously offloading of crude oil from three SPMs would rarely (if ever) occur. Simultaneous offloading at two SPMs would only occur if the crude products in the two carriers are compatible. In the most typical offloading scenario, while one vessel is offloading crude oil, a second vessel would be moored to the second SPM preparing to offload once the offloading of the first vessel is completed.

2.1.2 Location

Figure 1.1-3 depicts the location of the TOPS Project facilities, as described above. TOPS Project facilities are located in the Federal and state (Texas) waters of the GOM and Brazoria and Galveston Counties, Texas.

Offshore Terminal

A detailed overview of Offshore Terminal facilities and navigation areas is provided in Figure 2.1-1. The Offshore Terminal is proposed to be located entirely within MMS Block GA A56 in a water depth of approximately 120 feet (37 m) msl. A safety zone and a designated anchorage area are also planned for vessels calling on the Port. The anchorage area will span the southern portion of Block GA A56 and the northern and central portion of Block GA A59. The central coordinates for the proposed Offshore Terminal are 28º-28’-39.57” North latitude, 95º-04’-23.48” West longitude, approximately 30 statute miles (48 km) south of Freeport, Texas.

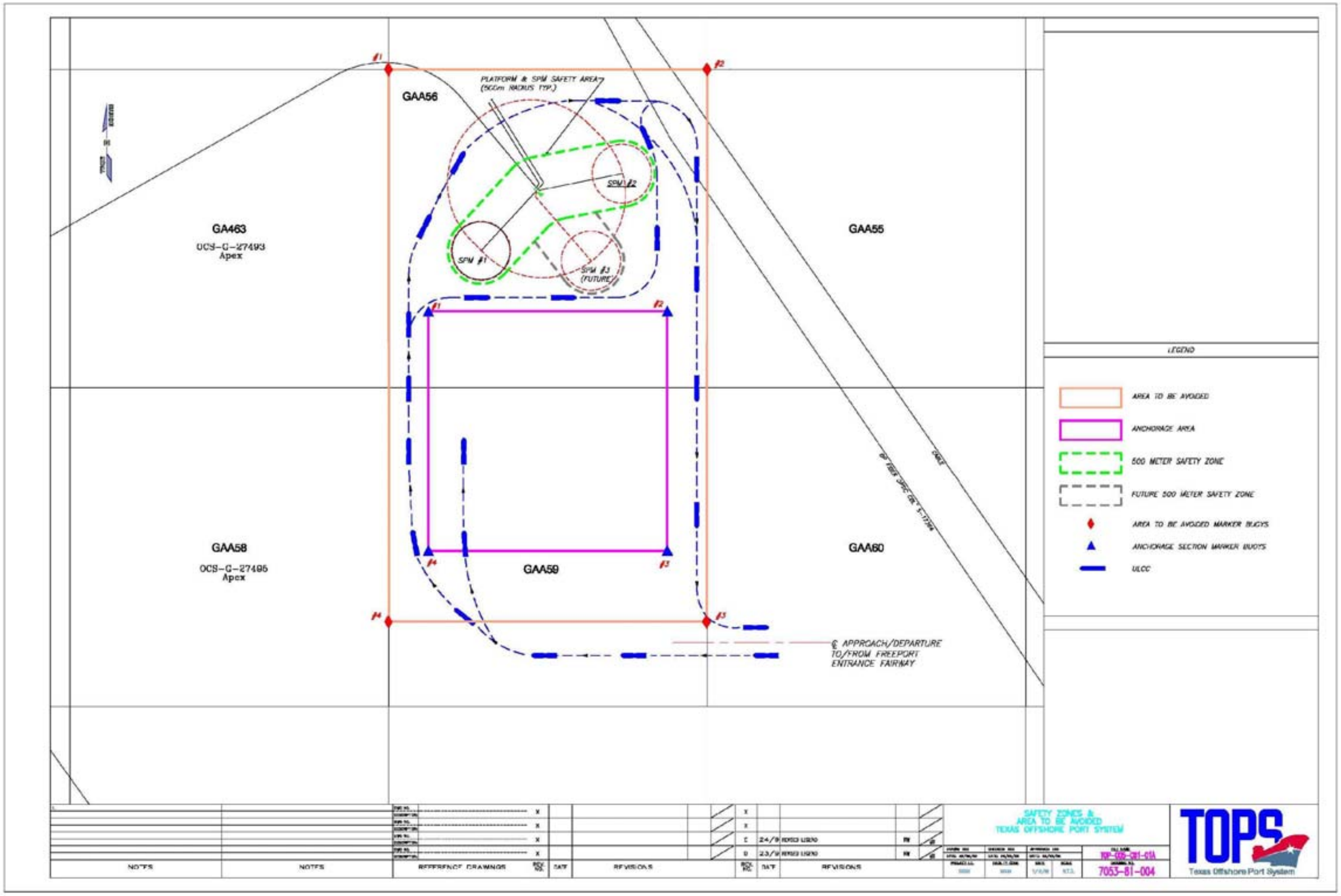
Offshore Pipeline

The proposed route for the approximate 35-mile-long (56-km), 42-inch OD Offshore Pipeline is described below:

- The Offshore Pipeline will depart from the proposed Pumping Platform GA A56-A in a northwesterly direction. Continuing in a northwesterly direction, the proposed route will cross from Block GA A56 into the southwest corner of Block GA 425 and continue through the eastern portion of Block GA 426, the southwestern portion of Block GA 421, the northeastern portion of Block GA 420, the western portion of Block GA 393, the northeastern corner of Block GA 394, until reaching the center of Block GA 380. At this point the pipeline will continue northwesterly crossing the Coastwise Safety Fairway as is passes through Block GA 380 to the southwest corner of Block GA 362. The pipeline will continue in a northwesterly direction across Block GA 363, exiting the fairway and extending towards the southwest portion of Block GA 343. The pipeline route will continue in a slightly more northerly direction through the western portion of Blocks GA 343 to the northeast corner of Brazos Area Block BR 342. The pipeline will then exit the MMS Western Planning Area and enter Texas waters where it will cross the eastern portion of Block BR 335 and through the center of Block BR 309. The pipeline route will then continue in a northerly direction towards shore, passing through Blocks BR 400S, BR 388S, BR 383S, BR 382S and BR 378S.

  Landfall for the Offshore Pipeline will be achieved by use of horizontal directional drilling (HDD), with an anticipated HDD length (from entry point to exit point) of 4,500 feet (1,372 m). The actual HDD pipeline segment will be longer (approximately 5,500 feet [1,676 m], to provide an offshore tail segment that will extend beyond the transition trench and facilitate the tie-in to the pipeline extending offshore. The onshore HDD entry point is expected to be located approximately 1,000 feet (305 m) inland of the mean high water mark (MHWM) and approximately 2,600 feet (792 m) upstream of the FVS. It is anticipated that the offshore exit point of the HDD will be located at the 18.0 foot (5.5 m) water depth contour, approximately 3,500 feet (1,067 m) offshore of the MHWM. The total pipeline distance from the PP GA A56-A to the FVS will be approximately 35 miles (56 km).

Figure 2.1-1 Offshore Terminal Layout Showing Safety Zone, Area to be Avoided and Anchorage Area



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Onshore Pipeline and Facilities

The proposed route for the approximately 47-mile (76 km)-long, 42-inch OD Onshore Pipeline is described below:

- The Onshore Pipeline will begin at the Freeport Valve Site near County Road 241 south of the GIWW. The pipeline will proceed in a northwesterly direction and cross beneath the GIWW near Bryan Lake. Turning northeast the proposed route will cross beneath the hurricane protection levee and then parallel Farm-to-Market road (FM) 1495 to its intersection with East 8th Street. The route will then turn southeast along East 8th Street and then turn north along Terminal Street where it will cross beneath the Old Brazos River. The route will then proceed north and cross FM 523 near its intersection with State Highway (SH) 332. The route will then extend north in an existing ROW and cross Oyster Creek and beneath FM 523. The route will then follow the existing ROW crossing Bastrop and Austin Bayous and turning east along FM 2004. The route will parallel FM 2004 for approximately 19 miles crossing Chocolate Bayou and several smaller waterways. Near Hitchcock, Texas the route will diverge from the FM 2004 ROW and follow a Department of Energy pipeline corridor. Approaching the proposed Texas City Crude Terminal facility the route will cross Highland Bayou, SH 6, Interstate Highway (IH) 45, SH 3, and a rail spur and hurricane protection levee prior to terminating at the Texas City Crude Terminal.

An intermediate crude oil booster pump station (the Onshore Pump Station) will be located on a site approximately 5 acres in size at an as yet not specified point along the Onshore Pipeline.

The proposed location for the TOPS Project is based upon the following factors, which are described in greater detail in the discussion of alternatives. In short, the proposed location:

- Provides for efficient, safe delivery to the Upper Texas Gulf Coast area refineries;
- Accommodates mooring of ULCCs and VLCCs (81 feet [24.7 m] and 79 feet [24.1 m] drafts, respectively) reducing the need for lightering and shuttling; also accommodates mooring of other smaller carriers (Aframax and Suezmax);
- Minimizes impact to environmentally sensitive areas;
- Does not interfere with existing or proposed exploration and production programs;
- Is in suitable proximity to existing shipping fairways, which allows safe approaches to the port; and
- Has soil conditions suitable for the construction and operation of the project facilities.

2.2 Project Construction and Construction Schedule

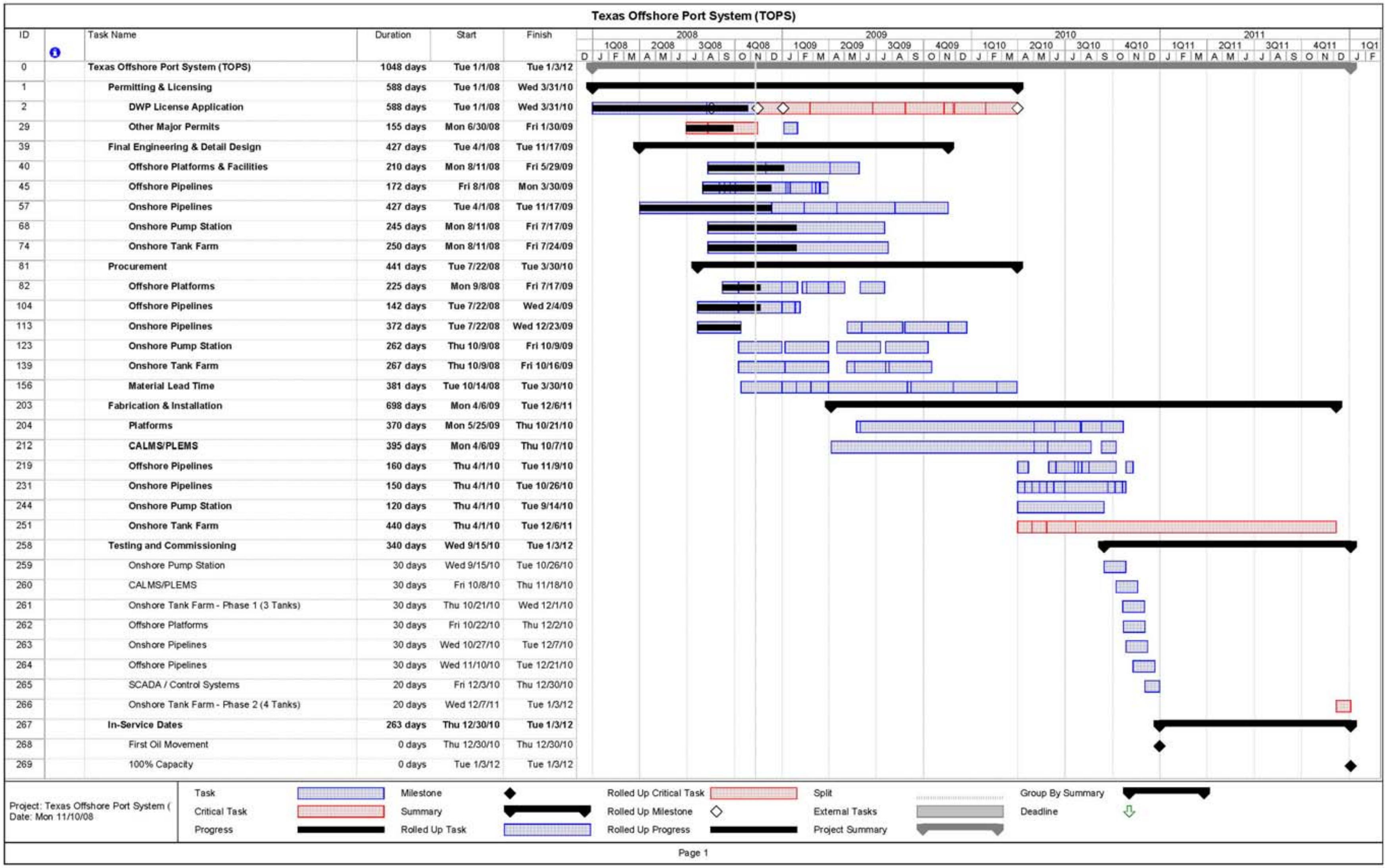
2.2.1 Overview of Construction Schedule

Figure 2.2-1 shows the overall Project schedule for the TOPS Project. As presented in the schedule, long-lead procurement of equipment and prefabrication of offshore and onshore components began as early as July 2008 and will continue through April 2010. Offshore installation of the proposed TOPS platforms, pipelines and SPMs is expected to begin in April

2010 and will be complete by mid-November 2010. Onshore installation will run concurrently, commencing in April 2010. Anticipated completion of the Onshore Pipeline, FVS, and Onshore Pump Station is scheduled for November 2010. Commissioning of the offshore and onshore components (not including the Texas City Crude Terminal), is expected to be completed by January 2011.

Construction of the Texas City Crude Terminal is scheduled to be completed in phases. Construction and commissioning of Phase 1, consisting of three tanks, is scheduled to be completed by December 2010. Construction and Commissioning of Phase 2 of the crude terminal, consisting of an additional 4 tanks, is scheduled to be completed by January 2012.

Figure 2.2-1 Project Schedule – Texas Offshore Port System



Texas Offshore Port System (TOPS)

ID	Task Name	Duration	Start	Finish
0	**Texas Offshore Port System (TOPS)**	**1048 days**	**Tue 1/1/08**	**Tue 1/3/12**
1	**Permitting & Licensing**	**588 days**	**Tue 1/1/08**	**Wed 3/31/10**
2	**DWP License Application**	**588 days**	**Tue 1/1/08**	**Wed 3/31/10**
29	**Other Major Permits**	**155 days**	**Mon 6/30/08**	**Fri 1/30/09**
39	**Final Engineering & Detail Design**	**427 days**	**Tue 4/1/08**	**Tue 11/17/09**
40	**Offshore Platforms & Facilities**	**210 days**	**Mon 8/11/08**	**Fri 5/29/09**
45	**Offshore Pipelines**	**172 days**	**Fri 8/1/08**	**Mon 3/30/09**
57	**Onshore Pipelines**	**427 days**	**Tue 4/1/08**	**Tue 11/17/09**
68	**Onshore Pump Station**	**245 days**	**Mon 8/11/08**	**Fri 7/17/09**
74	**Onshore Tank Farm**	**250 days**	**Mon 8/11/08**	**Fri 7/24/09**
81	**Procurement**	**441 days**	**Tue 7/22/08**	**Tue 3/30/10**
82	**Offshore Platforms**	**225 days**	**Mon 9/8/08**	**Fri 7/17/09**
104	**Offshore Pipelines**	**142 days**	**Tue 7/22/08**	**Wed 2/4/09**
113	**Onshore Pipelines**	**372 days**	**Tue 7/22/08**	**Wed 12/23/09**
123	**Onshore Pump Station**	**262 days**	**Thu 10/9/08**	**Fri 10/9/09**
139	**Onshore Tank Farm**	**267 days**	**Thu 10/9/08**	**Fri 10/16/09**
156	**Material Lead Time**	**381 days**	**Tue 10/14/08**	**Tue 3/30/10**
203	**Fabrication & Installation**	**698 days**	**Mon 4/6/09**	**Tue 12/6/11**
204	**Platforms**	**370 days**	**Mon 5/25/09**	**Thu 10/21/10**
212	**CALMS/PLEMS**	**395 days**	**Mon 4/6/09**	**Thu 10/7/10**
219	**Offshore Pipelines**	**160 days**	**Thu 4/1/10**	**Tue 11/9/10**
231	**Onshore Pipelines**	**150 days**	**Thu 4/1/10**	**Tue 10/26/10**
244	**Onshore Pump Station**	**120 days**	**Thu 4/1/10**	**Tue 9/14/10**
251	**Onshore Tank Farm**	**440 days**	**Thu 4/1/10**	**Tue 12/6/11**
258	**Testing and Commissioning**	**340 days**	**Wed 9/15/10**	**Tue 1/3/12**
259	Onshore Pump Station	30 days	Wed 9/15/10	Tue 10/26/10
260	CALMS/PLEMS	30 days	Fri 10/8/10	Thu 11/18/10
261	Onshore Tank Farm - Phase 1 (3 Tanks)	30 days	Thu 10/21/10	Wed 12/1/10
262	Offshore Platforms	30 days	Fri 10/22/10	Thu 12/2/10
263	Onshore Pipelines	30 days	Wed 10/27/10	Tue 12/7/10
264	Offshore Pipelines	30 days	Wed 11/10/10	Tue 12/21/10
265	SCADA / Control Systems	20 days	Fri 12/3/10	Thu 12/30/10
266	Onshore Tank Farm - Phase 2 (4 Tanks)	20 days	Wed 12/7/11	Tue 1/3/12
267	**In-Service Dates**	**263 days**	**Thu 12/30/10**	**Tue 1/3/12**
268	First Oil Movement	0 days	Thu 12/30/10	Thu 12/30/10
269	100% Capacity	0 days	Tue 1/3/12	Tue 1/3/12

Project: Texas Offshore Port System (
Date: Mon 11/10/08

Page 1

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2.2.2 Construction and Installation of Offshore Project Components

Offshore Pipelines

As shown in Figure 2.2-1, construction and installation of the Project's offshore pipeline is scheduled to begin as early as April 2010 and be completed, including testing and commissioning by early December 2010. An overview of proposed Pipeline construction and installation activities consists of the following:

- **Pre-lay surveys**: Surveys will be performed to locate existing pipeline and utility crossings and identify potential hazards. Surveys will be conducted along both the Offshore Pipeline route and the Fuel Gas Pipeline route.
- **Pre-lay pipeline lowering**: Existing, foreign pipelines that will be crossed by the proposed TOPS Offshore Pipeline will either be lowered (active pipelines) or be removed from the ROW (abandoned pipelines) to provide adequate separation between the two lines while lowering the exposed profile of the proposed TOPS Offshore Pipeline. Based on the recent hazard survey of the Offshore Pipeline corridor, as many as fifteen foreign pipelines may be encountered. Similar pre-lay pipeline lowering methods will be implemented along the Fuel Gas Pipeline route. Preliminary available information indicates that as many as three foreign pipelines may be encountered along the FGP route.
- **Pre-lay utility line crossing:** Existing utility lines that will be crossed by the proposed TOPS Offshore Pipeline route (and FGP route, if encountered) will be lowered to provide adequate separation between the two lines.
- **Pipelay – Fuel Gas Pipeline**: The sequencing of pipelay activities may vary based on the contracting of these activities. Laying of the FGP may be accomplished utilizing same vessel and S-lay method as will be used for the oil pipelines or, alternately, this smaller diameter pipeline may be laid using a reel lay method. One difference will be that the FGP will be laid dry (i.e., it will not be filled with water as part of the pipelay process).
- **Dredging, HDD, and nearshore pipelay**: The Offshore Pipeline at the shore crossing will be installed using the Horizontal Directional Drilling (HDD) method to prevent disruption to the surrounding areas. It is anticipated that the offshore HDD exit pit will be located at approximately the 18.0 foot (5.5 m) water depth contour, approximately 3,500 feet (1,067 m) offshore of the MHWM. Work will include dredging/excavation of the HDD transition trench, HDD work, and pipeline installation.
- **Pipelay:** A pipelay vessel and supporting barges will install the five crude oil pipelines (Offshore Pipeline and four Offloading Pipelines) and lay them on the seafloor.
- **Subsea tie-in spools:** The tie-in spools that connect the pipeline segments to the preinstalled risers, and the pipeline segments to the PLEMs, will be lowered and installed with the help of divers.
- **Pipeline burial:** The Offshore Pipeline, including the spool pieces, will be buried to a minimum depth of 3 feet (1 m) below the seafloor as required (10 feet [3 m] at the fairway crossing). The Fuel Gas Pipeline will also be buried to a minimum depth of 3 feet (1 m) below the seafloor as required. The four Offloading Pipelines running from the two SPMs to the Platforms (eventually six pipelines running to three SPMs to the PP) will not require

burial to the full 3-foot [1 m] depth required of the other pipeline. The Offloading Pipelines will be buried such that the top of pipe is just below the seafloor, per an agreement with MMS, as they will be located with the Project's Safety Zone.

- **Hydrotesting activities:** The crude oil pipeline system will be cleaned with a brush pig, hydrotested with filtered seawater (water inserted in the pipe during the laying activities), dewatered, and made ready for operational use and product flow. The Fuel Gas Pipeline will also be hydrotested; however, it will be tested using somewhat different methods due to its planned use as a natural gas pipeline.

A more detailed description of these various pipeline and facility construction activities including construction methods, equipment and vessels employed can be found in the DWP Application materials in Topic Report 1 "General Project Description and Location".

Offshore Platforms and SPMs

Construction and installation of the proposed Offshore Terminal and associated offshore facilities includes onshore fabrication and offshore installation of several components including the marine works (SPMs, platforms, jacket structures, personnel quarters, and operational equipment). As shown in Figure 2.2-1, fabrication of offshore platforms, SPMs and associated components is scheduled to begin in April 2009 and the installation is expected to be completed by November 2010.

It is anticipated that the installation of the offshore platforms will occur prior to installation of the SPMs, but the actual sequence will depend on when the fabricated components of the respective systems become available. The Pumping Platform likely will be installed first. Pumping Platform installation will be performed utilizing a conventional anchored or dynamic positioning (DP) derrick barge/vessel. Each jacket will be lifted from a transport barge by the crane on the derrick barge/vessel and set upright on the sea floor. The piles will be inserted inside of the jacket legs and driven down to the required penetration (approximately 400 feet [122 m]) using hydraulic or steam hammers. After the piles are driven to the design penetration, the jacket will be leveled and the jacket legs will be welded to the piles utilizing shim plates. After the welding is completed, the piles will be cut to the required elevation. The deck section will then be lifted from the transport barge and set on and welded to the pile sections. After the Pumping Platform is installed, the Quarters/Control Platform will be installed utilizing the same general procedure. Once Quarters/Control Platform is installed, the connecting bridge between the two platforms will be installed.

The SPMs and associated components will be constructed onshore at an existing fabrication facility and transported offshore for installation. They will be delivered to the site by conventional supply barge or vessel. The PLEM skids will be installed on the bottom at each SPM location by a conventional derrick barge/vessel. The PLEMs will be anchored by suction or conventional pile(s) driven to the design penetration using an underwater hammer or a "pile follower." After the PLEMs are installed, the six suction or conventional anchor piles will be installed radially around the SPM/PLEM location. After the anchor piles are installed, then the floating buoy section will be positioned over the PLEM locations and anchor chains will be installed between each anchor pile and the floating buoy. After anchor chains have been installed and tensioned properly, the two 24-inch ID subsea hoses between the floating buoy and the PLEM will be installed. The floating hose strings used for offloading the ships that are connected to the floating buoy will be installed later.

A more detailed description of platform and SPM construction and installation can be found in the DWP Application materials in Topic Report 1, "General Project Description and Location".

Tie-Ins

After the pipeline segments, platforms and SPMs are installed, then the pipeline tie-ins can be made. The tie-ins will be performed utilizing a dive support vessel (DSV) equipped with a crane capable of handing the 42-inch OD tie-in sections. The closing pipe spools that will be used to connect the pipe in the target box (located near the riser location) to the pre-installed risers on the platforms and the pre installed valve on the PLEMs will be partially pre-fabricated on shore. After final measurements are taken between the pipe in the target boxes and the pre-installed riser flange at the bottom of the jacket or PLEM flange, the closing spools will be added to or modified as necessary to fit. Five oil transmission pipeline tie-ins (with an additional two in the future when SPM No. 3 is installed) will be required at the Pumping Platform. Two oil pipeline tie-ins will required at each PLEM. The Fuel Gas Pipeline will also require a tie-in both at the Pumping Platform and the fuel gas supply point. Fuel Gas Pipeline tie-in will be performed by a natural gas pipeline tie-in contractor retained specifically to undertake this task.

Support Facilities for Offshore Construction

TOPS will utilize temporary onshore fabrication sites and contractor yards during the construction and installation of the proposed Project. Onshore fabrication sites will provide locations for onshore construction of portions of the Offshore Terminal and associated offshore facilities. Temporary contractor bases will provide support for offshore installation of the proposed Offshore Terminal and associated offshore facilities. Existing facilities in Texas and Louisiana will be used for the onshore fabrication sites and temporary contractor bases. Specific locations will be determined at a later date, but all practicable effort will be made to site these areas within previously impacted areas and outside of jurisdictional areas.

2.2.3 Construction and Installation of Onshore Facilities

Onshore Pipeline Segment

Except as noted below, the 42-inch OD Onshore Pipeline will be installed by conventional trench installation methods (please see Appendix B). A 125-foot (38-m) temporary construction ROW will be prepared by clearing, fencing where appropriate, grading, and trenching to allow for stringing/laydown of the pipeline segments. The pipeline string will then be bent, where necessary, welded together, coated, and lifted and lowered into the excavated trench. In wetlands and conventionally constructed water crossings, the proposed temporary ROW will be reduced to 85 feet (26 m). In general, the top 12 inches (30 cm) of agricultural and wetland soils will be segregated (see cross section depiction in Appendix B). Following welding and lowering of the pipeline into the trench, the pipeline will be backfilled with the excavated native material utilizing the segregated topsoil as the final material returned to the trench. HDD technology or boring also will be utilized at sites for waterway and infrastructure crossings along the onshore pipeline alignment. At crossings of existing pipelines or cables, protective concrete mattresses and/or bags of sand or cement will be used to protect and separate the structures while maintaining at least 3 feet (0.9 m) of cover.

Table 2.2-1 summarizes the proposed location and length of the proposed HDD crossings. Additional areas, including the additional public roads and some waterbodies will be crossed by boring. For detailed information on the pipeline construction and installation methods see the Project's Drawings and Figures, and the Onshore Project Execution Plan (Exhibits B and F).

Table 2.2-1 Proposed Location and Description of Horizontal Direction Drills

HDD Description	Approx. Length of Drill	Approx. Mile Post	Approx. Water Width at Crossing (feet)
Shoreline Beach HDD Entry	4,500 ft.	Offshore	3,500 offshore 1,000 onshore
GIWW Valve & Spec Break	2,200 ft.	0.2	700
Hurricane levee	1,200 ft.	1.4	150
North of hurricane levee	2,800 ft.	1.4	1,400
Old Brazos River HDD Site	2,000 ft.	4.3	600
DOW Barge Canal 1	1,500 ft.	5.4	550
Oyster Creek	2,400 ft.	9.2	150
Big Slough	1,000 ft.	12.6	150
Bastrop Bayou	1,600 ft.	15.8	200
FM 2004	500 ft.	19.1	n/a
Austin Bayou	900 ft.	19.5	150
Chocolate Bayou	2,200 ft.	27.5	750
New Bayou	1,400 ft.	30.5	50
Persimmon Bayou	1,500 ft.	32.2	50
Halls Bayou	800 ft.	34.4	80
Diversionary Canal	2,100 ft.	42.1	250
Highland Bayou	2,200 ft.	44.8	600
I-45 Road & Galveston Levee Crossing	3,000 ft.	46.0	n/a
T.C.T. Railroad Spur Crossing	2,300 ft.	46.9	n/a
Hwy 3 Interchange Crossing	1,400 ft.	47.4	n/a

Onshore Texas City Crude Terminal

The construction of the onshore Texas City Crude Terminal will start immediately after the licensing of the DWP. A newly constructed crude oil storage terminal will be constructed in Texas City consisting of seven external floating roof tanks, six with a storage capacity of 600,000 barrels and one with a storage capacity of 300,000 barrels. At least three of the planned seven, 600,000 bbl storage tanks will be complete by the time the pipelines are installed and are ready for testing and commissioning. A DA permit has been obtained for a portion of the existing tank terminal site in Texas City (DA Permit 23405 and subsequent amendment 23405(01)).

Support Facilities for Onshore Construction

TOPS will utilize existing fabrication yards, equipment laydown sites, existing access roads, staging areas, and other necessary construction spaces to the maximum extent practicable. Details of temporary construction and installation impacts associated with the Project are detailed in Section 4.0. TOPS will make all practicable efforts to avoid and minimize impacts to wetlands and other sensitive habitats as detailed in Section 3.0.

2.2.4 Pipeline Testing and Commissioning

The USDOT requires all newly installed offshore oil pipelines to be hydrostatically tested at a stabilized pressure of at least 1.25 times the Maximum Allowable Operating Pressure (MAOP) for at least eight (8) hours prior to operational service. The yard fabricated & installed risers, and the yard fabricated tie-in spool pieces, will be hydrostatically tested at a stabilized pressure of at least 1.25 times the MAOP for a period of not less than four (4) hours. A successful test will confirm that there are no existing leaks in the line, and it is indeed safe for product flow. The testing of the prefabricated components will take place at the fabrication facility.

During detailed design, a hydrostatic testing plan will be developed that will identify the number and location of the specific pipeline test sections. After the pipelines are installed, they will be pigged and hydrostatically tested in segments. The Offshore Pipeline will be tested from the FVS to the Pumping Platform. The Offloading Pipeline pairs will be tested using the pigging loop, first with one pipeline from the Pumping Platform to the PLEM and then with the second pipeline tested from the PLEM to the Pumping Platform. The Onshore Pipeline and Texas City Crude terminal will be hydrostatically tested separately.

Offshore Hydrostatic Testing

The hydrostatic testing and dewatering process for the Offshore Pipeline and Offloading Pipelines will be conducted as follows:

- As noted previously, the 5,500 foot (1,676 m) HDD segment will initially be laid dry. Prior to pull-back it will be filled with filtered seawater, hydrostatically tested, gauged and dewatered. It is not anticipated that treatment chemicals (e.g., corrosion inhibitors, biocides, or oxygen scavengers) will be added to the filtered seawater as the pipeline filled. It is expected that approximately 390,000 gallons of seawater will be dewatered from the pipeline segment at an approximate discharge rate of 3,900 gallons per minute (gpm), with the discharge occurring in the general vicinity (approximately 150 ft [46 m] south) of the offshore HDD exit pit.

- The remaining offshore pipeline segments (the Offshore Pipeline and the Offloading Pipelines) will be installed “wet”. These pipelines will be hydrostatically tested using the initial fill water as a testing medium; the injection of corrosion inhibitors, biocides, or oxygen scavengers into the fill water is not envisioned at this time.

- Whether the Offshore Pipeline or the Offloading Pipelines will be laid first will ultimately be determined based on logistical considerations at a latter point in the design. The sequencing in the evaluation that follows assumes that the Offloading Pipelines will be laid first, followed by the laying of the Offshore Pipeline.

- The Offshore Pipeline will be installed from north to south (from the HDD tie-in point to the target box north of the PP). The Offloading Pipelines will similarly be installed from target boxes near the respective PLEMs to target boxes near the PP. The onshore component to the FVS would be constructed at some point in time during the Offshore Pipeline installation process (likely after completion of HDD pullback). Once construction of the Pumping Platform and the installation of the PLEMs have been completed, the offshore tie-ins will be completed, as will the lowering of the Offshore Pipeline.

- With the completion of all tie-ins, the Offshore Pipeline will be one complete pipeline from the FVS to PP risers and the Offloading Pipelines will be completed looped pipeline pairs from the PP to the respective SPM PLEM. Filtered seawater will be added to the Offshore Pipeline at the PP in order to fill the final 0.68 mile (1.09 km) long on-shore segment of the pipe from the MHWM to the FVS.

- The 35-mile (56-km) Offshore Pipeline then will be tested, as will the each of the 4,000-foot (1,219 m) long Offloading Pipeline segments.

- Post hydrostatic testing dewatering of the Offshore Pipeline and Offloading Pipelines will be performed using pressurized oil originally inserted at the Texas City Crude Terminal location. Oil will be routed from the crude terminal through the Onshore Pipeline Segment No. 2 and Onshore Pipeline Segment No. 1, arriving at the FVS. A pig will be installed at the FVS and the pressurized oil force the pig through the Offshore Pipeline, displacing approximately 13.3 million gallons (MG) of seawater from the pipeline, and resulting in a discharge at the Pumping Platform. Oil will continue to be forced through the Offshore Pipeline, until it is completely dewatered. The discharge of 13.3 MG of seawater will be allowed to cascade over the side of the platform cellar deck, to provide for aeration as it drops to the water surface below. The estimated discharge rate will be approximately 3,900 gpm.

- Oil then will also be used to dewater the Offloading Pipeline loops. Approximately 0.61 MG of seawater will be discharged at the Pumping Platform in association with the dewatering of the loop to SPM No. 1 and a similar quantity for the dewatering of the loop serving SPM No. 2.

- At a future time (once constructed), a similar process would be conducted for the SPM No. 3 Offloading Pipeline loop.

TOPS does not plan to use treatment chemicals (e.g., corrosion inhibitors, oxygen scavengers, biocides, etc.) during the initial flooding of the pipeline. A filter train will be installed in the open end of the pipeline prior to placing the pipeline in the water. These filters will prevent debris, sediment and larger aquatic organisms from entering the pipeline.

The Fuel Gas Pipeline will be tested independently from the various crude oil pipelines. The pipeline will be filled with filtered seawater (approximately 0.55 MG) in the vicinity of the PP, tested and then dewatered from BR 538 towards the PP, with the discharge occurring at the PP. The discharge rate is expected to be approximately 160 gpm. It is not anticipated that treatment chemicals will be used associated with the hydrostatic testing of the FGP.

Onshore Hydrostatic Testing

The hydrostatic testing and dewatering process for the Onshore Pipeline and Texas City Crude Terminal will be conducted as follows:

- The Onshore Pipeline from the Texas City Crude Terminal to the FVS will be filled with filtered water from the GIWW. It is anticipated that approximately 18.8MG of brackish water will be drawn from the GIWW. Once the hydrostatic testing is complete the water will be returned to the GIWW at a controlled rate so as not to contribute erosion or affect navigation on the GIWW.

- The Texas City Crude Terminal will be filled from a local source immediately adjacent to the existing tank facility. This existing pond was excavated in the construction of the hurricane protection levees and has been used in prior hydrostatic testing for the existing tanks on the site. A detailed procedure for the hydrostatic test is currently being formulated.

TOPS does not plan to use treatment chemicals (e.g., corrosion inhibitors, oxygen scavengers, biocides, etc.) during the hydrostatic testing of the pipeline. A filter will be installed in the open end of the pipeline prior to placing the pipeline in the water. This filter will prevent debris, sediment and larger aquatic organisms from entering the pipeline.

2.3 Operations

Once construction of the proposed Offshore Terminal and associated offshore facilities is complete, TOPS will establish an onshore office that will serve as an operations center for communication, personnel deployment, and other operations activities necessary to support the proposed Project. The onshore operations center will be located on the upper Texas coast. TOPS intends to use an existing facility for the onshore operations center.

For the purposes of this report, Port operations will be categorized into several operating areas, including transportation, docking, crude oil transfer, crude oil transmission, and safety, as described below. Some operations within these categories likely overlap with other categories. The normal operations and maintenance (O&M) compliment will be approximately 16 positions on a rotational schedule, employing approximately 35 people.

2.3.1 Crude Oil Transportation (Shipping)

Crude oil will be transported from its source (likely overseas) in vessels designed to carry crude oil that have been constructed in accordance with all applicable (MARPOL, etc.) standards. To use the proposed Port, all vessels will be required to meet the Port’s standards for safety and environmental protection, which will be detailed in the Port’s Operations Manual contained in the DWP application.

Crude oil carriers will vary in size, capacity, draft, and other physical characteristics. The expected maximum sizes for these attributes are included in Table 2.3-1.

Table 2.3-1 Expected Maximum Sizes of Crude Oil Vessels

Attribute	Expected Maximum							
	ULCC		VLCC		Suezmax		Aframax	
	SI Units	U.S. Customary	SI Units	U.S. Customary	SI Units	U.S. Customary	SI Units	U.S. Customary
Length Overall	384.0 m	1,260 feet	345.9 m	1,135 feet	274.3 m	900 feet	237.7 m	780 feet
Beam	63.7 m	209 feet	56.7 m	186 feet	47.9 m	157 feet	38.1 m	125 feet
Depth	35.0 m	114.5 feet	30.0 m	98.4 feet	24,4 m	80 feet	21.4 m	70 feet
Draft Loaded	24.7 m	81 feet	24.1 m	79 feet	16.2 m	53 feet	14.3 m	47 feet
Cargo Capacity	305,280 to 559,680 m^3	1,920,000 to 3,520,000 bbls	203,520 to 325,632 m^3	1,280,000 to 2,048,000 bbls	122,112 to 183,168 m^3	768,000 to 1,152,000 bbls	80,454 to 122,112 m^3	506,000 to 768,000 bbls
Power	40,000 kW	53,640 hp	35,000 kW	46,935 hp	17,000 kW	23,797 hp	14,000 kW	18,775 hp
Deadweight	304,814 to 558,826 tonnes	300,000 to 550,000 Ltons	203,209 to 325,135 tonnes	200,000 to 320,000 Ltons	121,926 to 182,888 tonnes	120,000 to 180,000 Ltons	80,268 to 121926 tonnes	79,000 to 120,000 Ltons
Gross Tonnage (Regulatory)	250,000 tons		170,000 tons		90,000 tons		60,000 tons	
Net Tonnage (Regulatory)	200,000 tons		150,000 tons		52,000 tons		35,000 tons	

Note: Numbers listed are estimates.

2.3.2 Docking at Terminal / Anchoring

The Port and the USCG will require that crude oil carriers serving the proposed Offshore Terminal adhere to all requirements set forth by the International Maritime Organization (IMO). TOPS and the USCG also will require that all crude oil carriers arriving at the proposed Offshore Terminal comply with current USCG anti-pollution and other applicable requirements.

VLCCs, ULCCs, Aframax, and Suezmax vessels will approach the proposed Offshore Terminal in GA A56 at an appropriate speed of less than three knots. Refer to Figure 2.3-1 for a depiction of proposed vessel approach routes.

The vessels will arrive and either go to an available SPM for offloading or will be anchored within the anchorage area. The time a vessel will stay in anchorage will depend on how many ships are scheduled in front of it. The time it takes for a ship to moor and unmoor to and from a SPM is approximately four hours for each occurrence.

Vessels that proceed to a mooring immediately upon arrival at the Offshore Terminal must allow the Mooring Master, Assistant Mooring Master, Deck Watch, and Oil Inspectors to board. The Port furnished equipment will be picked up by the vessel prior to entering the Safety Zone.

During the mooring operation, including transit of the approach and terminal sections, the Mooring Master and the Assistant Mooring Master perform the following functions:

- The Mooring Master advises the tanker's Master on operational and ship control matters and requirements that are peculiar to the port, such as navigational aids, depth of water and current characteristics of the maneuvering area during existing conditions, mooring equipment and procedures, emergency towing procedures, and the Port's vessel control procedures. The Mooring Master will maintain communications with the Vessel Traffic Controller, mooring launches and the Assistant Mooring Master until the mooring operation has been completed.

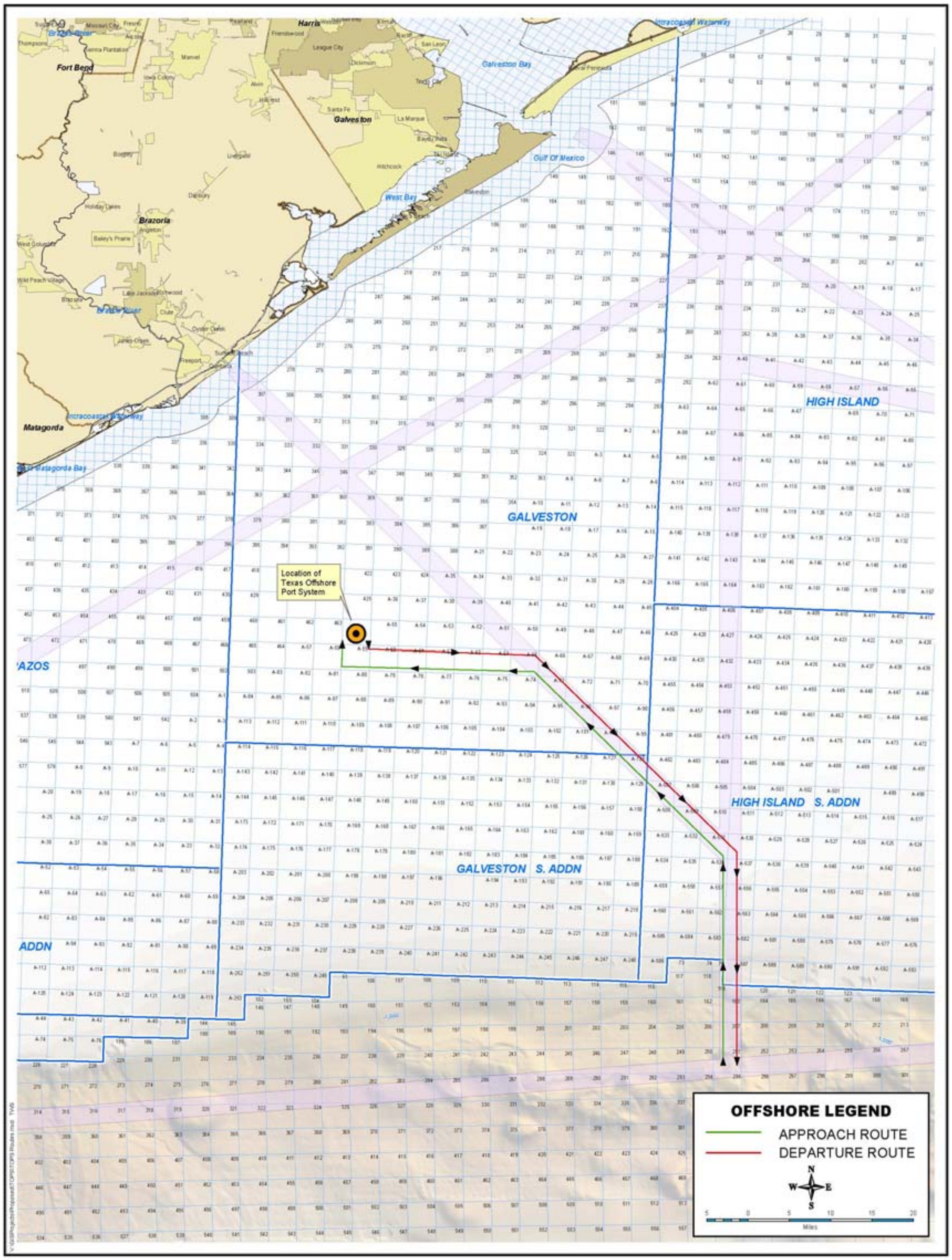
The proposed SPMs will be designed to offload one vessel at a time in approximately 24 to 36 hours. While one vessel is offloading, another will be mooring at the free SPM. When a buoy becomes available, the vessel with the earliest Firm Arrival Window will be moored. Simultaneous offloading at two SPMs will be possible, but will only occur if the crude products in the two carriers are compatible.

As discussed in Section 2.1.2, TOPS will establish an Anchorage Area to the south of the proposed Offshore Terminal to provide for safety and continuity of operations (see Figure 2.2-1). The Anchorage Area will accommodate approximately four anchored ships, and will be designated as a 2.25-mile (3.62-km) by 2.25-mile (3.62-km) (3,240 acres [1,311 ha]) area south of the proposed Offshore Terminal. Vessels will be encouraged to utilize this Anchorage Area unless they are proceeding directly to moor upon arrival. If more than four ships need to anchor while waiting on for a free buoy, they will be able to anchor at their risk outside of the Safety Zone. While vessels are at anchor in the Anchorage Area, a competent deck officer shall be stationed at all times on the bridge to watch for any dragging of the anchor which can be detected by taking radar ranges or rounds of bearing as necessary on the pumping platform or on any other fixed objects.

Vessels proceeding directly to the Anchorage Area will be able to proceed into the Anchorage Area without a Mooring Master on board. Vessels proceeding from the anchorage area to the Offshore Terminal for offloading will be required to embark the Mooring Master before proceeding to the SPM.

In order to minimize the potential for vessels to be delayed during the mooring, offloading, and unmooring process, arrivals and departures of crude carrying vessels will be pre-scheduled.

Figure 2.3-1 Proposed Vessel Approach Routes



2.3.3 Offloading

The SPMs will be designed to offload ULCCs, VLCC, Aframax, and Suezmax vessels. ULCCs and VLCCs will typically be offloaded at an average rate of 80,000 BPH and a maximum rate of 100,000 BPH. The smaller Aframax and Suezmax vessels will typically be offloaded at an average rate of 30,000 BPH and a maximum rate of 45,000 BPH.

Pumping rates from the carriers will be highest (near maximum) when the oil storage compartments being offloaded are relatively full and will decrease (i.e., pumping will be slowed) as a compartment empties and crude oil levels drop. Pumping rates from a vessel will be lowest during stripping operations, which occur when a vessel completely empties a compartment.

The SPMs will be equipped with two flexible floating offloading hoses, which will extend from the floating buoy outward to be retrieved by crude carriers during loading operations (refer to Appendix 1.A, Figure 1.A-2). The vessels will moor to the buoy with help from an assist boat and the offloading hose also will be maneuvered into position by an assist boat so the vessel can lift and attach the hose to the ship's manifold.

The crude oil will be transferred from the crude carrier through the two flexible floating offloading lines to the SPM. From the SPM the oil will flow through two 24-inch ID subsea hose strings which will run from the SPM down to a PLEM located on the sea floor. The PLEM of each SPM will be connected to two 42-inch OD pipelines, which will run in parallel the approximate 4,000-foot (1,219-m) distance from the PLEM to the Pumping Platform.

At the Pumping Platforms a set turbine pumps (six pumps plus one spare) will boost the pressure of the crude from approximately 60 psig up to 1,950 psig and will route the pressurized oil through the Offshore Pipeline towards shore. As much as 100,000 BPH of oil will flow through the Offshore Pipeline to the FVS and into the Onshore Pipeline until it reaches the Onshore Pump station. At the Onshore Pump Station similar booster pumping equipment will again boost the oil pressure in order to route as much as 100,000 BPH on to the Texas City Crude Terminal.

2.3.4 Pipeline Operations

Pipeline facilities will be operated and maintained in accordance with requirements of the DPA and the USDOT, as applicable, and other industry-proven practices and techniques. In addition to the inspection and surveillance protocols outlined for the Offshore Project components, the onshore operations will include inspection and surveillance as detailed in an Operations Manual and a Facility Response Plan (FRP) being developed for the Project (please refer to Appendices in the DWP License application). Operation of the pipeline also includes proper identification and signage for the Onshore Pipeline and facilities. Operational responsibilities will include:

- Operating the pipeline safely to provide the required oil flow;
- Inspecting and maintaining pipelines (see DWP application materials, Topic Report 11, "Safety and Reliability"); and
- Maintaining the proper required administrative records.

Design and construction criteria will be incorporated to enhance the system's ability to withstand natural phenomena and accidents. In areas of known potential for subsidence, pipeline construction, operation and maintenance procedures will be designed to maximize stability and to minimize the possibility of damage (at the date of this application, these measures are not anticipated). Combustible and hazardous materials will be stored and handled in the manner prescribed by applicable codes and regulations.

2.3.5 Utility Systems

Offshore utilities

The offshore components of the proposed Project will incorporate the necessary utility systems for each platform to be nearly self-sufficient. However, there will be some utility systems that will be shared between the adjacent platforms to be located in Block GA A56. Details of power generation and distribution, fuel gas systems, drains and oily waste collection and treatment, service and fire water, potable water, sewage treatment, instrument and utility air, emergency shutdown, and communications systems for the offshore facilities can be reviewed in the DWP application's Topic Report 1, "General Project Description and Location".

Onshore utilities

The onshore component of the Project will utilize existing utility infrastructure where possible. Necessary utility service at the FVS will be limited to electrical service, which is available in the vicinity of the Project. The Booster Pump Station will require electrical, water, and waste systems. Design details of the pump station are being addressed, but it is anticipated that these services will be locally available given the proximity to existing infrastructure along FM 2004.

2.3.6 Safety

TOPS has a comprehensive safety program to meet the varying requirements of USDOT, USCG, MMS, and OSHA. This program is set forth in the Operations Manual being developed for approval by the USCG prior to operation of the DWP. TOPS safety program includes life support systems for the crew, fire control and emergency shutdown systems, spill prevention and response measures, procedures for the testing, inspection and protection of the pipelines, security, and aids to navigation, and procedures for the transit, maneuvering, mooring, and offloading of vessels. Site specific FRPs are being developed for the Offshore and Onshore operations that will address issues related to spill prevention, detection, and response.

2.4 Future Plans

The Offshore Terminal is designed with the option to install a third SPM in the future when crude oil volumes exceed 1.2 MMBOPD. Installation of two additional 650,000 bbl tanks will be required at the onshore Texas City Crude Terminal to accommodate the increase in crude oil supplies provided by third SPM. Although TOPS currently does not plan to construct a fourth SPM, the layout of the facility has been designed such that future expansion beyond the third SPM will be possible.

2.5 Decommissioning

Offshore Facilities

The Offshore Terminal and associated onshore and offshore facilities ultimately will be decommissioned. Decommissioning will include the removal of all structures above the seabed from the site. Structures will be transported in accordance with applicable government regulations for recycling or disposal. Offshore pipelines will be flushed and cleaned until there are no hydrocarbons present and the pipelines will be abandoned in place in accordance with MMS and Texas RRC requirements. MMS requires that the pipelines be severed 150 feet (45.7 m) away from the platform and that the severed end be plugged and buried. This will be accomplished at each SPM location and each platform location by removing the closing spools at each end of the 42-inch OD pipelines, installing "plumber's plugs" in each end and jetting the ends of the pipeline down 3-feet below the mud line. The Texas RRC will allow abandonment in place in Texas State Waters and onshore as long as the pipeline is free of hydrocarbons and chemicals and the ends are plugged. Details of the DWP decommissioning can be found in the DWP application, in Topic Report 1, "General Project Description and Location".

Onshore Facilities

The Onshore Pipeline and facilities have an anticipated operational life of approximately 40 years. Upon cessation of use, the pipeline and onshore facilities, including the FVS and Booster Pump Station, will be decommissioned. The removal and disposal of the facilities will be done in accordance with Texas Railroad Commission requirements and applicable waste management requirements for recycling and/or disposal. Surface facilities constructed in wetlands will be cleared and restored to surrounding marsh elevations. The 42-inch OD pipeline at the onshore FVS, Onshore Pump Station and onshore Texas City Crude Terminal locations will be cut and plugged 3.0 feet (0.9 m) below the ground elevation when these facilities are decommissioned.

2.6 Alternatives

TOPS has analyzed thoroughly the alternatives to building the Texas Offshore Port System Project, including 1) not building the facilities and taking no action to meet U.S. energy demands; 2) using energy alternatives to oil; 3) practicing energy conservation; and 4) relying on other sources of oil to meet the increasing demand for energy supplies in the U.S. TOPS also has evaluated systems alternatives, Offshore Terminal locations, Offshore Pipeline routes, Onshore Pipeline routes, and alternative sites for onshore facilities. Based on a very thorough analysis, TOPS has determined that oil imported to an offshore port at the proposed location (GA A56), with a pipeline to shore near Freeport, Texas, would be the preferred overall alternative for importing crude oil to meet the specific customer demands and to help meet U.S. energy demands. In addition, the TOPS project will result in a reduction of environmental impacts and the potential for spills due to reduction of lightering operations. The analyses used to reach this conclusion are addressed in detail in the following sections.

2.6.1 No-Action Alternative

The EIA's Annual Energy Outlook 2007 forecasts that annual consumption of liquid fuels and other petroleum products will increase from 20.7 million barrels per day in 2007 to 22.8 million barrels per day in 2030 (EIA, 2008). According to the EIA, in 2007 the U.S. depended upon foreign imports for approximately 10 million BOPD. An expected decline in inland production likely will be offset by an expected increase in GOM production in the short-term; therefore, reliance upon foreign crude will continue into the foreseeable future. Despite plans to build pipelines to transport Canadian oil sand production to meet part of this need, a significant portion of this U.S. Gulf demand is going to be met through seaborne trade. Planned refinery expansions and normal incremental refinery capacity creep are projected to add between 415 and 515 thousand barrels per day of incremental crude oil distillation capacity over the next four years to the U.S. Gulf Coast.

The No-Action alternative is defined as no action being taken as a preference to the Proposed Action. Under the circumstances described above, the No-Action alternative would deprive the U.S. of a port capable of receiving oil for redelivery to domestic markets and could adversely affect the ability of the U.S. to meet the projected demands for oil.

With respect to adverse environmental impacts, the No-Action alternative would eliminate the construction of the proposed Port and would eliminate all associated environmental and economic impacts and benefits altogether. The No-Action alternative likely would result in either an increase in lightering and its associated impacts, or another port being built at another location, possibly with fewer environmental benefits than those associated with the proposed Project and would not accomplish the stated purpose and needs for the project. If supplies were not available from offshore terminals such as this DWP proposed by TOPS, refineries seeking to use more oil would obtain it through more conventional sources such as lightering. TOPS maintains that its proposed DWP will have significantly less environmental impact than lightering while providing crude oil at an extremely competitive cost. It would eliminate the need for over 2000 lightering transits annually. Each ULCC or VLCC would be offloaded in one operation, as opposed to up to eight cargo handling operations for lightered vessels (approximately four lightering offloadings at the tanker, with a subsequent dockside offloading associated with each lightering operation). Air emissions associated with offloading would occur further offshore while air emissions associated with lightering transits to shore and the associated emissions from dockside cargo transfer would be essentially eliminated. These emissions reductions are especially important in areas in non-attainment status for ozone standards. Incremental reductions also can be expected in oil spills and marine mammal and reptile collisions. Furthermore, TOPS likely would be subject to fewer operating restrictions since it can operate within a wide spectrum of weather conditions and is not limited to daylight operations.

In short, the Proposed Action is needed to increase the reliability of the energy market, as specified by the White House's National Energy Policy Development Group (NEPDG 2001), and it is needed to maintain the oil import component of national energy security (Downs 2006). For these reasons, No Action is not a preferred alternative to the Proposed Action.

2.6.2 Energy Conservation

In general, energy conservation and some energy alternatives may be options for reducing projected demand for oil in the U.S.; however, these alternatives are not practical to the proposed action.

The demand for additional oil supplies have been identified (EIA 2006), and the proposed Port has been designed for the specific purpose of meeting part of the projected demand. The use of energy conservation as a means to meet the demand for oil is viable only as a partial long-term way to slow the increase in the need for oil. Thus, the demand for increased supplies of oil would continue even if additional energy conservation measures were implemented. Moreover, the use of energy conservation as even a partial solution to oil supply shortages would involve large-scale public education efforts, significant incentives, and governmental intervention. This process of implementing energy conservation measures would take years to complete and, even if successful, would only partially offset the demand for increased oil supplies. For these reasons, energy conservation is not a preferred alternative to the Proposed Action.

The proposed project is designed to meet the specific needs of downstream customers for a specific commodity (oil) used to produce fuels (e.g., fuel oil, diesel, and gasoline) or to provide feedstock for other processes (e.g., production of plastics and chemicals). These fuels and feedstocks have been developed as integral parts of the U.S. infrastructure and economy. While over the long term (decades), the infrastructure and economy could adjust to the use of some alternatives to petroleum, in the short and mid term, alternative energy sources would not meet the specific needs provided by petroleum; therefore, they would not be a practical alternative to the Proposed Action. However, together with oil, these alternative energy sources could contribute to meeting the overall future energy needs of the U.S.

Electricity

Electricity primarily is a second-tier energy source, meaning that electricity is generated from first-tier energy sources, such as hydropower, natural gas, coal, oil, nuclear power, wind power, geothermal power, and solar power. For this reason, by itself, electricity is not a viable option for meeting the immediate and specific needs of potential customers of the TOPS Project, particularly those who already have liquid-fueled equipment or need the hydrocarbon feedstock. To meet future electric power needs, additional electrical power generation will be required, as well as the use of additional oil and other fuels to power the generation facilities. Projects such as the one currently proposed by TOPS are needed to supply the required fuels. Thus, rather than being an alternative to this project, future electric generation would depend on the TOPS Project as a source of fuel.

2.6.3 System Alternatives

In alignment with the purpose and need, this alternatives analysis will focus on methods to bring crude oil to the upper Texas Gulf Coast.

System alternatives to the proposed project include other potential means of transporting crude oil supplies to upper Texas Gulf Coast refineries. Alternatives were evaluated to determine whether oil supplies to these refineries could be provided by means other than building the proposed DWP. It should be noted that the refineries with which service has been contracted also had the opportunity to review systems alternatives before selecting this Proposed Action. The system alternatives considered by TOPS include:

- Using existing or expanded marine facilities along inland waterways of the upper Texas Gulf Coast;
- Constructing additional marine facilities along the upper Texas Gulf Coast;
- Using existing or proposed onshore pipeline systems to deliver crude oil to the upper Texas Gulf Coast.

These alternatives were determined to be not feasible due to the lack of available capacity, lack of adequate delivery options, potential difficulties in considering new onshore facilities, and potential difficulties with commercial agreements, preclusive site conditions, or potentially adverse environmental impacts.

Increased Lightering/Dock-side Alternative in Port Arthur

Construction of a new crude oil dock in the Sabine-Neches ship channel was evaluated as an alternative means of providing the necessary crude oil supply to Beaumont and Port Arthur areas refineries. For the crude oil dock to be a reasonable alternative to the proposed Project, it would have to be serviced by a higher number of smaller vessels (i.e. Aframax and Suezmax) and/or vessels of larger size (i.e., ULCCs and VLCCs).

The size of crude carrier ships that could use new or expanded docking facilities near Port Arthur would be limited by the shallow water depths of the Sabine-Neches ship channel, which is not deep enough to service ULCCs and VLCCs. Additional lightering would be required to provide increased quantities of crude oil to area refineries requiring additional marine traffic on the Sabine-Neches ship channel. The Motiva Refinery in Port Arthur has announced that it would increase its capacity by 325,000 BOPD. TOPS has contracts in place to provide 725,000 BOPD, which includes the contract for the increased capacity at the Motiva Refinery. Based on projected needs of Port Arthur area refineries, construction of TOPS will alleviate the need for 238 shuttle tanker trips and many of their associated impacts per year (HDR/Shiner Moseley 2008).

To provide the additional required crude oil by lightering, ULCCs, which can carry up to approximately 3.5 million barrels of oil, and VLCCs, which can carry up to approximately 2.0 million barrels, would offload their crude oil cargo to smaller vessels (i.e. Aframax and Suezmax) capable of using the Sabine-Neches ship channel and the docking facilities. Anywhere from five to seven smaller vessels are needed to completely offload one ULCC, and three or four smaller vessels are needed to completely offload one VLCC. The smaller vessels then would transport their crude oil cargo to the new dock.

Because multiple small vessels are required to completely lighter each ULCC or VLCC, the lightering of these large vessels to smaller vessels would lead to increased small vessel traffic between the offshore lightering zones and the onshore crude oil dock. Increased vessel traffic likely would increase the potential for more adverse impacts to the surrounding environment than construction of the proposed Port in GA A56.

For adequate supply to be offloaded, an increased number of vessels would need to be able to move in and out of the ship channel without delay. Any restriction, including daylight transit restrictions, vessel congestion, channel limitations and weather delays, on shipping would slow the transit, docking and offloading process and otherwise decrease efficiencies to the point the alternative docking facilities would not be able to receive and provide the needed volumes of crude oil. Moreover, the vessel congestion in the Sabine-Neches Ship Channel is expected to only increase in the future.

In addition to the direct problems inherent in using new or expanded docking facilities to provide additional supplies of crude oil to Beaumont and Port Arthur area refineries, use of this alternative would satisfy only a portion of the Project’s stated Purpose and Need, and preclude the proposed supply of additional volumes of crude oil to other regions of Texas. An alternative means of supplying the needed crude oil to other refineries in the region to meet demand would be necessary.

Increased Lightering/Dock-side Alternative in Texas City

An alternative means of supplying additional crude oil to the Houston/Texas City refinery region to meet demand would require new or additional dock facilities in Texas City. Similar to constructing dock-side facilities in Sabine-Neches ship channel, constructing dock-side facilities in Texas City would satisfy only a portion of the Purpose and Need. Shipping directly to these docks would involve the same inherent disadvantages that would be associated with direct shipping to a new or expanded dock in the Port Arthur area (see above). Lightering of ULCCs and VLCCs to smaller vessels would be necessary. As addressed above, lightering of large crude oil vessels to smaller vessels would lead to increased vessel traffic between offshore lightering zones and onshore crude oil docks/terminals, thus increasing shipping volume in an area where shipping already is congested.

In summary, adverse environmental and safety impacts associated with the expansion of existing docking facilities or construction of new docks at both Port Arthur and Texas City to receive crude oil directly from ships, along with the associated increased shipping traffic and shipping congestion, would have a significant potential to be greater, overall and would not allow the environmental benefits to be realized. Furthermore, facilities at both locations would be required to satisfy the Purpose and Need of the Proposed Action, which would be prohibitively expensive. For these reasons, TOPS does not consider the construction of onshore crude oil docks to be a reasonable system alternative to the Proposed Action.

2.6.4 Facility Design Alternatives

The design of an oil port facility could influence how it affects environmental resources during its construction and operation. Depending on its design, an oil port facility could variously affect land use, alter or replace hundreds of acres of plant and wildlife habitat, increase air emissions, affect surface water and groundwater resources, disturb cultural resources, affect local economies, affect soils, and affect public safety or the public's perception of their safety. Because facility design can affect environmental impacts, several alternative designs were analyzed for the proposed Port.

The limiting criteria for the design of the oil Port include the following:

- Ability to offload crude oil tankers;
    - Up to 3.5 million barrels of oil per vessel;
    - At a minimum water depth of 110 feet (33.5 m);
    - At a maximum rate of at least 100,000 barrels of product per hour;
- Ability to segregate crude oil grades;
- Dedicated storage tanks onshore to accept deliveries from the Port;
- Direct pipeline from the offshore Port terminal to the onshore tank farm;
- Interconnect with existing and proposed pipeline infrastructure and other design criteria as specified in Exhibit L, "Design Basis".

TOPS evaluated both land-based and offshore designs relative to the ability to meet these criteria and deliver crude oil economically and efficiently to the largest number of area refineries/terminals. The evaluation included other factors, as well, such as public perception and permitting issues, potential environmental impacts, safety, and reliability.

2.6.5 Offshore Terminal

Construction of a new offshore crude oil terminal was evaluated as a means to meet the criteria for the design of the oil port. This facility type was found to meet the criteria previously described while minimizing environmental and safety impacts. In addition, this facility type provides for greater efficiency related to offloading and transporting oil imports and the versatility to offload oil from multiple types of ships without lightering. Because lightering is not required for TOPS, the potential for environmental impacts from spills are expected to be reduced. The operation of this alternative should also reduce future ship traffic congestion due to the ability to offload ships offshore without the need for lightering operations. The construction of an offshore terminal was also determined to reduce the potential for adverse socioeconomic effects and avoid the constraints associated with siting a new facility onshore. In addition, an offshore terminal prevents or greatly reduces the potential for environmental impacts, including air emissions during unloading, oil spills, and noise. By reducing the current level of lightering, a reduction in existing onshore environmental impacts is expected. Construction of TOPS will alleviate the need for additional shuttle tanker trips and many of their associated impacts per year (HDR/Shiner Moseley 2008). For these reasons, this alternative was selected as the preferred alternative.

2.6.6 Facility Siting Alternatives

Multiple facility siting alternatives have been evaluated for constructing new offshore facilities to meet the Project needs. Sites have been evaluated for a minimum depth of 110 feet, the presence of bathymetric, geologic and oceanographic constraints (particularly bottom type, geologic features, underwater obstructions, magnetic anomalies, etc.), distance to shore, distance to onshore storage and pipeline sites, MMS Block lease status (leased or unleased), relationship to shipping fairways and designated anchorage areas, space constraints and navigability, relative availability of fuel gas, and proximity to refineries requiring waterborn imports of crude oil. These alternatives included the following:

- HIA 130: This alternative was identified to assess the feasibility of siting an offshore terminal offshore from Texas City.

- GA 427: – This alternative was identified to evaluate an offshore terminal location nearer to shore than other options. The location was originally based on existing mapping data that indicated the limits of the 110 ft. MSL depth contour.

- GA A59 (Alternative A): This alternative was identified to evaluate a deeper location with minimal crossings of foreign pipelines and shipping fairways required for construction of fuel gas supply and main oil export pipelines.

- GA A36 (Alternative B): This alternative was identified to evaluate a location nearer to landfall than Alternative A with minimal crossings of foreign pipelines and shipping fairways required for construction of fuel gas supply and main oil export pipelines.

- GA A56 (Preferred): This location was identified to evaluate a location nearer to landfall than Alternative A with minimal crossings of foreign pipelines and shipping fairways required for construction of fuel gas supply and main oil export pipelines.

Figure 2.6-1 depicts the location of these preliminary sites that were considered. Table 2.6-1 provides a matrix of data used to compare each of the alternatives. The conclusions of the assessment for each of the alternative terminal locations are summarized below:

- HIA A 130: This alternative was initially considered and determined to be not feasible for commercial and environmental reasons. This alternative would have involved constructing new pipelines to Port Arthur tying in to the existing CHOPS pipeline to Texas City. However, the existing CHOPS pipeline consists of a single 24-inch diameter pipe determined to be insufficient to handle the volume of product necessary to meet the purpose and need of the project to deliver its supply of crude oil to the upper Texas Gulf Coast. It was also considered whether the Port Arthur Crude Oil Express (PACE) pipeline could be utilized, but this pipeline is a one way system moving product away from the target refinery locations. In this case, the PACE pipeline would have to be made bi-directional or have a parallel line installed.

- GA 427: – This alternative was initially considered, but hazard survey results demonstrated that the depth at the terminal location for this alternative was too shallow to meet the minimum project criteria. Therefore, this alternative was determined to be not feasible and was not carried forward.
- GA A59 (Alternative A): This alternative was determined to meet the target siting criteria. The potential for environmental impacts related to the construction of the offshore platform facility was similar to the alternative locations in GA A56 and A36, which are described below, but the overall potential for environmental impacts related to construction was greater than that required for the alternative located in GA A56, due to the longer offshore pipeline length required. Also, considerable added expense would be required to construct the longer pipeline associated with this alternative.
- GA A36 (Alternative B): This alternative was determined to meet the target siting criteria. The potential for environmental impacts related to the construction of the offshore platform facility was similar to the alternative locations in GA A56 and A59, which are described below, but the overall potential for environmental impacts related to construction was greater than that required for the alternative located in GA A56, due to the longer pipeline length required. Also, considerable added expense would be required to construct the longer pipeline associated with this alternative.
- GA A56 (Preferred): This alternative was determined to meet the target siting criteria and its location resulted in the shortest distance for the onshore approach of the locations that were at an acceptable depth. The potential for environmental impacts related to the construction of the offshore platform facility was similar to the alternative locations in GA A59 and A36, which are described below, but the overall potential for environmental impacts related to construction was reduced, due to the shorter pipeline length required.

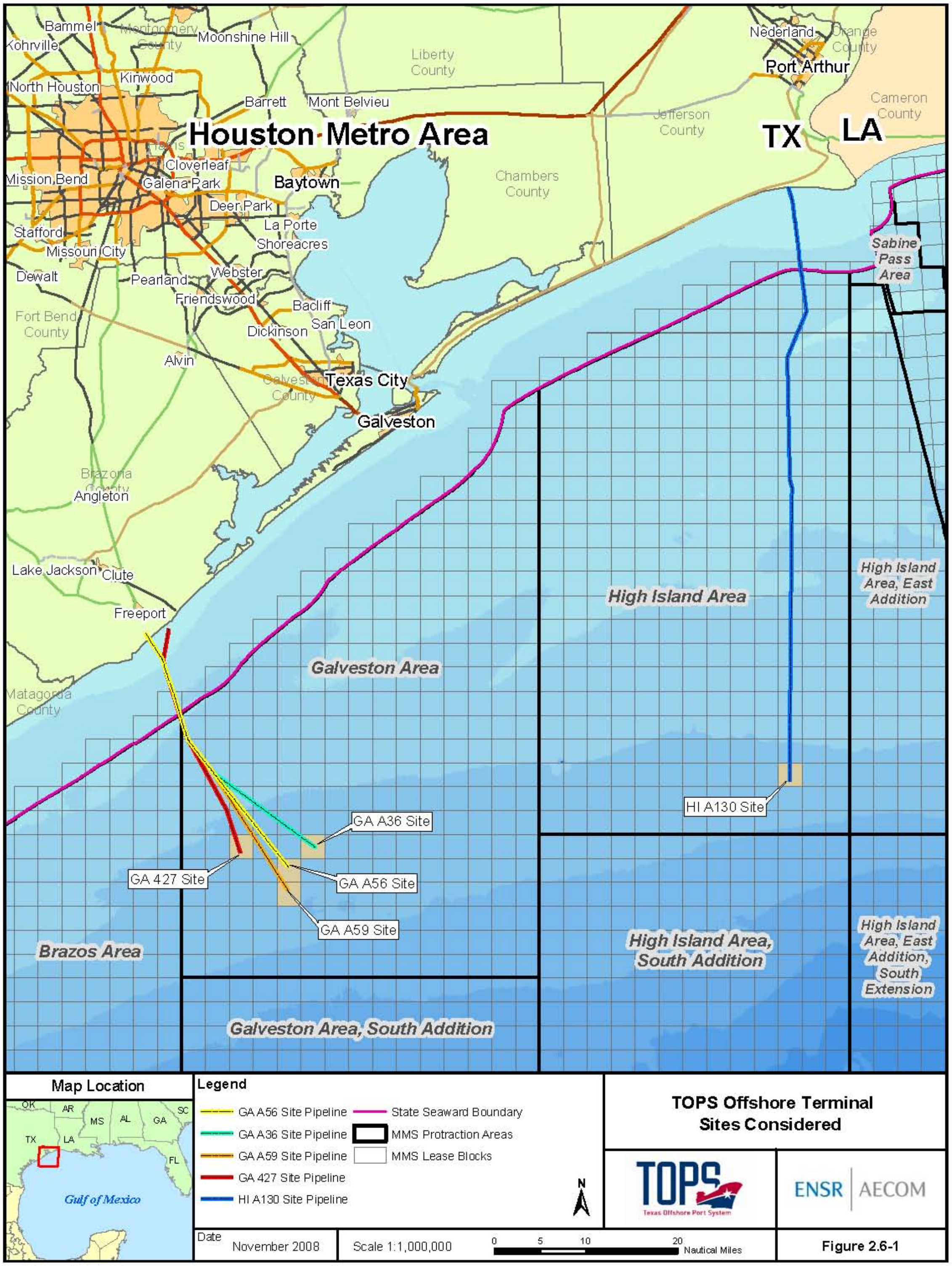
Table 2.6-1 Alternative Terminal Comparison Matrix

Criteria	**OCS Block**				
	High Island A130	**Galveston 427**	**Galveston A36**	**Galveston A56**	**Galveston A59**
Delivery Options for Port Arthur Area	New onshore and offshore pipeline construction	Connection to PACE pipeline	Connection to PACE pipeline	Connection to PACE pipeline	Connection to PACE pipeline
Delivery Options for Texas City/Houston Area	New onshore pipeline (connection to CHOPS lacks capacity)	New offshore and onshore pipeline	New offshore and onshore pipeline	New offshore and onshore pipeline	New offshore and onshore pipeline
Depth	111 ft.	107 ft. – Fatal Flaw	110 ft.	116 ft.	122 ft.
OCS Block Lease Status	Open	Open	Open	Open	Open

Table 2.6-1 Alternative Terminal Comparison Matrix

Criteria	OCS Block				
	High Island A130	Galveston 427	Galveston A36	Galveston A56	Galveston A59
Pipeline Distance to Shore	74.3 mi.	27.5 mi.	34.91 mi.	34.18 mi.	36.62 mi.
New Delivery Pipeline Required	161 mi., (74.3 mi offshore, 17.0 mi onshore to Port Arthur, approximately 70 mi onshore to Texas City)	76.12 mi. (27.5 mi offshore, 48.62 mi onshore)	83.53 mi. (34.91 mi offshore, 48.62 mi onshore)	82.8 mi. (34.18 mi offshore, 48.62 mi onshore)	85.24 (36.62 mi offshore, 48.62 mi onshore)
Pipeline Pumping Stations Required	3 (2 offshore, 1 onshore)	2 (1 offshore and 1 onshore)	2 (1 offshore and 1 onshore)	2 (1 offshore and 1 onshore)	2 (1 offshore and 1 onshore)
Shipping Fairways Crossed	3	1	1	1	1
Marine Traffic Suitability	Suitable (no structures within path, 11 blocks off suitable fairway)	Suitable (no structures within path, 2 blocks off fairway)	Suitable (no structures within path, 1 block off fairway)	Suitable (no structures within path, 2 blocks off fairway)	Suitable (no structures within path, 3 blocks off fairway)
Alternative to be carried forward?	No – total infrastructure requirements and commercial feasibility	No – Fatal Flaw with depth	Yes	Yes – preferred site	Yes

Figure 2.6-1 TOPS Offshore Terminal Sites Considered



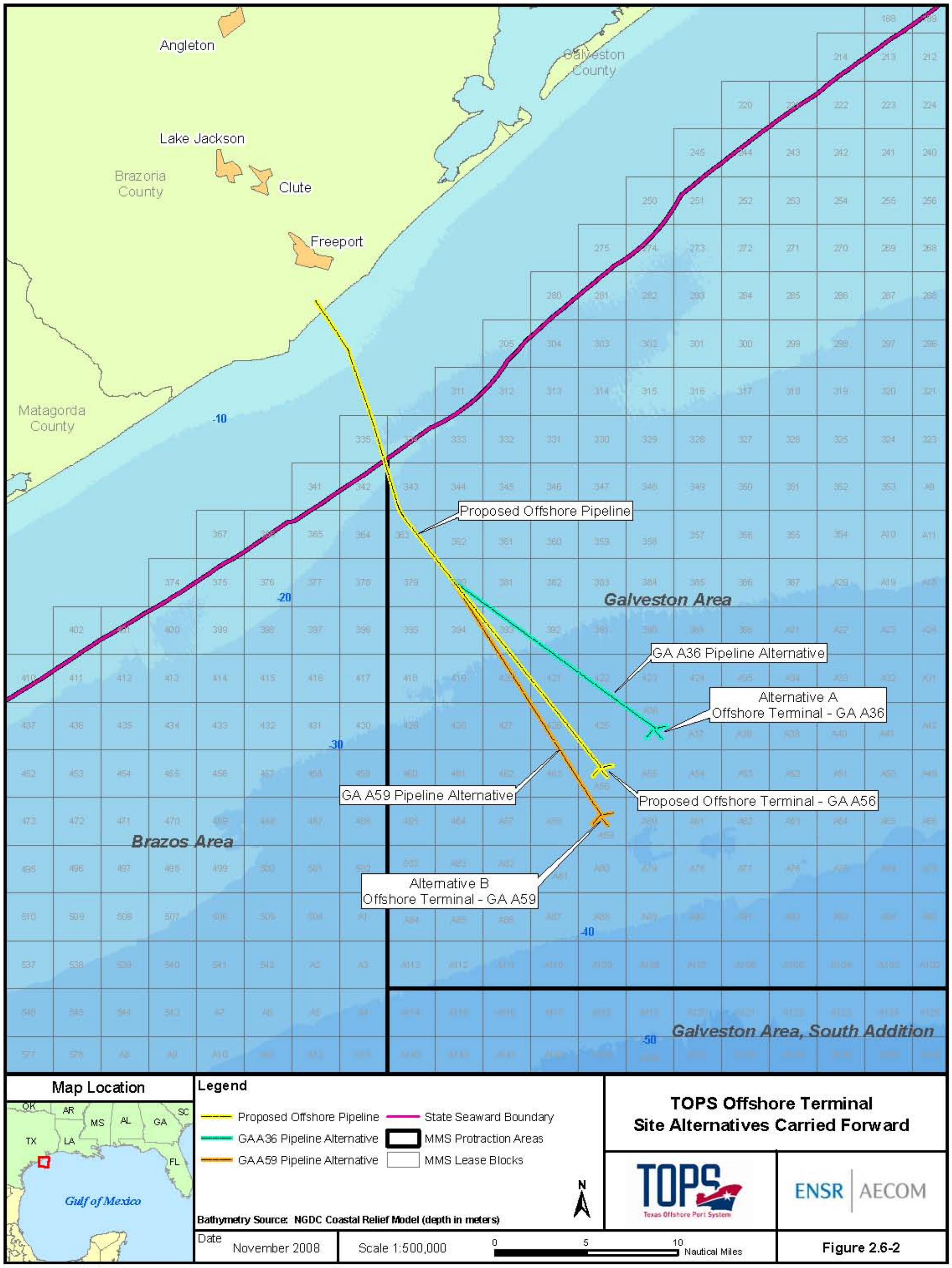
Offshore pipeline alternatives were evaluated relative to each of the previous three alternative platform facility locations. These alternative approaches are shown on Figure 2.6-2 and Table 2.6-2 provides a matrix of data used to compare each of the alternatives. The offshore pipeline alternatives include the following:

- Offshore Pipeline Alternative (OPA) A Option - One 42-inch OD export pipeline (the Pipeline Segment) between the Alternative A Pumping Platform GA A59 and the shore landing. The length of the Pipeline Segment is 34.91 miles.
- OPA B Option - One 42-inch OD export pipeline (the Pipeline Segment) between the Alternative B Pumping Platform GA A36 and the shore landing. The length of the Pipeline Segment is 36.62 miles.
- Preferred OPA Option - One 42-inch OD export pipeline (the Pipeline Segment) between the Preferred Alternative Pumping Platform GA A56 and the shore landing. The length of the Pipeline Segment is 34.18 miles.

Table 2.6-2 Pipeline Route Options

Criteria	**Galveston A56 to Valve Site**		
	Preferred Alt.	**Alt. A**	**Alt. B**
Length (mi.)	34.86 mi.	35.59 mi.	37.30 mi.
Platform to Landfall Distance (mi.)	34.18 mi.	34.91 mi.	36.62 mi.
Sediment Disturbance	Least	More	More
Active Pipelines Crossed	8	8	8
Shipping Fairways Crossed	1	1	1
Protected Marine Areas Crossed	None	None	None
Protected Nearshore Areas Crossed	None	None	None
Protected Onshore Areas Crossed	None	None	None
Active Lease Blocks Crossed	6	6	6

Figure 2.6-2 Offshore Pipeline Site Selection



2.6.7 Onshore Approach Alternatives

Three onshore approaches have been evaluated as alternatives for transporting oil from the offshore pipeline to storage and refinery facilities. All of these alternatives involve landfall near the City of Freeport, Texas, as the nearest location of existing petroleum pipeline infrastructure. The landfall alternatives were based upon locations that presented practical pathways to the proposed Freeport Valve Station. Alternatives further west of the proposed landfall locations would encroach upon public lands (Bryan Beach State Park or Hurst WMA). Alternatives further east would make a Freeport Harbor Entrance Channel crossing and potentially significantly greater wetland and other environmental impacts necessary as the Project was moved to the relatively undeveloped areas east of Freeport and north of Surfside Beach. These factors weighed heavily in the selection of onshore approach alternatives. Each of the alternatives detailed herein seeks to avoid direct impacts to protected lands and minimize impacts to sensitive environments. Table 2.6-3 provides a matrix presenting the primary evaluation criteria used to compare these alternatives. These alternatives are shown in Figure 2.6-3. These locations included the following:

- Onshore Approach Alternative A – This alternative consisted of a 1.2 mile connection segment from the offshore pipeline to the point of landfall near Quintana, TX.

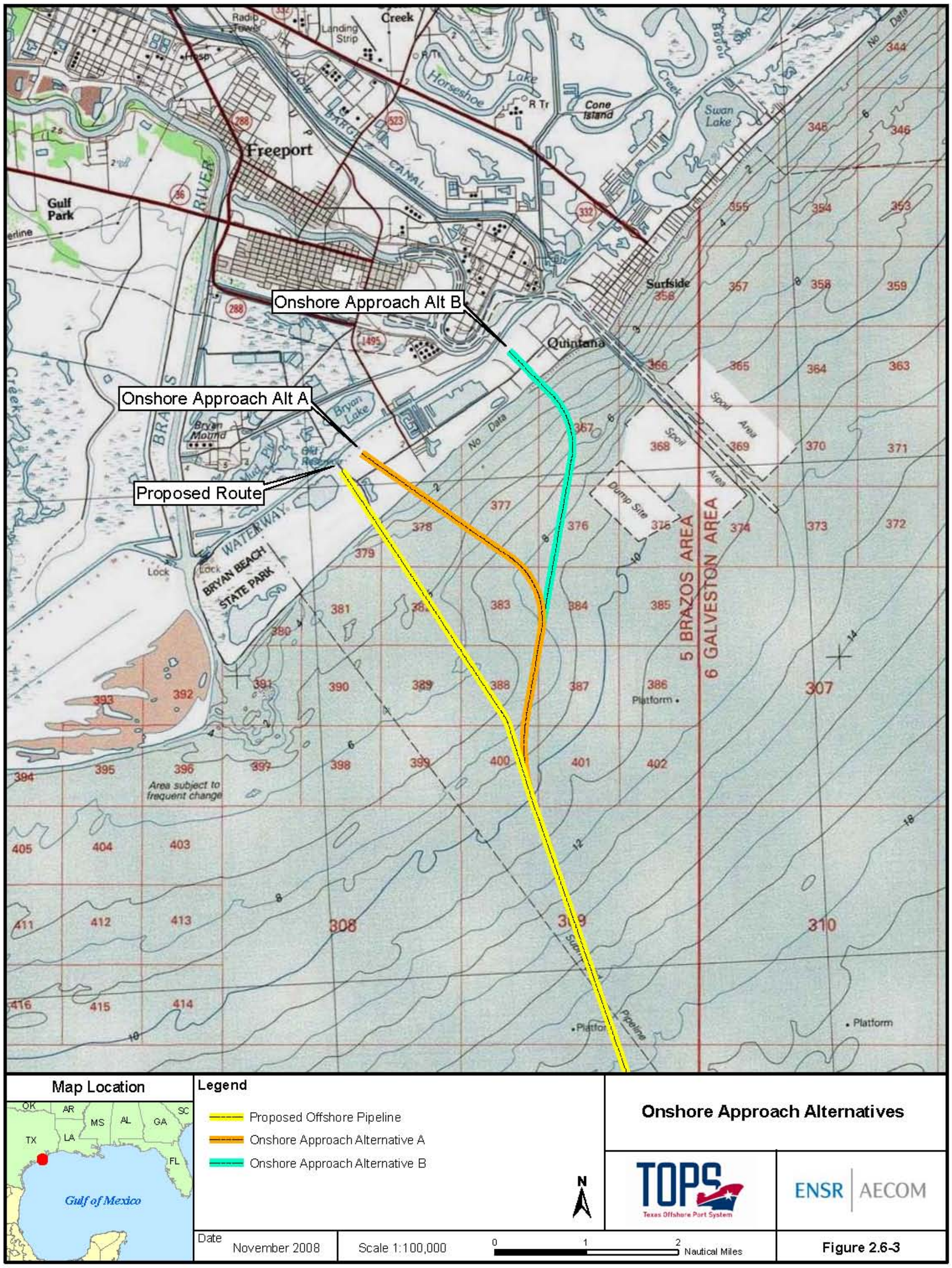
- Onshore Approach Preferred Alternative - This alternative consisted of a 1.2 mile connection segment from the offshore pipeline to the point of landfall near Quintana, TX. This alternative was preferred due to the least distance, least cost, and the least environmental and socioeconomic impacts associated with the alignment.

- Onshore Approach Alternative B - This alternative consisted of a 1.7 mile connection segment from the offshore pipeline to the point of landfall near Quintana, TX.

Table 2.6-3 An Overview of the Preferred and Alternative Onshore Approaches

Metric	Preferred Approach	Alternative A Approach	Alternative B Approach
Offshore to Onshore Connection Distance (Miles)	1.2	1.2	1.7
Onshore Length to Valve Station (Miles)	12.4	12.5	13.4
Closest Protected Nearshore Habitat (Miles)	1.5	2.0	4.1
Distance to Closest Disposal Area (Miles)	2.38	1.21	0.33
Hard Bottom in Vicinity	None	None	None
Cultural Resources (Sonar Contacts and Magnetic Anomalies)	32 unid. sonar contacts, 13 unid. magnetic anomalies potentially associated with historically significant cultural remains.	31 unid. sonar contacts, 13 unid. magnetic anomalies potentially associated with historically significant cultural remains.	35 unid. sonar contacts, 13 unid. magnetic anomalies potentially associated with historically significant cultural remains.
Nearest National Wildlife Refuge	San Bernard NWR - 6.4 mi	Brazoria NWR - 5.8 mi	Brazoria NWR - 3.2 mi
Nearest Protected Nearshore Habitats	Justin Hurst Wildlife Management Area - 1.5 mi	Justin Hurst Wildlife Management Area - 2.0 mi	Brazoria National Wildlife Refuge -3.2 mi

Figure 2.6-3 Onshore Approach Alternatives



Onshore Approach Alternative A includes an onshore landfall by HDD similar to the preferred alternative. This alternative was evaluated because it avoids residential areas adjacent to FM 1495 and road and bridge infrastructure associated with the GIWW crossing of FM 1495. However, this alternative would require additional access roads. Some of the necessary access would be necessary in an existing dredged material placement area, which poses considerable engineering and design problems. Furthermore, this alternative crosses relatively undisturbed wetlands south of the GIWW. For these reasons this alternative was determined to be less practicable than the preferred alternative.

Onshore Approach Alternative B would make landfall at Quintana by HDD. While this alternative has existing access and fewer wetland impacts in the immediate vicinity of the landfall location, it requires a crossing of the Freeport Ship Channel, which was least favorably viewed by officials with Port Freeport. In addition, selection of this route would require avoidance of DOW's Freeport facility to the north of the Ship Channel. This alternative also would require additional wetland impacts to the east of Freeport as described in Section 2.5.8.

The Onshore Approach Preferred Alternative includes a landfall of the Offshore pipeline by HDD to a point approximately 1,000 feet landward of the MHWM. This alternative represents the shortest route to shore and roughly parallels a DOE pipeline. This alternative, like Approach Alternative A, includes crossing of a dredged material placement area; however, only one such area is crossed with the Preferred Alternative. This alternative also makes the best use of existing access and no additional access roads are anticipated to be required. For these reasons, this alternative was determined to be the least damaging practicable alternative.

2.6.8 Onshore Pipeline Alternatives

Onshore Pipeline alternatives evaluated were limited based upon the selection criteria that establish the goal of co-locating the pipeline with existing facilities and in previously disturbed areas to the maximum extent practicable. Therefore, only minor variations of the existing proposed alignment were evaluated given that more than ninety percent of the proposed alignment onshore is located in or immediately adjacent to existing utility, road, or pipeline ROW. The Onshore Pipeline Alternatives were evaluated as extensions of the corresponding Onshore Approach Alternatives to a common junction near the anticipated Booster Pump Station location. From the proposed Booster Pump Station alternatives were not evaluated in detail because of the relative lack of jurisdictional features, the frequent use of HDD for the major crossings eliminating jurisdictional impacts, and because much of the proposed alignment parallels existing ROW and previously impacted areas. Table 2.6-4 provides a matrix of data used to compare each of the alternatives. Three Onshore Pipeline Alternatives were evaluated as described below:

- Alternative A – This alternative consists of the extension of Onshore Approach Alternative A. The onshore route would make landfall at a location approximately 1,000 feet shoreward of the existing vegetation line on the beach and east of County Road 241. This alternative then crosses the GIWW and parallels an existing Department of Energy pipeline west of Bryan Lake. This route would then cross by HDD beneath the hurricane levee. From this point, the route is essentially the same as the preferred alternative as the pipeline crosses through Freeport. The total distance of this alternative is approximately 12.5 miles.

- Alternative B – This alternative is the extension of Onshore Approach Alternative B. The onshore route of the Onshore Approach Alternative B crosses the Freeport Ship Channel then turns north, west of SH 332, and roughly parallels the hurricane levee until it crosses Oyster Creek near Suggs Road. The route then turns northwest and parallels Suggs Road and SH 523. This alternative then proceeds northeast in an existing pipeline corridor through the Brazoria NWR. The total distance of this alternative is approximately 13.4 miles.

- Preferred Onshore Pipeline Alternative – This alternative is the extension of the Onshore Approach Preferred Alternative. This onshore route would begin approximately 1,000 feet shoreward of the existing vegetation line on the beach and parallel an existing Department of Energy pipeline west of Bryan Lake. This alternative makes use of existing roads and previously disturbed areas north of the GIWW. This route then crosses beneath the hurricane levee by HDD and continues through Freeport north to the Booster Pump Station. The total distance of this alternative is approximately 12.4 miles.

Alternative A results in similar wetland impacts at the landfall location. However, once north of the GIWW this alternative results in impacts to relatively undisturbed wetlands, including the shallow waters and wetlands around Bryan Lake and would require additional access roads to accommodate construction equipment. This alternative also crosses multiple confined dredged material placement areas onshore and was viewed less favorably than the Preferred Alternative by Port officials in preliminary discussions.

Alternative B results in wetland impacts near the landfall location and is a longer, and therefore, generally, a more expensive alternative. This alternative also impacts a greater area and variety of wetlands and cuts across the northwest corner of the Brazoria NWR. This alternative would have resulted in substantial cost savings and would have been located largely within existing ROW; however, TOPS understands that the USFWS will not grant additional permanent easements within their properties at this time. This policy and the ROW necessary for a large diameter pipeline preclude siting the TOPS pipeline in the narrow permanent ROW available, even if additional temporary workspace could be obtained through a special use permit. Therefore, no additional evaluation was undertaken for this alternative.

Preferred Onshore Pipeline Alternative results in similar wetland impacts as Alternative A; however, this alignment crosses previously disturbed wetlands rather than those which are relatively undisturbed surrounding Bryan Lake. This alternative also makes best use of existing access roads. For these reasons, this alternative was determined to be the least damaging practicable alternative.

Table 2.6-4 An Overview of the Preferred and Alternative Onshore Pipeline Routes

Metric	Preferred Onshore	Alternative A Onshore	Alternative B Onshore
Managed/Protected Areas Crossed	None	None	Brazoria NWR
Onshore Dredge Material Disposal Areas in the Vicinity	Yes	Yes	No
Onshore Disposal Areas Crossed (Miles)	1.0	0.5	0.0
Ship Channel Crossing	No	No	Yes
Relative impact to wetlands	Low	Med	High
Onshore Length to Valve Station (Miles)	12.4	12.5	13.4

2.6.9 Tank Terminal Alternatives

Department of the Army authorization for fill of the proposed Texas City Crude Terminal site is currently largely in place and the site is currently owned by one of the TOPS partners. A DA permit for the Texas City Alternative site was obtained in January 2005 and permitted the fill of the site with the exception of a 1.82 acre area in the southeast corner of the tract near Loop 197. Given that the fill of this area would be necessary for the construction of the TOPS Project, an evaluation of alternatives is necessary. Criteria used for the selection of a crude storage site were sufficient size to accommodate multiple new storage tanks with the requisite containment levees, access roads, utilities, and firewater pond, proximity to infrastructure to transport the crude oil to refineries in the upper Gulf Coast, and minimal social and environmental impacts. A number of sites were preliminarily identified as having favorable characteristics, but upon further review they were deemed unfavorable or unavailable with the exception of the Hitchcock Alternative site described below. As the discussion of alternatives should be commensurate with the level of impacts, the sites evaluated herein for the location of a storage tank terminal is limited to two sites.

Texas City Site

The preferred site is located within an existing crude storage facility located north of Loop 197 and east of SH 3 in Texas City. This site is approximately 100 acres in size and is accessible by SH 3 and Loop 197. The surrounding land uses are largely undeveloped or industrial and the site currently contains multiple existing and permitted crude oil storage tanks. The site contains existing infrastructure (utilities and roads) to service the proposed storage tanks. Existing jurisdictional areas on the site are limited to the wetlands that were avoided in the previous DA permit. This alternative is the applicant's preferred location based on the criteria set forth above.

Hitchcock Alternative

An alternative site was evaluated for the construction of the tank terminal. The Hitchcock Alternative is an approximate 268-acre tract southeast of FM 2004 and southwest of the Hitchcock Naval Air Station property, in Hitchcock, Texas. While attractive for its size, access to FM 2004, and general proximity to the refinery capabilities in Texas City and Houston as the preferred alternative, this property is located in an area void of heavy industry that generally includes residential or agricultural land uses. Based on a desktop analysis of the site utilizing National Wetland Inventory (NWI) data, it appears that approximately 42 acres of the site is classified as palustrine emergent and palustrine shrub wetlands, with the majority of the remaining 226 acres classified as upland. However, a wetland field survey conducted by Brown and Caldwell in 2008 revealed no wetlands on the property. As the NWI mapping is likewise derived from photo interpretation this information needs to be verified with USACE. It is possible that some of the aesthetic and land use impacts could be minimized by setting the facility further from the road or by vegetative screening. However, due to the this alternative's proximity to existing residential areas and with a potential of wetland impacts equal or greater than that of the preferred alternative, this alternative was determined to be a less practicable alternative than the preferred alternative in Texas City.

3.0 Existing Conditions

This section describes the existing conditions in the Project vicinity, including the DWP and Offshore Pipeline, and Onshore Pipeline and Crude Terminal. Land use, shoreline erosion and accretion, water quality and water supply, air quality, geology, historic properties, navigation, socioeconomic values, safety, biological resources, including threatened and endangered species and fish and wildlife values, and physical habitats, including essential fish habitat (EFH) and wetlands and other special aquatic sites are considered.

3.1 Land Use

3.1.1 Offshore Facilities

Because the proposed DWP will be located off the Texas coast in federal waters, the only landowners for the offshore portion of the Project are the U.S. federal government, managed by the MMS, and the state of Texas, managed by the Texas General Land Office. Particular rights to these lands periodically can be leased by the respective managing bodies to interested parties. The proposed Project's Offshore Pipeline route traverses a total of 19 lease blocks within the Federal waters of the GOM, six of which currently are leased. The proposed Fuel Gas Pipeline route crosses 18 lease blocks, six of which are currently leased. Of the 21 lease blocks within a 6-mile radius of the proposed Terminal location, five are currently leased.

The proposed Offshore Pipeline and Fuel Gas Pipeline cross existing pipelines in eight and three locations, respectively (Table 3.1-1). There are no shipping fairways within a 6-mile (9.7 km) radius of the proposed DWP Terminal or Anchorage Area (see Figure 3.1-1). Vessels will approach the proposed Terminal from the east and west, utilizing either the Coastway Safety Fairway or the Freeport Harbor Safety Fairway. The Offshore Pipeline crosses the Coastway Safety Fairway as it passes through Block GA 380 to the southeast corner of Block GA 363. The length of the crossing is 2.05 miles (3.29 km). Neither the Offshore Pipeline nor the Fuel Gas Pipeline crosses any Federal navigation channels.

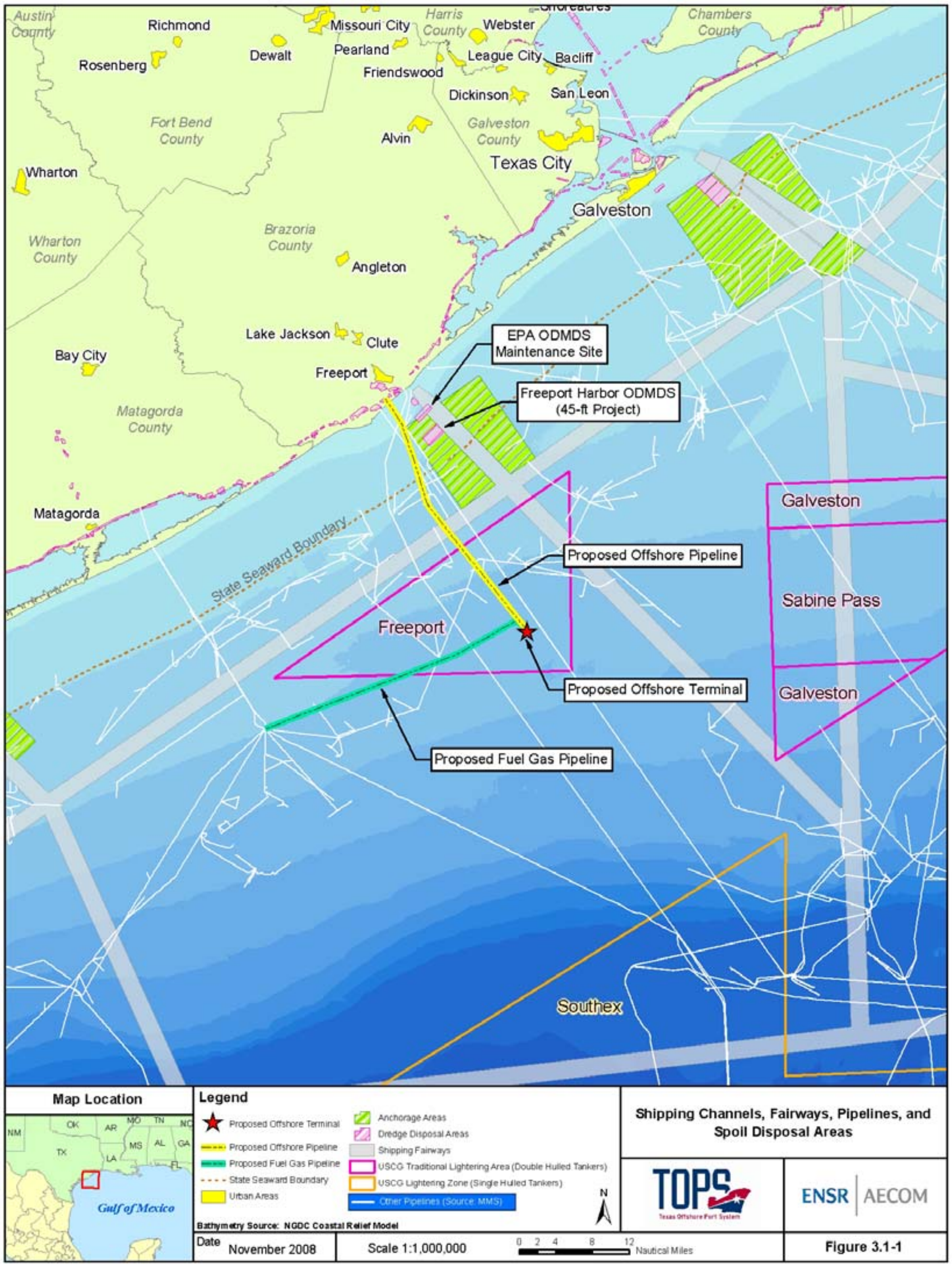
The proposed DWP, Offshore Pipeline, and proposed Anchorage Area do not occur in close proximity to any designated Ocean Dredged Material Disposal Sites (ODMDSs). The closest ODMDSs are located approximately 1.8 miles from the pipelines. Within Texas state waters, the proposed Offshore Pipeline does pass within the proximity of three disposal areas, a Freeport Disposal Area, a USEPA ODMDS Maintenance Site, and the Free Port Harbor 45-foot Project ODMDS (USEPA 2003). However, the ODMDS is outside of the construction and pipeline ROWs (Figure 3.1-1).

The Offshore Pipeline makes landfall at Bryan Beach. Bryan Beach is located in an industrial section of Brazoria County adjacent to the Freeport Harbor Navigation Channel. It is one of three beach systems along the county's coast and provides for fishing, camping, and other recreational activities that are discussed further in Section 3.2.

Table 3.1-1 Existing Pipelines Traversed by the Proposed Offshore Pipeline and Fuel Gas Pipeline

Pipeline	OCS Area/Block	Crossing Coordinates
Offshore Pipeline		
Enron 3" & 8" P/L	BR 382S	28° 53’ 04.87” N, 95° 19’ 51.04” W
Exxon-Mobil 18" - 20" S-11952	BR 388S	28° 52’ 13.87” N, 95° 19’ 26.56” W
King Ranch 4" P/L	BR 309	28° 48’ 20.99” N, 95° 17’ 55.27” W
Rutherford 2" P/L	BR 335	28° 47’ 25.88” N, 95° 17’ 38.42” W
Rutherford 2" P/L	BR 335	28° 47’ 12.85” N, 95° 17’ 34.90” W
Rutherford Dual 6" P/L	BR 335	28° 47’ 29.00” N, 95° 17’ 39.26” W
Enbridge 6" S-9696	GA 343	28° 44’ 55.87” N, 95° 16’ 55.33” W
Williams 20" S-6460	GA 393	28° 36’ 06.77” N, 95° 10’ 36.63” W
Fuel Gas Pipeline		
Transco 20" S-6460	GA 465	28° 25’ 38.87” N, 95° 15’ 42.39” W
Exxon-Mobil 18" - 20" S-11952	GA 462	28° 20’ 57.48” N, 95° 11’24.38” W

Figure 3.1-1 Shipping Channels, Fairways, Pipelines, and Spoil Disposal Areas – Proposed Location



3.1.2 Onshore Facilities

The northern GOM coastal zone includes miles of recreational beaches, coastal wetlands, barrier islands, oil and gas support industries, manufacturing facilities, and various protected habitats. This area is one of the major recreational regions of the U.S., particularly in connection with marine fishing and beach-related activities (MMS, 2007). Onshore land requirements will be needed to support construction and operation of the proposed DWP, including temporary contractor bases and the use of existing fabrication facilities. TOPS intends to utilize existing infrastructure (shore bases, fabrication yards, etc.) for both temporary construction use and a base of operations. It is anticipated that these facilities will be located at existing facilities on the Texas and/or Louisiana coast.

Land uses which may be affected by the Onshore Pipeline and associated facilities have been classified into eight categories based upon the prevalent land use types that will underlay the proposed Project facilities: open land, commercial/industrial, agricultural, residential, wetlands, open water, ROW, and forest. The land use/land cover categories are adapted from GLO and USFWS classifications for land and wetland categories. Table 3.1-2 contains a list of the land use categories and their prevalence within the Project area. These areas were delineated using aerial photograph interpretation with geographic information system (GIS) software and supplemented with survey data obtained from the wetland delineation report (Appendix E). Appendix J contains land use/land cover maps for the proposed Onshore Pipeline route.

Definitions of the eight land use/land cover categories are provided below:

- Open land consists of non-forested upland area, fallow fields, grasslands or other areas not used for agriculture.
- Commercial/industrial includes aboveground electrical power facilities, manufacturing and industrial plants, landfills, mines, quarries, commercial and retail facilities.
- Agricultural includes all areas used for grazing and cultivated fields.
- Open water is characterized as all waterbodies (i.e., rivers, creeks, and other linear waterbodies).
- Wetlands consist of forested and emergent wetlands.
- Residential land includes residential yards, residential subdivisions, and planned new residential development.
- Right-of-way consists of road and utility ROW.
- Forest includes upland forest, wetland forest and forested areas where invasive species are dominant.

Table 3.1-2 GIS Analysis of Land Use

Land Use/Land Cover Category	Area (Acres) within the 125-ft Construction Corridor	Area (Acres) of Additional Temporary Workspace adjacent to 125-ft Corridor (false ROW)
Open Land	202.05	8.86
Commercial/industrial	22.95	5.18
Agricultural Land	52.22	0.23
Residential Land	31.01	0.01
Wetlands	243.12	14.52
Open Water	20.31	0.86
ROW	103.81	7.75
Forest	46.07	0.14
Total	**721.54**	**37.55**

In addition to the federal and state owned submerged lands and waters, the Project will cross publicly owned and privately owned lands. The proposed Onshore Pipeline crosses 303 parcels and 241 landowners. Right of entry and necessary easements from each of the landowners have or are expected to be obtained prior to permit issuance. The Onshore Pipeline will cross confined upland dredged disposal areas north of the GIWW owned by Port Freeport, privately owned utility rights-of-way, railroads, and numerous state-owned land and water transportation facilities maintained by the Texas Department of Transportation (TXDOT). Table 3.1-3 contains a list of the highway and road crossings for the Project and the anticipated crossing type (HDD or bore).

Table 3.1-3 Highways and Roads Crossed by the Onshore Pipeline Route

Crossing Location	Approximate Milepost	County	Crossing Method
Levee Road	1.4	Brazoria	HDD
State Highway (SH) 36	2.9	Brazoria	Bore
Farm-to-Market (FM) 1495	3.2	Brazoria	Bore
East 2nd Street	4.2	Brazoria	Bore
Dow Canal Road	4.6	Brazoria	Bore
Old Surfside Road	4.9	Brazoria	Bore
SH 332	6.5	Brazoria	Bore
FM 523	6.9	Brazoria	Bore
Levee Road	9.2	Brazoria	HDD
FM 523	11.0	Brazoria	Bore
Hoskins Mound Road	11.8	Brazoria	Bore
FM 2004	19.0	Brazoria	HDD
Peltier/Hoskins-Mound Road	22.0	Brazoria	Bore
Liverpool-Hoskins Road	23.7	Brazoria	Bore

Table 3.1-3 Highways and Roads Crossed by the Onshore Pipeline Route

FM 2004	25.1	Brazoria	Bore
Amoco Chemical Road	30.7	Brazoria	Bore
Landrum Road	34.8	Galveston	Bore
FM 646	38.1	Galveston	Bore
2nd Street	41.4	Galveston	Bore
S. Redfiah Drive	42.0	Galveston	HDD
North Redfish Drive	42.2	Galveston	HDD
Burns Street	42.4	Galveston	Bore
North Redfish Drive	42.5	Galveston	Bore
Bering Street	43.0	Galveston	Bore
Gulf Street	43.8	Galveston	Bore
Texas Street	43.9	Galveston	Bore
Flamingo Street	44.6	Galveston	Bore
SH 6	44.7	Galveston	Bore
Interstate 45 & Galveston Levee Crossing	46.1	Galveston	HDD
State Highway 3 Interchange	47.4	Galveston	HDD

3.2 Recreation and Aesthetics

3.2.1 Recreation

In addition to public ROWs, commercial and industrial facilities detailed in the land use/land cover maps (please see Appendix J), the Freeport area is also a productive commercial and recreational fishing destination. Commercial landings rank Freeport 5th in Texas and 65th in the nation in terms of dollar value (NOAA 2008). Public beaches at Bryan Beach and Quintana and various County parks in the vicinity of the Project area are used for camping, wildlife viewing, fishing and swimming. Recreational use of the area's state and federal wildlife refuges, listed below, support hunting, fishing, camping, cycling, and wildlife viewing. Public boat launches are adjacent to the Project area at Chocolate Bayou and Bastrop Bayou.

Brazoria NWR is located approximately 6 miles (10 km) east of the Preferred Shore Approach and within several hundred feet of the Onshore Pipeline near FM 2004. The 43,388 acre (17,561 ha) NWR has a rich ecology ranging from salt marshes to bluestem prairie grasses. It also attracts over 200 species of birds. In winter, more than 100,000 geese, ducks and sandhill cranes arrive. In summer, birds that nest on the refuge include ten species of herons and egrets, white ibis, roseate spoonbill, mottled duck, black skimmer, and scissor-tailed flycatcher (TPWD 2008a).

Justin Hurst WMA, formerly Peach Point, (Bryan Beach) is the closest protected habitat to the Preferred Shore Approach and is located approximately 1.5 miles (2 km) to the west. It contains 15,612 acres (6,318 ha) of upland hardwood, upland prairie, fresh and saltwater marshes. The Justin Hurst WMA is representative of the Gulf Coast Prairies and Marshes Ecoregion. Elevation is generally 5 feet (1.5 m) or less above mean sea level with a few areas 10 feet (3 m) or more above sea level (TPWD 2008b). The WMA supports hunting, fishing, cycling, hiking, wildlife viewing, and primitive camping.

3.2.2 Aesthetics

Offshore

No aesthetically sensitive areas are located near the proposed Project. The closest land mass to the proposed DWP is Southern Brazoria County, Texas, which is approximately 30 miles (48 km) away. Based on the proposed platform height of 127 feet, the proposed DWP facilities, including the Platforms, will not be visible from the mainland, and will be visible only to vessels within approximately 22.5 miles (36.2 km), assuming a vessel deck height of 50 feet (15.2 m), and other existing platforms within approximately 27.2 miles (43.8 km), assuming a platform height of 115 feet (35.1 m) (please refer to Appendix B for schematics of the offshore structures). The DWP Terminal will be visible to smaller shipping and fishing vessels within approximately 17.7 miles (28.5 km) assuming a vessel deck height of 10 feet (3 m). At these distances, small visual interferences such as waves or haze likely would further impede the view. The Offshore Pipeline and FGP will be buried below the sediment surface and not visible.

Onshore

Freeport contains numerous commercial and heavy industrial facilities including petrochemical storage, transport and refining, liquefied natural gas regasification and transport, port and railroad infrastructure and support facilities for offshore oil and gas exploration. Many of the natural features of the area have been altered to accommodate the presence of industry. The GIWW, the re-routed Brazos River, the Freeport Navigation Channel, and the hurricane protection levees are but a few examples of the modifications that have taken place in Freeport in support of commerce and industry. Texas City has undergone similar modification for industrial and flood prevention purposes. However, the Project area is also, as detailed in Section 3.9, a diverse assemblage of physical habitats and biological communities. In general, the Project construction will be the most noticeable component of the Project and any disturbance to the aesthetic value of the area will be temporary. Except for valve stations and the Project components detailed above (the FVS, Booster Pump Station, and Crude Terminal), the pipeline will be buried and not visible during its operational lifespan.

3.3 Navigation

Offshore

In addition to the discussion in Section 3.1 above, Topic Report 7, “Land Use, Recreation, and Aesthetics”, of the DWP application materials include discussions of existing offshore facilities, leases, military areas, lightering zones, anchorages and fairways. In addition, a Marine Traffic and Navigation Evaluation is included in the DWP application as an appendix. As the 14th largest port in the U.S. in terms of foreign tonnage and the 25th largest in terms of gross tonnage, Port Freeport is a major center of waterborne commerce (USACE 2008). Navigation in the Offshore Project area includes large freight vessels and smaller supply and service vessels that utilize the GOM and call on Port Freeport and its 45 ft-deep navigation channel for both foreign and domestic shipping.

Onshore and Nearshore

The GOM, GIWW, Old Brazos River, and Chocolate Bayou are all commercially important navigable waters in the project area. Additional navigable-in-fact waterways include Oyster Creek, Bastrop Bayou, Austin Bayou, Halls Bayou, the Diversionary Canal, and Highland Bayou. While the GOM, GIWW, Old Brazos River and Chocolate Bayou are the major navigable waterways and the most utilized for waterborne commerce within the Project area, all of these waterbodies are utilized by recreational boaters.

3.4 Shoreline Erosion and Accretion

Erosion and accretion are land changing processes that occur everywhere and to varying degrees based on local climate, geology, and anthropogenic factors. The Texas coast along the GOM and the inland bays and waterways abutting the GOM are experiencing shoreline loss. Reasons for this loss vary based on factors that are locally highly variable, but include sea level rise, subsidence, wave action/increased fetch, and land use practices. The Texas Bureau of Economic Geology (TBEG)has documented shoreline loss rates of 10-15 feet/year in the vicinity of the Freeport and Quintana at the point where the Project makes landfall (TBEG 2008). Similarly, loss rates on the bay shorelines of West Galveston Bay, including its secondary bays such as Chocolate Bay, historically exceed several feet per year. Based on the TBEG's historical shoreline analysis, approximately 34 percent of the Chocolate Bay shoreline experienced shoreline loss exceeding a rate of two feet per year since the 1930s (Gibeaut et al. 2003). In the vicinity of the Project near Texas City where most of the natural shorelines have been highly modified (for example, as with bulkheads or riprap), the shoreline loss rates on the remaining natural shorelines of Jones Bay and the adjoining Highland Bayou are in excess of five feet per year. Overall Jones Bay experienced retreating shorelines in 69 percent of its remaining natural shoreline (Gibeaut et al. 2003).

3.5 Existing Water Quality

3.5.1 Offshore Facilities

The discussion of the existing condition of water quality with regard to proposed offshore facilities provided herein is a general topic overview. A detailed discussion of these conditions can be reviewed in Topic Report 2, "Water Use and Quality", of the DWP application.

Contaminants

GOM marine waters can be heavily impacted by point and nonpoint source discharges. Petrochemical plants and petroleum refineries constitute the major point source discharges along the Gulf Coast. Coastal runoff, riverine input, and to a lesser extent discharges from offshore activities, such as oil and gas development and marine transportation also contribute to the degradation of water quality in the shelf area. Rivers draining into the Gulf, particularly the Mississippi River, carry large volumes of contaminants from agricultural and industrial activities, as well as municipal discharges (MMS 1996).

Offshore activities including oil and gas development and marine transportation discharge some form of treated wastewater into the GOM and have resulted in accidental spills of oil and other chemicals. Floating debris, hypoxic conditions, and toxic and pathogen contamination are the most apparent offshore water quality problems within the GOM (MMS 2001). However, hypoxic conditions are expected to occur very infrequently in the Project area.

Water quality sampling conducted as part of an MMS study (MMS 1998b) provided a general characterization of contaminant concentrations in the coastal areas of the Louisiana–Texas shelf. Analysis of dissolved phase contaminants on the nearshore shelf indicated detectable concentrations of polycyclic aromatic hydrocarbons (PAHs), with naphthalene being the predominant parameter with a mean concentration of 142 micrograms per liter (µg/l) in the samples collected across the shelf. Herbicides (e.g., atrazine and cyanazine), pesticides (e.g., chlordane and dieldrin), and polychlorinated biphenyls also were detected at trace levels (nanograms per liter) in the dissolved phase.

As the primary source of contaminants is contributions from fresh water flows (e.g., runoff), contaminant concentrations were highest nearshore and decreased offshore and were inversely proportional to water salinity. For similar reasons, dissolved contaminant concentrations generally were greater at the surface than at the bottom of the water column. A similar trend can be expected in the Project area, with contaminant concentrations (to the degree that they exist) generally higher nearshore than offshore and generally higher in the upper water column than at depth.

Currents

Although circulation in the greater GOM is dominated by the Loop Current and its detached Loop Current Eddies, currents over the inner Louisiana–Texas shelf (e.g., in the vicinity of much of the proposed Project) are mainly driven by wind stress and, to a lesser degree, buoyancy effects associated with freshwater discharges from the Mississippi and Atchafalaya rivers and other smaller tributaries to the Gulf. Generally, currents in the vicinity of a majority of the proposed Project components are predominantly alongshore and follow a bimodal pattern with upcoast (west to east) current flows typically occurring during the summer months (mid-June through late-August) and downcoast (east to west) current flows typically occurring during the non-summer months. Current velocities in the vicinity of the proposed SPMs, platforms, and along the pipeline route can be expected to be in the general range 10 to 25 cm/s in the mid to upper-portion of the water column and in the general range of 2 to 10 cm/s near the sea floor (MMS 1998a).

Temperature

Mean surface seawater temperatures in the Project vicinity range from approximately 55°F (12.7°C) in January to 85°F (29.6°C) in August (NDBC 2008, MMS 1998a). Thermal stratification occurs during the summer months, with warmer less dense waters in the upper section of the water column and cooler water in the lower portion. A similar, but less significant, stratification appears to establish during the winter months, with cooler waters near the surface and warmer waters at depth. Temperatures tend to be relatively uniform across the water column during the spring and fall months.

Waves

MetOcean evaluations have recently been prepared for the TOPS Project. One component of these evaluations was the development of wave height hindcast data for two locations: one in the vicinity of the proposed DWP and one in shallower water along the proposed Offshore Pipeline route.

Table 3.5-1 and Table 3.5-2 provide significant wave height (H_s) and maximum wave height (H_{max}) hindcasts (tropical extremes) in the vicinity of the proposed DWP and along the proposed Offshore Pipeline route. Significant wave height is defined as the average height (trough to crest) of the highest one-third of the waves in at a given location. The representative shallow water location used for wave hindcast predictions was GOMOS grid point 9093, which is located in the northern section of Block GA 343 (28.75º N, 95.25º W) in a local water depth of 62 feet (19 m). This grid point is located approximately 1.0 mile (1.6 km) east of the proposed Offshore Pipeline route and approximately 12 miles (19 km) offshore. The representative DWP location used for wave hindcast predictions was GOMOS grid point 8832, which is located in the southern section of Block GA 425 (28.5º N, 95.125º W) in a local water depth of 100 feet (30.5 m). This grid point is located approximately 3.5 miles (5.6 km) north of the proposed Pumping Platform.

These hindcasts were developed to coincide with a 106-year period of record (1900 to 2005). The dominant wave direction at both locations is toward the northwest, with minor seasonal shifts towards the north-northwest and west-northwest.

Table 3.5-1 Wave Height Hindcasts (Tropical Extremes) Along Offshore Pipeline Route

Wave Heights	Return Period		
	1-year	10-year	100-year
H_s	7.2 ft (2.2 m)	16.7 ft (5.1 m)	26.6 ft (8.1 m)
H_{max}	14.4 ft (4.4 m)	30.8 ft (9.4 m)	45.3 ft (13.8 m)

Wave heights estimated at GOMOS grid point 9093 – located in MMS Block GA 343, 62-foot local water depth.

Table 3.5-2 Wave Height Hindcasts (Tropical Extremes) in the Vicinity of the DWP

Wave Heights	Return Period		
	1-year	10-year	100-year
H_s	8.2 ft (2.5 m)	20.0 ft (6.1 m)	30.8 ft (9.4 m)
H_{max}	16.4 ft (5.0 m)	36.7 ft (11.2 m)	53.1 ft (16.2 m)

Wave heights estimated at GOMOS grid point 8832 – located in MMS Block GA 425, 100-foot local water depth.

Tides

In general, tidal conditions along the GOM coast of west Louisiana and east Texas involve a mixed tidal regime which varies between a semi-diurnal to diurnal pattern. Site specific tidal data is not available in the immediate vicinity of the Project’s offshore structures. The two closest stations are USCG Freeport station (ID 8772447), a shoreline tide gauge located near Quintana Beach, immediately adjacent to the Freeport Entrance Channel, and the “Galveston Offshore, TX” station (ID 8771904) in MMS High Island Area Block 208 (local water depth approximately 54 feet) (NOAA 2008). The data from these two tidal stations indicate a typical mean tidal range of approximately 1.4 feet (0.4 m), with a maximum tidal range of approximately 1.8 to 2.2 feet (0.5 to 0.7 m). Actual tides observed in the immediate vicinity of the Project’s SPMs, platforms and pipelines would vary, but might be expected to fall within these general ranges.

3.5.2 Onshore Facilities

Surface Water Quality

Information from the Texas Commission on Environmental Quality's (TCEQ's) targeted water quality assessments were reviewed for stream and waterbody segments within the Project area onshore. The assessments for each segment detail the designated uses and specify which uses were not supported, if any. Approximate mileposts (MPs) where the Project crosses each named stream segment are provided for reference, where appropriate.

While water quality in the Project area can generally be classified as satisfactory, degradation of surface water quality can locally be attributed to nonpoint agricultural stormwater runoff, urban runoff in developed areas, and point sources such as industrial facilities and municipal sources. In turn, stream and riverine inputs affect water quality in the bays and nearshore environment.

Near the onshore beginning of the pipeline in Brazoria County, water quality in Segment 1201 - Brazos River Tidal can be characterized as good. The TCEQ's 2002 and 2004 assessments for the Brazos River basin classifies this segment as fully supportive of general, aquatic life, contact recreation, and public water supply uses (TCEQ 2004). Fish consumption use was not assessed in the most recent assessments and historically fish kills have occurred at times due to low dissolved oxygen concentrations; however, there are no current public advisories for prohibiting fish consumption in the Brazos River.

Segments 1107 Chocolate Bayou Tidal (MP 27.5), 1108 Chocolate Bayou Above Tidal, 1109 - Oyster Creek Tidal (MP 9.2), and 1111 – Old Brazos River Channel Tidal (MP 4.3), are classified as fully supporting general, contact recreation, and aquatic life uses.

Segment 1110 – Oyster Creek Above Tidal contains an assessment unit approximately 15 miles north of the Project area in Fort Bend County where water quality standards are not being met. This segment is on the TCEQ's 303(d) list of impaired waterbodies; however, the distance of that segment from the Project area and the improvement of water quality in Oyster Creek in the lower reach within the Project area suggest the problem is isolated to the upper reach.

Segment 2432 – Chocolate Bay, south of the Project area, is classified as fully supporting general, contact recreation, and aquatic life uses; however, this waterbody does not support the oyster waters use due to elevated levels of bacteria and appears on the 303(d) list.

A portion of West Galveston Bay (Segment 2424) between the east end of Galveston Island and Texas City has recurring problems with fecal coliform bacteria levels and does not support use for the consumption of oysters from these waters. Other uses including contact recreation, aquatic life, fish consumption and general use are fully supported.

A portion of Highland Bayou (Segment 2424A) from the headwaters to FM 2004 located near the eastern terminus of the Project area does not support contact recreation due to elevated bacteria levels and partially support aquatic life use due to low DO.

Water Supply

While most of the regional demand for water is supplied by surface water, groundwater remains an important component of the area's water supply. The Gulf Coast aquifer is the groundwater source that underlies the Project area. Within the San Jacinto-Brazos Basin, the major uses of water in Brazoria and Galveston Counties are agricultural irrigation, manufacturing, and municipal (TWDB

2006). A total of seventeen water wells lie within 1,500 feet of the proposed 42-inch Onshore Pipeline centerline, according to a review of the Texas Water Development Board's water well database (TWDB 2008); however, of these, only one lies within the proposed construction corridor and it is anticipated that this well will be avoided by use of HDD or through a minor shift in the permanent ROW, if necessary. Table 3.5-3 lists the wells located within 1,500 feet of the proposed Project centerline. Construction and operation of the Project should not interfere with the use and continued function of these wells.

Table 3.5-3 Water Wells in Proximity the Project Area (source TWDB water well data 2008)

Well Owner	State Well Number	Primary water use	Latitude (decimal degrees)	Longitude (decimal degrees)	Distance from Centerline
Dow Chemical Co.	8106408	Stock	28.927221	-95.361388	1,241 ft.
Dow Chemical Co.	8106407	Unused	28.935556	-95.352222	965 ft.
City of Freeport	8106405	Public Supply	28.946944	-95.339444	308 ft.
B.H. Gardner	8106423	Industrial	28.954444	-95.34111	175 ft.
Dow Chemical co.	8106112	Industrial	28.978333	-95.341944	1,039 ft.
Dow Chemical Co.	8106113	Industrial	28.97861	-95.340277	665 ft.
Dow Chemical Co.	8106109	Industrial	28.981666	-95.338055	718 ft.
Amoco Chemical Corp.	6562409	Industrial	29.065833	-95.338611	870 ft.
Amoco Chemical Corp.	6562408	Industrial	29.069167	-95.338056	652 ft.
Amoco Chemical Corp.	6562407	Industrial	29.073056	- 95.340556	1,434 ft.
Freeport Sulphur Co.	6554604	Unused	29.176944	-94.258889	1,372
Freeport Sulphur Co.	6554605	Unused	29.176944	-94.258056	1,247
Superior Building Co.	6554802	Industrial	29.148333	-95.318332	48 ft.
J.D. Hillyer	6547901	Domestic	29.286666	-95.130554	82 ft.
Fred Konzack	6547902	Public Supply	29.284999	-95.129721	562 ft.
Hall's Bayou Bait Camp	6547903	Commercial	29.285277	-95.129166	589 ft.
Stewart Production Co.	6441113	Unused	29.335000	-94.971111	1,353 ft.

3.6 Existing Geology

This section provides an overview of geology in the Project area, including the geologic setting, sediment composition, mineral resources, and geological hazards. More detail on geology related to the Project area offshore geology is provided in the DWP application Topic Report 6, "Geology and Sediments".

3.6.1 Geologic Setting

Offshore Facilities

The GOM lies within the geologic province known as the Gulf Coast Basin. The GOM is a passive marine basin that initially formed during the late Triassic and early Jurassic Periods when Africa/South America separated from North America during the breakup of the supercontinent, Pangea. During continental rifting, a number of shallow seas formed in the basin that were periodically isolated from the open ocean waters during the early Jurassic. Cyclical periods of seawater influx and evaporation resulted in the precipitation of salt formations in the basin. During the late Jurassic, the basin was exposed to the open sea and the depositional environment changed to a shallow marine setting. During the Cretaceous Period, broad carbonate banks grew around the margins of the basin in the shallow seas. Two distinct depositional environments (Cenozoic and Mesozoic) developed in the western and eastern regions of the GOM.

In the eastern GOM, carbonate and evaporite deposition dominated the depositional environment until the middle Miocene. During the Cenozoic, clastic influx became significant enough to prograde onto and across the Cretaceous carbonate platform. The carbonate and evaporite deposits, interbedded with clastic deposits, range from the Florida Peninsula Arch in the east and southeast portion of the eastern GOM to Mobile Bay in the northwest portion of the eastern GOM. These deposits exceed 30,000 feet (9,144 meters [m]) in thickness and define the Mesozoic Province of the GOM (Lore et al. 1999).

During the late Cretaceous Period through the Tertiary Period, the western GOM was dominated by an influx of large amounts of clastic deltaic sediments. Continental uplift and the Laramide Orogeny in the western U.S. and Mexico provided the source for these clastic sediments. Periods of glaciation during the Quaternary increased clastic sediment load in the central and western portions of the basin. In the early Tertiary, the Rio Grande River and a system of smaller rivers that drained the Texas coastal plain were the primary sources of sediment entering the GOM (MMS 2002). Clastic sediments deposited during the Cenozoic exceed 50,000 feet (15,240 m) in thickness and define the Cenozoic Province of the GOM (Lore et al. 1999).

The modern day GOM is comprised of four physiographic areas: continental shelf, continental slope, continental rise, and the abyssal plain (Thurman 1981). The continental shelf extends seaward from the shoreline to a depth of approximately 650 feet (200 m) and slopes a few meters per kilometer (km) (MMS 2007). The width of the continental shelf ranges from a few tens of meters to more than 620 miles (1,000 km) (Monroe and Wicander 2001). The leading edge of the continental shelf is defined by a break in slope that is followed by the continental slope. This break in slope, which constitutes the upper portion of the continental slope, can vary between 1 degree to more than 20 degrees and averages about 4 degrees (Blatt et al. 1980). Generally, this break in slope is found at depths of approximately 440 feet (135 m) (Monroe and Wicander 2001). The continental slope in the GOM extends to water depths of 6,562 to 9,842 feet (2,000 to 3,000 m) with a typical gradient of 1-2 degrees (MMS 2007).

The continental rise is a thick accumulation of sediment located at the base of the continental slope (MMS 2002) and inclines gently, normally less than half a degree, to the abyssal plain (Blatt et al. 1980). According to Plummer et al. (2003) the sediments associated with the continental rise appear to be deposited by turbidity currents flowing down the continental slope and by contour currents flowing parallel along the continental slope. The abyssal plains are very flat regions of the ocean floor typically found at the base of the continental rise. Seismic profiling has shown that abyssal plains are formed of horizontal layers of sediment, primarily terrigenous in nature

(Plummer et al. 2003). The abyssal plain beneath the GOM is identified as the Sigsbee Abyssal Plain.

Onshore Facilities

Along its the upper margins, the Gulf Coast Basin includes most of the physiographic region known as the Gulf Coastal Plain, which extends inland 30 to 80 miles (50 to 135 km) and to elevations of about 250 feet above msl. Included within the coastal plain is the Gulf Marshes, an area of nearly level, sedimentary deposits that terminate at the mouths of rivers and at the highly dynamic barrier islands. This area is underlain by relatively recent deposits from riverine transport processes. The complex interaction of deposited riverine sediments and the cyclical inundation and exposure during periods of sea level change formed this transitional zone between the GOM and relatively recently formed coastal bays, beaches, barrier islands and deltas of the present day Texas coast.

3.6.2 Sediments

The DWP terminal and associated Offshore Pipeline and Fuel gas Pipeline fall within the Cenozoic sedimentary providence. The Cenozoic Province is a clastic regime, characterized by thick deposits of sand and shale that overly carbonate rocks. The sediment deposits are from the Paleocene to Regent age and the carbonate rock layer is from the Jurassic and Cretaceous age (MMS 2007).

Surficial deposits on the seafloor in the GOM generally are comprised of sediments from their adjacent or feeding coasts. During the early Tertiary, the Rio Grande, Brazos, Colorado and Nueces rivers were the main sources of sediment. In the Western Gulf these deposits lead to a thick amount of sediment accumulation. The center of sediment deposition shifted eastward toward the Mississippi River during the late Tertiary (MMS 2007).

Historically, the sediment deposition process has been affected by sea level transgressions and regressions. Several cycles of emergence and submergence of the continental shelf occurred concurrently with glacial advances and retreats. As a result, the changes in sea level caused the shoreline to shift landward or seaward (USCG 2003). The current configuration of the Gulf Coast is a result of these fluctuations in sea level (USGS 2004).

In recent geologic history, the Mississippi River has been identified as the largest sediment carrier for the GOM. To a lesser degree, sediments have also been deposited by other river systems into the northern GOM. Other rivers that contribute sediment in the Project area include the Sabine and Atchafalaya rivers. Minimal quantities of sediment originate from the southwest portion of the basin because the discharge of the small drainage basins tends to accumulate less sediment.

TOPS characterized offshore sediments by conducting geophysical surveys and other geotechnical evaluations (see Exhibit I of the DWP license application).

3.6.3 Soils

NRCS Soil Survey information Brazoria and Galveston Counties list Surfside-Velasco, Francitas-Narta, Mustang-Veston, Lake Charles, and Bernard-Edna complexes within the Project area. Soils of these complexes are comprised of clay, clay-loam, and sandy loam soils. Individual soil series mapped in the Project area include Asa Silt Loam, Edna Fine Sandy Loam, Lake Charles Clay, Narta Fine Sandy Loam, and Surfside Clay, Mustang fine sand, Galveston fine sand, Pledger clay, Velasco clay, Veston, Ijam, Edna, Fransitas clay, and Bernard clay loam. In general, these soils are nearly level, somewhat poorly to poorly drained and are commonly associated with crop and pastureland in the coastal plain. A more detailed discussion of Project area soils can be found in the Wetland Delineation Report (Appendix E).

3.6.4 Mineral Resources

Mineral resources in the GOM include energy resources (i.e., oil and gas) and non-energy resources. In the general vicinity of the Project, mineral resources of greatest interest are oil, gas, and sand. These resources are discussed in more detail below.

Offshore Facilities

Oil and Gas

The GOM offshore Texas and Louisiana is a major oil and gas producing area because the area has the geologic structure and history favorable to hydrocarbon formation and entrapment. However, oil and gas production in the vicinity of the proposed Terminal and in deeper waters lacks the hydrocarbon potential of areas to the north and east (MMS 2007). There are no existing platforms within 1 mile (1.6 km) of the proposed Terminal in GA A56. The Offshore Pipeline route passes within 1 mile of 2 existing platforms (Table 3.6-1). In addition, there is one platform within 1 mile of the FGP.

Table 3.6-1 Oil and Gas Platforms within 1 Mile of Project Area

Platform ID	Lease Block	Distance from Pipeline (feet)
Offshore Pipeline		
1582	GA393	4987
1849	GA343	4442
Fuel Gas Pipeline		
1375	BA538	59

Sand and Gravel

There are no identified sand and gravel resources in the immediate vicinity of the project. The Offshore Pipeline route passes within approximately 100 feet (30.5 m) of Freeport Rocks Bathymetric High, a shoal seaward of the Brazos Delta in 49 to 66 feet (15 to 20 m) of water (Wellner and Anderson 2003, Rooker et al. 2004). However, most of the sand at Freeport Rocks is in mixed layers that have high silt and mud percentages (Wellner and Anderson 2003). The shoal is dominated by coarse shell hash and relic oyster beds (Rooker et al. 2004).

No other current economically viable OCS sand and gravel resources have been identified in proximity to the proposed pipeline route or proposed DWP locations. In 2006 a Sand Sources Workshop was held by the Texas General Land Office (GLO) held in part to identify feasible sand sources currently available for coastal restoration projects on the upper Texas coast. The proposed pipeline will make landfall in Brazoria County, and the priority eroding area identified for this county was Surfside Beach, approximately 1.3 miles northeast of the point of landfall. The areas identified for additional investigation as potential sand sources are outside of the Project area and included an inland sand source, the mouth of the San Bernard River, the Port of Freeport Pass, and an area of the Brazos River Channel. One other potential sand source, also outside of the Project area, was identified within an apparent buried channel directly off of Surfside Beach; however, very little is known about the actual sediments themselves (Dellapenna, et al 2002).

Onshore Facilities

Oil and Gas

There are numerous oil and gas related facilities located in and immediately adjacent to the Project area. Surface facilities include infrastructure for exploring, producing, and transporting hydrocarbons. Similarly, the proposed Onshore Pipeline crosses numerous hydrocarbon pipelines in the proposed alignment.

Sand and Gravel

The State of Texas, specifically TPWD, regulates sand, gravel, shell and marl and requires a permit for disturbance or take of thee resources from state owned water bottoms. There are no identified active sand and gravel mining operations in waterways in the Project area; however, there are several commercial sand operations in the immediate vicinity of the Project area. These businesses supply local commercial needs for sand and gravel.

3.6.5 Geologic Hazards

Geologic hazards are conditions or phenomena that present a risk or are potentially dangerous to life and/or property, either naturally occurring or man-made (Bates and Jackson 1984). Geologic hazards that occur in the GOM OCS include earthquakes, faults, submarine landslide susceptibility, karst topography, diapiric structures, and gas hydrates. The geological features of the inner continental shelf of the GOM (< 200 feet depth [61 m]) are simple and uniform with the main hazards being faulting, shallow-gas pockets, and buried channels (MMS 2007).

Offshore Facilities

Topic Report 6, "Geology and Sediments", in the DWP application materials, provide a detailed overview of the geologic hazards potentially encountered by the Offshore Project. In summary, issues for the safe construction and operation of the offshore facilities arising from faults, seismicity, and soil liquefaction are believed to be minimal and are characterized as low risk. Similarly, the Project risk with regard to submarine slides, gas hydrates, subsidence, and shallow gas is believed to be low.

An area of hard bottom was also identified within BR 335. This area is part of Freeport Rocks. Freeport Rocks is a shoal seaward of the Brazos Delta in 49 to 65.5 feet (15 to 20 m) of water (Wellner and Anderson 2003, Rooker et al. 2004). The shoal runs northeast southwest for 12.4 miles (20 km). Maximum lateral dimensions of the feature in close proximity to the Offshore Pipeline are approximately 2,100 feet by 1,900 feet (640 m by 579 m), with a maximum measured height above the ambient seafloor of approximately 22 feet (6.7 m). Most of the sand at Freeport Rocks is in mixed layers that have high silt and mud percentages (Wellner and Anderson 2003). The shoal is dominated by coarse shell hash and relic oyster beds (Rooker et al. 2004). The Offshore Pipeline route was adjusted to avoid Freeport Rocks hard bottom areas by nearly 100 feet (30.5 m) on either side. However, hard bottom material may be within 2 feet (0.6 m) of the surface covered by a thin layer of softer material (please refer to Exhibit H of the DWP application). Based on vibracoring data, the Offshore Pipeline route will be adjusted to avoid direct impact to all hard bottom areas. The Terminal and Offshore Pipeline route do not cross any other seafloor features rising above the surrounding seafloor or biologically sensitive topographic features (Exhibit I of the DWP License application).

Onshore Facilities

The low relief topography and minimal seismicity along the Texas coast make the risk of landslide or earthquake low in the onshore extent on the Project. Surface faults in the Galveston-Brazoria area are one of the primary geologic hazards encountered. There are dozens of surface faults in the greater Houston area with surface expressions measuring from 0 feet to 12 feet and from less than 0.5 miles in length to more than 8 miles (Gibeaut et al. 2000). Fault movement typically ranges from 0.2 to 0.8 inches per year, but can exceed 1.6 inches per year (Gibeaut et al. 2000). The principal cause of these movements is believed to be the expression of sub-surface faults. These effects are sometimes exacerbated by the effects of subsidence.

Subsidence from the extraction of fluids, for municipal or industrial water uses and from oil and gas extraction contributed to the locally pronounced sinking of the land surface in portions of the greater Houston area and peaked in the 1970's. The sinking of the land occurred most notably near Baytown, Texas and to a lesser extent, near the Project area in the vicinity of Texas City and Freeport (Gibeaut et al. 2000). The recognition of the effects of fluid extraction from beneath the surface resulted in a formation of a regulatory subsidence district. While the effects of subsidence are irreversible, the rate of subsidence has slowed greatly as a result of decreased fluid extraction in these areas.

3.7 Historic Properties and Cultural Resources

Cultural resources for the Offshore Terminal and Pipelines in federal waters were coordinated with the MMS in accordance with the U.S. Department of the Interior (USDI) MMS Notices to Lessees (NTL) 2005-G06 and 2006-G07 and in accordance with Section 106 of the National Historic Preservation Act (NHPA) of 1966 (Public Law 89-665, as amended), Executive Order 11593. Cultural resources investigations for the Project's onshore components were prepared in coordination with the Texas Historical Commission (THC) and the USACE Galveston District's archeologist, and in accordance with Section 106 of the NHPA, Executive Order 11593; as well as the Antiquities Code of Texas and the Texas Administrative Code (Title 13). Other pertinent federal legislation concerned with cultural resources includes the National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190) and the Archaeological and Historic Preservation Act of 1974 (Public Law 93-291).

3.7.1 Offshore Facilities

Between May 24 through July 1, 2008, Fugro GeoServices, Inc. (Fugro) conducted geophysical surveys in the proposed Project area, which consists of a Terminal site located in Galveston Area (GA) A56 and a pipeline route. The preferred Terminal site in GA A56 is located approximately 35 miles southeast of Freeport, Texas. The archaeological assessment is included as Exhibit I of the DWP application in the Fugro GeoServices Inc. report titled, "*ARCHAEOLOGICAL, ENGINEERING AND HAZARD SURVEY FROM BLOCK A56 GALVESTON AREA TO BLOCK 378S, BRAZOS AREA, GULF OF MEXICO Report No. 2408-1110*", which presents the findings of the proposed pipeline survey in Federal and Texas State waters. In addition, DWP application materials, specifically Topic Report 4, "Cultural Resources", address cultural and archeological resources in the Offshore portion of the Project area and includes an Unanticipated Discovery Plan to further ensure compliance with the state and federal statutes listed above.

In summary, the results of geophysical surveys, including bathymetry, magnetometer, side-scan sonar, sub-bottom profiler surveys conclude that the vast majority of the Project area sonar contacts and magnetic anomalies identified were interpreted as probable modern debris. A total of four unidentified sonar contacts and 13 unidentified magnetic anomalies were recorded in the preferred alignment. Avoidance of these contacts and anomalies by a distance of at least 200 feet is the recommended action.

3.7.2 Onshore Facilities

A cultural resources survey was conducted within the accessible portions of the Project area in September 2008 (Appendix G, SWCA 2008). The report, entitled “Archeological Survey of the Onshore Component of the Texas Offshore Port System (TOPS) Pipeline Project, Brazoria and Galveston Counties, Texas“, concludes that no properties eligible for listing on the National Register of Historic Places were identified within the surveyed ROW. Additional survey of the inaccessible portions of the ROW will be coordinated with THC and USACE prior to commencement of field activities and the results of these studies will be incorporated into the application.

3.8 Socioeconomic Values

To assess the potential effects of the TOPS Project on socioeconomic conditions of nearby communities, baseline conditions were investigated in the counties of Texas nearest the offshore Terminal and Pipeline landfall. This investigation considered construction and installation, operation, and decommissioning activities associated with the offshore facilities and briefly addresses the associated onshore support facilities (please refer to Topic Report 5, “Socioeconomics”, of the DWP license application for details of the socioeconomic evaluation of the Project impacts). Socioeconomic impacts associated with the Project’s Onshore Facilities will be addressed in Section 4. Regarding socioeconomics, the Project area is defined as Brazoria and Galveston Counties, Texas. Brazoria and Galveston Counties were used to define the Project area as they are the closest counties to the offshore components of the Project, as it is analyzed in the DWP application. The nearest towns to the offshore components of the Project include Freeport, Surfside Beach, Oyster Creek, Jones Creek, Clute, Hitchcock and Texas City.

3.9 Biological Resources

Biological resources anticipated in the Project area are summarized below. For a detailed account related to the offshore components of the Project, see Topic Report 3, “Biological Resources”, of the DWP application (Appendix C).

3.9.1 Fish

Offshore

The northern GOM traditionally has been one of the most productive fishery areas in North America (Gunter 1967). The GOM marine habitats, ranging from coastal marshes to the deep-sea abyssal plain, support a diverse and abundant fish assemblage. The distribution of species is related to a variety of ecological factors, including salinity, primary productivity, and bottom substrate. These factors differ widely across the Gulf and between the inshore and offshore waters.

Approximately 46 percent of the southeastern U.S. wetlands and estuaries important to fish resources are located within the GOM (Mager and Ruebsamen 1988). Consequently, estuary-dependent species of finfish and shellfish dominate the fisheries of the central and north-central Gulf. Many finfish resources are linked both directly and indirectly to the estuaries located in the GOM. Finfish are directly estuary-dependent when the population relies on low-salinity brackish wetlands for most of their life history, such as during the maturation and development of larvae and juveniles. Offshore demersal species are related indirectly to the estuaries because they influence the productivity and food availability on the continental shelf (Darnell and Soniat 1979; Darnell 1988).

Fish species likely to be found in the offshore waters in the vicinity of the proposed Project are characterized as coastal pelagic, reef, ocean pelagic and demersal. Coastal pelagic species can be found from the shoreline to the shelf edge. Reef species are associated most commonly with natural or artificial topographic relief such as live/hard bottoms or oil platforms that tend to support a great diversity of species. Oceanic pelagic species occur mainly in the deep, open oceanic waters offshore from the shelf break. Demersal and coastal pelagic fish assemblages are recognized within broad habitat classes for the continental shelf and oceanic waters of the GOM and typically are characterized by water depth and bottom substrate. The fish assemblage associated with the GA A56 Project location is referred to as the intermediate shelf assemblage (20-40 m). The fish assemblage associated with the pipeline and nearshore facilities is referred to as the inner shelf assemblage (0-20 m) (Gallaway 1981).

Coastal Pelagic Fish

Coastal pelagic fish inhabit the shelf waters of the GOM throughout the year. The lowest abundance of all species occurs in winter, with peak numbers found during summer and fall. The distribution of most species depends upon water column structure, which varies seasonally and spatially. Some species such as Spanish mackerel (*Scomberomorus maculates*), Gulf menhaden, anchovies, and herrings form large schools, while others such as cobia form small schools or travel singularly. Most of the large-bodied, predatory coastal pelagic species are important to commercial or recreational fisheries. The smaller coastal pelagic species are often preyed upon by the larger species as well as by piscivorous birds (MMS 2002). Some coastal pelagic species show an affinity for vertical structure and often are often observed around natural or artificial structures, where they are best classified as transients rather than true residents. This is particularly true for Spanish sardine, round scad, blue runner, king mackerel, and cobia (Klima and Wickham 1971; Chandler et al. 1985). Most of the large-bodied, predatory coastal pelagic species are important to commercial or recreational fisheries. King and Spanish mackerel, cobia, and jacks, in particular, are sought by recreational fisheries.

Reef Fish

Reef fishes range from shallow estuaries to depths of more than 1,640 ft (500 m) offshore. Drilling rigs and platforms on the Texas-Louisiana continental shelf attract a wide range of species, including snappers, sharks, jacks, groupers, and sardines.

Demersal Fish

The bottom-oriented, or demersal, fish fauna of the GOM are characterized by substrate composition and water depth (Gallaway 1981). Demersal fish assemblages are commonly named by the dominant shrimp species found in the same sediment/depth regime. The dominant assemblage in the area of the Offshore Pipeline is the white shrimp assemblage found at depths of 3–20 m. The white shrimp assemblage consists of species such as Atlantic croaker, star drum, Atlantic cutlassfish (*Trichiurus lepturus*), sand seatrout, silver seatrout (*Cynoscion nothus*), Atlantic threadfin (*Polydactylus octonemus*), and hardhead catfish (*Arius felis*). The dominant assemblage further offshore in the area of the proposed platforms and SPMs is the brown shrimp assemblage found at depths of 20-60 m. The brown shrimp assemblage consists of longspine porgy, blackfin searobin, Mexican searobin and shoal flounder (MMS 2002).

Commercial Species

The GOM provides nearly 17 percent of the commercial fish landings in the continental U.S. on an annual basis (NMFS 2007). Reef fish, along with coastal pelagic fishes, are the groups most sought after by fisherman in the GOM. Important finfish groups landed at ports in Louisiana and Texas include menhaden, mullet, tuna, catfish, drum, snapper and other pelagics. Commercially important shellfish groups include shrimps, blue crab, and eastern oyster. However, there are no live oyster reefs in the vicinity of the project area.

Recreational Species

The largest harvests of recreational fish species by weight in the GOM were groupers, red snapper, spotted seatrout, King mackerel, red drum, dolphin, Spanish mackerel, Greater amberjack, sheepshead, and white grunt (NMFS 2007).

Onshore

Estuary Fish

Nearshore estuarine fishes include species that inhabit the estuary their entire life cycle, as well as those that spend their juvenile or subadult stages or their spawning season there. Estuarine-dependent species constitute more than 95 percent of the commercial fishery harvests from the GOM (MMS 2002). Gulf menhaden and members of the Sciaenidae family such as croaker, red and black drum, and spotted sea trout are directly dependent on estuaries during various phases of their life history. These species, along with commercially important invertebrate species such as blue crab and panaeid shrimp, are likely to be found in the nearshore environment as well as in the inland waterways including Oyster Creek, Bastrop Bayou, Chocolate Bayou, Halls Bayou, Highland Bayou and the Hitchcock Diversion Canal within the Project area, depending upon salinity, time of year, and the life stage of the individual species.

Freshwater Fish

The Project crosses many of the waterways at the transitional zone between the influences of the marine and estuarine environments and the influence of freshwater from riverine and upland sources. Species adapted to tolerate this variability likely include the striped mullet, alligator gar, spotted gar, grass carp, American eel, bowfin, skipjack herring, gizzard shad, creek chub, sheepshead minnow, sailfin molly, western mosquitofish, and several species of topminnows and killifishes.

3.9.2 Birds

The northern GOM is populated by both resident and migratory species, with the Texas and Louisiana coast containing primary nesting sites for many species (MMS 2002). The proposed Project is located in or near the habitats of many coastal and marine birds. The proposed Pipeline comes onshore in the vicinity of the major route (north-south) of the Central Flyway and the coastal (east-west) route of the Mississippi Flyway (Figure 3.9-1). The majority of the birds in the

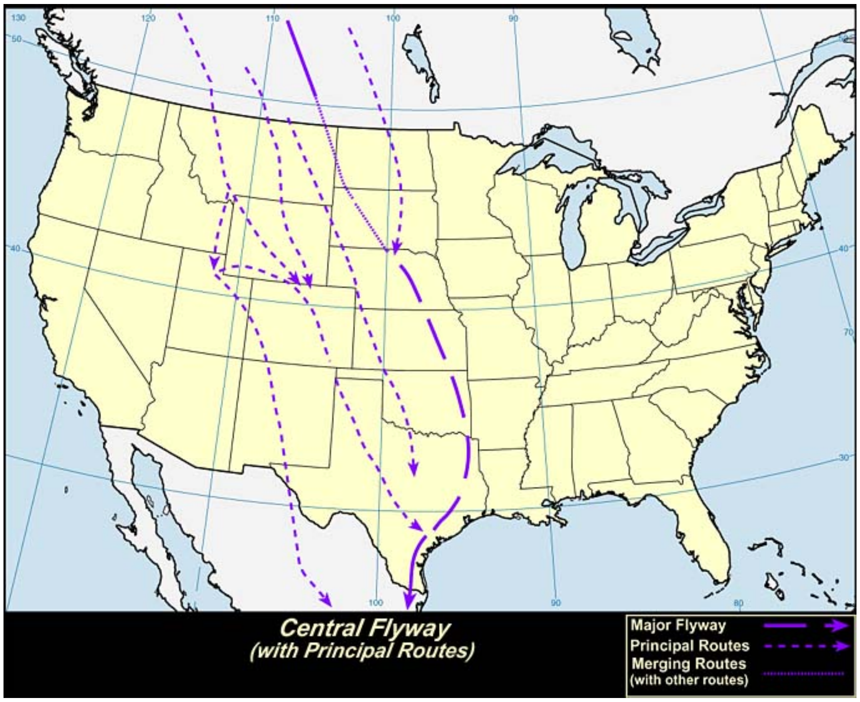
Central Flyway make direct north and south journeys from breeding grounds in the North to winter quarters in the South (Nutty Birdwatcher 2007). The nearshore portion of proposed Project is located in the vicinity of the Upper Texas Coast Wildlife Trail, which is also part of the Great Texas Coastal Birding Trail. The Great Texas Coastal Birding Trail is a designated trail along the Texas coast that allows for individuals to view birds in their native habitat. The trail covers the entire coast of Texas. The trail contains over 300 distinct wildlife viewing sites and has additional amenities such as boardwalks, parking pullouts, observation platforms, and landscaping to attract native wildlife. The avifauna of the nearshore coastal areas of Texas consists largely of wading birds (Order Ciconiformes: herons; egrets; ibises), shorebirds (Order Charadriformes: phalaropes; gulls; terns; skimmers; plovers; sandpipers, etc.), diving birds (Order Gaviiformes: loons; Order Podicipediformes: grebes; Order Pelecaniformes: pelicans; cormorants), waterfowl, (Order Anseriformes: ducks and geese), some raptors (Order Falconiformes: Osprey; Bald Eagle), and other miscellaneous species. Wading birds and shorebirds are common throughout the year along the coast.

Waterbird Nesting

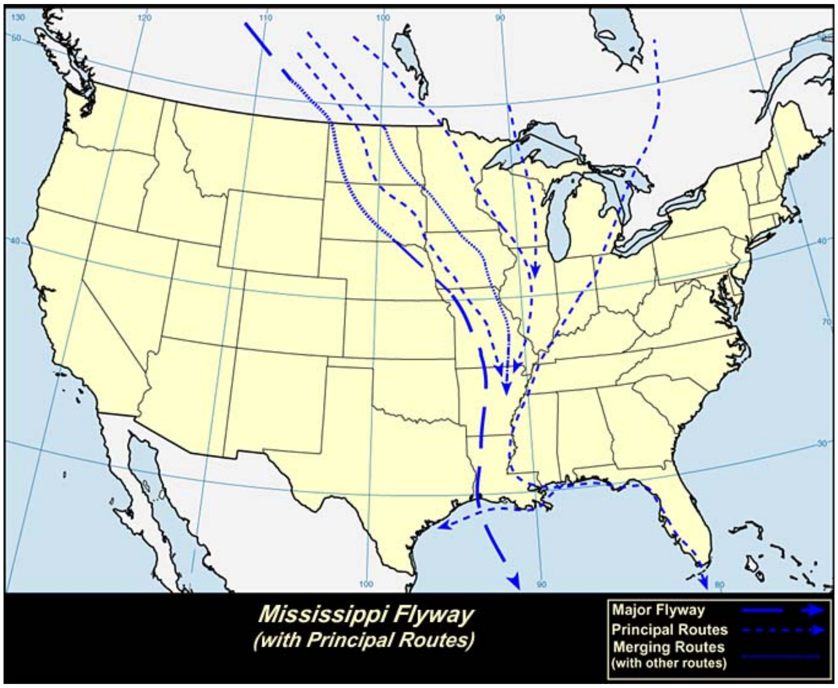
There are nearly 30 species of colonial waterbirds that regularly nest along the Texas Coast. Nesting pairs of many coastal species including several herons, terns, and egrets have been identified within Brazoria County, in the area where the proposed pipeline comes onshore (TCWC 2005).

Figure 3.9-1 Location of Bird Migration Pathways in the GOM, a) Central Flyway and b) Mississippi Flyway

a)



b)



3.9.3 Amphibians

Common amphibian species potentially found in Brazoria and Galveston counties include toads (Woodhouse's toad, Gulf Coast toad), frogs (Northern cricket frog, Gray tree frog, green tree frog, spotted chorus frog, upland chorus frog, bull frog, and Southern leopard frog), and salamanders (smallmouth salamander and Eastern newt).

3.9.4 Reptiles

Offshore

Marine reptile species potentially found in the GOM and in the Project vicinity are all marine turtles. All five species of marine turtles that inhabit coastal Texas waters are threatened or endangered species. A discussion of these species follows in Section 3.9.5.

Onshore

Common reptile species found in Brazoria and Galveston counties include, turtles (Snapping Turtle, Eastern Box Turtle, Ornate Box Turtle, Texas Tortoise, Texas Diamondback Terrapin, Red Eared Slider), snakes (Louisiana Milk Snake, Western Ribbon Snake, Cottonmouth, Timber Rattlesnake, Eastern Hognose Snake, Gulf Coast River Snake, Common Garter Snake, Copperhead, Western Diamondback Rattlesnake), lizards (Texas Horned Lizard, Mediterranean Gecko, Green Anole, Ground Skink) and the American Alligator.

3.9.5 Mammals

Offshore

Marine mammals potentially found in the Project vicinity are addressed at length in the DWP License application, Topic Report 3, "Biological Resources" (Appendix C). The only species expected to occur with any frequency are the bottlenose dolphin and Atlantic spotted dolphin. Other whales and dolphins might transit the area, but these species largely prefer open ocean waters and water depths of more than 100m. Similarly, manatees are only infrequent strays into Texas waters and the USFWS generally regards Louisiana waters as their western

Onshore

Common mammal species found in Brazoria and Galveston counties include, bats (Northern Yellow Bat, Seminole Bat), shrews and moles (southern short-tailed shrew), hares and rabbits (Swamp Rabbit, Eastern Cottontail, Black Tailed Jack Rabbit), rodents (Eastern Gray Squirrel, Eastern Flying Squirrel, Bairds Pocket Gopher, Marsh Rice Rat, Eastern Harvest Mouse), carnivores (Striped Skunk, Eastern Spotted Skunk, Coyote, Common Raccoon), and opossums (Virginia Opossum).

3.9.6 Threatened and Endangered Species

TOPS has begun consultation with the state and federal natural resource agencies regarding threatened and endangered species to properly scope this assessment for potential impacts to these resources. In addition to letter requests for information and pre-application meetings (see DWP License application, Appendix 1.D), NMFS, USFWS, and TPWD listings of threatened and endangered species were reviewed for the marine, inland and state listed species of plans and animals that potentially occur in the vicinity of the Project area. Table 3.9-1 is a summary of the listed species, their status, and a brief description of their typical habitat. For additional discussion of threatened and endangered species related to the offshore components of the Project, see Topic Report 3, “Biological Resources”, of the DWP application (Appendix C).

Plants

There are no listed threatened or endangered plants within the proposed Project area; however, Texas prairie dawn (*Hymenoxys texana*), federally listed as endangered, is known to occur on exposed, sparsely vegetated sandy soils in Fort Bend, Harris, and Trinity Counties, and is therefore, potentially found on the sparsely vegetated mima or pimple mounds that occur in the proximity of the project area in Galveston County. While the plant has not been documented within Galveston County, suitable conditions potentially exist for the plant in portions of the project area, particularly in Galveston County, near Hitchcock, Texas.

Invertebrates

No federally listed coral species occur in the proposed Project area. Staghorn coral (*Acropora cervicornis*) and Elkhorn coral (*Acropora palmata*) are the only two federally listed threatened invertebrates that occur in the GOM (NMFS 2006). Staghorn coral does occur in the western GOM, but it is absent from U.S. waters. Elkhorn coral is not found in the western GOM.

Fish

The Gulf sturgeon (*Acipenser oxyrinchus desotoi*) is the only federally listed threatened fish that may occur in the GOM (NMFS 2006). The Federal Register lists critical habitat for the Gulf sturgeon as the Pearl River in Louisiana/Mississippi eastward to the Suwannee River in Florida. There is no critical habitat for the Gulf sturgeon within the waters of Texas. The range of the Gulf Sturgeon does not include the Terminal’s proposed location or the proposed Pipeline route.

Birds

Coastal and marine bird species listed by the USFWS as either endangered or threatened may be present in the coastal region of the Project area include the following: brown pelican, piping plover, and whooping crane. Though recently delisted, the bald eagle is frequently sited in Brazoria County and there are at least two known nest sites north of Freeport and along Bastrop Bayou more than a mile from the proposed Onshore Pipeline alignment. The species is still afforded protection under the Bald and Golden Eagle Protection Act (BGEPA) and the Migratory Bird Treaty Act (MBTA) and the USFWS recently codified a definition of “disturb” to clarify the protection under the BGEPA. The bald eagle and brown pelican have ranges that include the proposed Project location where there is a potential for construction or operational impacts.

The Project area potentially includes eastern brown pelican habitat. Brown pelicans are not likely to occur at the terminal, as they seldom venture more than 20 miles (32.2 km) out to sea except to take advantage of especially good foraging conditions. Sand spits and offshore sand bars are used extensively as daily loafing and nocturnal roost areas. They live in flocks of both sexes year round. Some Texas brown pelicans do not migrate during the winter and remain on the Texas coast, while others migrate south to the eastern coast of Mexico (UMMZ 2006). There are no known nesting islands in the Project area. The nearest nesting islands are Mustang Bayou Island in Chocolate Bay, approximately 5 miles southeast of the pipeline crossing at Chocolate Bayou and North Deer Island, approximately 4 miles from the proposed alignment near Highland Bayou.

Information obtained in coordination with the Clear Lake Ecological Services Office of the USFWS indicates that potential whooping crane habitat exists in Brazoria County and within the project area's flats and marshes near Freeport. The remaining wild population migrates from Wood Buffalo National Park in Canada's Northwest Territories to winter on the Aransas National Wildlife Refuge's (ANWRs) 22,500 acres of salt flats and marshes. They begin their fall migration south to Texas in mid-September and begin the spring migration north to Canada in late March or early April. Whooping cranes numbers are slowly but steadily increasing and the wintering population could make use of the coastal marsh habitat within the project area. Specifically, salt marsh is a preferred feeding habitat and blue crabs the preferred prey item. Once limited to the ANWR, these birds are increasingly likely to utilize such habitats as their numbers have shown slow but steady increases. A census at the ANWR in the winter of 2007-2008 documented 260 individuals in ANWR and surrounding properties with an additional six birds believed to be still in the flyway or in nearby marshes outside the survey area for a total estimated population of 266 (USFWS 2008).

The piping plover (*Charadrius melodus*) is a migratory North American shorebird. Piping plovers breed on sandy beaches along the Atlantic Coast from Canada to North Carolina and winter primarily along the Gulf Coast beaches from Florida to Mexico. Wintering habitats for the Plover include beaches, sand flats, mudflats, algal mats, emergent sea grass beds, wash-over passes, and very small dunes where seaweed or other debris has accumulated. Spoil islands along the GIWW are also used by wintering plovers. Piping plovers spend more than 70% of the year on wintering grounds and Texas is estimated to winter more than 35% of the known population of the species (Campbell 2003).

Wintering Piping Plovers in Texas prefer bare or very sparsely vegetated tidal mudflats, sand flats, or algal flats, areas which are periodically covered with water and then exposed either by tides or winds. Piping Plovers begin arriving on the Texas coast in mid-July. The number of plovers appears to increase on the Texas coast through October and begin migrating towards the breeding grounds in late February. Most individuals are gone from Texas by mid May.

The loss of sandy beaches and lakeshores due to recreational, residential, and commercial development has reduced available habitat on the Great Lakes, Atlantic Coast, and Gulf of Mexico. Critical habitat for wintering populations of the piping plover has been designated by the USFWS in Texas Unit 33 near Bryan Beach.

Marine Reptiles

Five species of sea turtles are known to inhabit coastal waters of the GOM: green sea turtle, Kemp's ridley sea turtle, loggerhead sea turtle, hawksbill sea turtle, and leatherback sea turtle. Each of these species is listed as either endangered or threatened under the ESA. Because of their wide distribution and developmental history, sea turtles have the potential to occur in the area of the proposed Project during some stage of their life cycle. All five of the GOM species of sea turtles are highly migratory along the nearshore and inshore waters of the northern and eastern GOM, including the upper Texas and Florida coast; however, none of the species is likely to be permanent residents of the Project area. Some individuals may be present at any given time, but Fritts et al. (1981) found a much higher abundance of marine turtles in Florida waters compared to Texas. Critical habitat within the proposed Project area was not identified for any sea turtle species. However, the number of known nesting occurrences of this species is on the rise. While the mechanism signaling the return of Kemp's ridleys to Texas is not well understood, the number of sea turtles utilizing beaches of the upper Texas coast is increasing. In 2008, a total of 195 nests were identified along Texas beaches with one at Surfside, two at Surfside Beach and one at

Quintana. A total of 12 more were found north of Brazoria County along Galveston Island and the Bolivar peninsula. In addition, there was a single Loggerhead sea turtle nest found on the Bolivar peninsula during the 2008 nesting season. Nesting season for sea turtles in Texas begins in April and extends through July.

Marine Mammals

Five species of endangered baleen whales, including the blue whale (*Balaenoptera musculus*), sei whale (*B. borealis*), fin whale (*B. physalus*), humpback whale (*Megaptera novaeangliae*), and northern right whale (*Eubalaena glacialis*), and one toothed whale, the sperm whale (*Physeter macrocephalis*), have been observed occasionally in the GOM. The observations of baleen whales have been rare and they are considered extralimital (MMS 2002). One exception was the observation of a mother and calf northern right whale sighted off of Corpus Christi, Texas, on January 16, 2006. Similarly, a juvenile humpback whale was observed near Bolivar in 1992 (Davis and Schmidly 1994). North Atlantic right whales spend most of the year off the coast of New England and Canada. From November to April, females migrate down to the south Atlantic coast of the U.S. to their only known calving grounds off of the Georgia and north Florida coasts. They are extremely rare within the GOM (NOAA 2006).

Of the six endangered whale species, only the sperm whale is known to have resident populations in the GOM (NOAA 2003). One other marine mammal, the Florida Manatee, is a permanent resident of the northern GOM. Neither the sperm whale nor the Florida manatee is expected near the proposed offshore platforms or pipeline.

Although the sperm whale is a regular inhabitant of the GOM, it is a pelagic species that favors depths much greater than those in the Project area. The manatee favors shallower water and only rarely ventures as far west as the Project site, which doesn’t contain any seagrasses for foraging. Because the five other species of endangered cetaceans are not regular inhabitants of the GOM and are rarely associated with the habitat in the Project area, they are not expected to be affected.

Twenty-nine species of marine mammals are known to occur in the waters of the GOM (MMS 2002; Davis et al. 2000). Based upon the geographic location and depth of the proposed TOPS, only two non-endangered species are considered likely to be present in the Project vicinity: the bottle-nosed dolphin and the Atlantic spotted dolphin (Holliman 1979).

Table 3.9-1 Federal and State-Listed Endangered and Threatened Species Potentially Occurring Within the Proposed Project Vicinity Brazoria and Galveston Counties, Texas

Common Name	Scientific Name	Federal Status	State Status	Comments
Plants				
Texas prairie dawn	*Hymenoxys texana*	E	E	Occurs in similar soils in adjacent counties
Birds				
Bald Eagle	*Haliaeetus leucocephalus*	DL	T	Near rivers & large lakes; nests in tall trees or on cliffs near
Brown Pelican	*Pelecanus occidentalis*	LE	E	Coastal, near shore areas
Piping Plover	*Charadrius melodus*	LT	T	Beaches & bayside, mud or salt flats
Reddish Egret	*Egretta refuscens*		T	Brackish marshes, shallow salt ponds & tidal flats
White-faced Ibis	*Plegadis chihi*		T	Freshwater marshes, sloughs, & irrigated rice fields
White-tailed Hawk	*Buteo albicaudatus*		T	Prairie, cordgrass flats, & scrub-live oak
Whooping Crane	*Grus americana*	LE	E	Fresh and brackish marshes
Wood Stork	*Mycteria americana*		T	Prairie ponds, flooded pastures or fields, ditches, & other
Reptiles				
Green Sea Turtle	*Chelonia mydas*	LT	T	Gulf & bay system; shallow water seagrass beds, barrier
Hawksbill Sea Turtle	*Eretmochelys imbricate*	LE	E	Gulf & bay system; shallow water seagrass beds, barrier
Kemp's ridley Sea Turtle	*Lepidochelys kempii*	LE	E	Gulf & bay system; shallow water seagrass beds, barrier
Leatherback Sea Turtle	*Dermochelys coriacea*	LE	E	Gulf & bay system; shallow water seagrass beds, barrier
Loggerhead Sea Turtle	*Caretta caretta*	LT	T	Gulf & bay system; shallow water seagrass beds, barrier

Table 3.9-1 Federal and State-Listed Endangered and Threatened Species Potentially Occurring Within the Proposed Project Vicinity Brazoria and Galveston Counties, Texas

Common Name	Scientific Name	Federal Status	State Status	Comments
Mammals				
West Indian Manatee	*Trichechus manatus*	LE	E	Gulf & bay stream

E = Endangered: Species in danger of extinction throughout all or a significant portion of its range
T = Threatened: Species likely to become endangered within the foreseeable future throughout all or a significant portion of its range
LT-PDL= Federally Listed Threatened; Proposed for Delisting
T/SA; NL = Threatened by Similarity of Appearance; Not Federally Listed

3.10 Water Resources and Protected Habitats

Certain habitats are of particular concern in order to retain biological species and ecological processes. These habitats include known areas of species concentrations or areas important to reproduction, feeding, or migration; areas of high species diversity or high biological productivity; rare or unique habitat types; and habitats of rare, threatened, or endangered species. An area that is particularly fragile, unique or small size is likely to be of special concern. Management of such areas involves the assessment of two sets of factors; importance and sensitivity. Additional species and habitats, protected under federal authority, are presented in Topic Report 3, “Biological Resources”, of the DWP environmental report. Special aquatic sites and protected habitats include seagrass beds, oyster reefs and other hard bottom areas, wetlands and waterbodies, mudflats, coral reefs (which are well south of the Project area and unlikely to be affected), National Marine Sanctuaries (NMS) and other Marine Managed Areas (MMAs), and EFH (particularly Habitat Areas of Particular Concern). Other coastal and offshore habitats that may be present in the Project area are also described below.

3.10.1 Special Aquatic Sites/Protected Habitats

Seagrass Beds – Seagrass habitat is not expected to be present in the Project area due to the following limiting factors: low light penetration, high sedimentation, total suspended solids, and wave energy. Seagrass habitat is likely limited along the Freeport, Texas coastline as there are no barrier islands to provide protection from wave energy and sediment disturbance. Only 6 ha (14 ac) of seagrasses were mapped in a 21,400 ha (52,900 ac) area extending from the Gulf shoreline to the GIWW between Freeport southwestward to East Matagorda Bay in 2002 (White et al. 2005). This study area is located more than 30 miles from the offshore terminal location and more than 4 miles from the closest portion of the pipeline to shore.

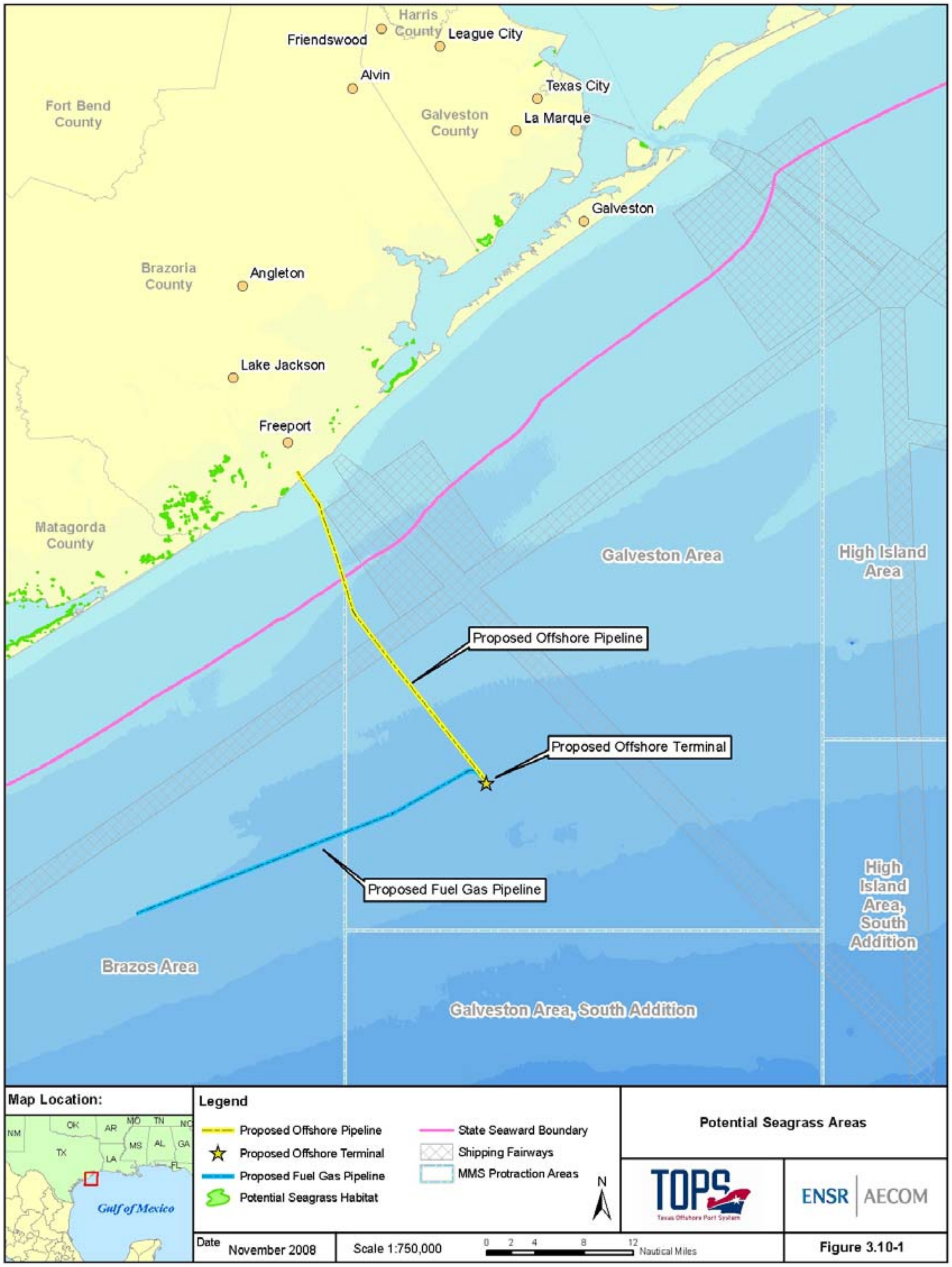
According to the data presented by the NOAA National Coastal Data Development Center (NCDDC) ArcIMS program, potential seagrass habitat has been identified along the Texas coast in the vicinity of Freeport (NOAA NCDDC, 2008). Additionally, potential seagrass habitat has been identified by the USFWS NWI near the project location (Figure 3.10-1). The area of potential seagrass habitat is located over 28 miles from the Terminal location and over one mile from the Offshore Pipeline landfall.

In addition to reviewing published reports, TOPS has conducted informal consultation with NOAA, USFWS, and TWPD regarding the presence of submerged aquatic vegetation (SAV) in the Project area (Appendix 1.D of the DWP application). TOPS will also undertake survey for SAV as access for environmental survey is granted. A desktop review of recent color infrared aerial photography suggests that SAVs may be present within the Project area near the landfall location of the Offshore Pipeline. TOPS will continue coordination efforts with the resource agencies and supplement the desktop analysis as information becomes available.

Oyster Reefs/Hard Bottom Areas — Oyster reef habitat has the potential to be found in the general area of the Project, near the mouths of estuaries in areas with low to moderate wave action. According to the NCDDC ArcIMS program, oyster reefs have not been identified along the Texas coast from Sabine Pass to High Island (NOAA NCDDC 2007). Similarly oyster reefs were not identified in this region by USGS data sources (USGS 2007). The majority of the oyster fishery as well as the oyster reefs in Texas are located within the Galveston Bay area (80-90 percent) with some additional areas in the Corpus Christi-Aransas Bay area (Kilgen and Dugas 1989). Though salinites of the open GOM would preclude the existence of live oyster reef, results of side-scan interpretation of a geophysical survey conducted on behalf of TOPS (please refer to the DWP license application, Exhibit I) confirm the finding that oysters are not present along the proposed Offshore pipeline corridor.

Other hard-bottom habitat found within the Project area includes a remnant barrier island called Freeport Rocks. Freeport Rocks is located in Lease Block BR 335, along the proposed offshore pipeline route, and made up of very hard clay to rock. It is unlikely there is any calcareous reef material but there was some shell and coral rubble in test cores collected at the site. Although not a coral reef, this hard-bottom area represents a biologically sensitive environment. The proposed pipeline route was adjusted to clear this area by nearly 100 feet.

Figure 3.10-1 Potential Seagrass Areas



Wetlands and Waterbodies – Based on preliminary field surveys supplemented with a desktop analysis of aerial imagery to delineate the location and extent of aquatic resources, the Project area, including additional temporary workspaces, contains approximately 259.5-acres of potentially jurisdictional wetlands, approximately 0.3 acre of SAVs, and an additional 21.2-acres of jurisdictional waterbodies, including streams, rivers, and estuarine waters. The area of the GOM within the approximate 200-foot-wide (61 m) construction ROW for the proposed 34.2 mile Offshore Pipeline is 828.6 acres. It is understood that the GOM within the Project area from the offshore platforms to the annual high tide line on the beach is considered jurisdictional by the USACE.

Wetlands in the project area include saline and brackish coastal marshes dominated by salt tolerant vegetation near the coast and freshwater emergent marsh further inland. Saline and brackish marshes near Freeport and at the project terminus at Texas City contain vegetation including *Spartina alterniflora*, *Schoenoplectus americanus*, *Distichlis spicata*, *Spartina patens*, *Baccharis halimifolia* and a number of other salt tolerant species. Freshwater wetlands in the project area occur in roadside ditches and along natural and man-made drainages and are dominated by *Typha latifolia*, *Carex* spp., *Scirpus* spp., *Eleocharis* spp., and a variety of freshwater emergent vegetation. Appendix E contains the USACE wetland delineation report and data sheets for the wetlands identified within the project ROW.

Fifty-four waterways, bayous, unnamed agricultural ditches, road side ditches, and drainages will be crossed by the Project within the workspaces associated with the 47-mile crude oil transmission pipeline, crude oil booster pump station, and the Texas City Crude Terminal (Table 3.10-1).

The Texas Water Development Board (TWDB), in its 2006 Regional Water Plan for Region H, which includes Brazoria and Galveston Counties, and under authority granted it under the Texas Water Code (31 TAC § 357.8 of the Texas Administrative Code), has recommended for designation two stream segments, within or immediately adjacent to the Project area, as Ecologically Unique River and Stream Segments. Bastrop Bayou, within TCEQ stream segment 1105, and within the Brazoria NWR immediately south of the Project area is the ecologically significant segment (TWDB 2006). Austin Bayou from its confluence with Bastrop Bayou north to FM 2004 is the ecologically significant segment (TWDB 2006). Designation of stream segments recognizes the biological functions of the waterbody with respect to water quality, biodiversity, location in relation to conservation areas, hydrologic functions, and threatened or endangered species utilization. Designation as ecologically unique places prohibition on state agencies for funding reservoir projects within waters so designated. Table 3.9-1 also classifies those waterways within the Project area that have unique ecological value as defined herein.

Table 3.10-1 Waterbodies crossed by the proposed Project

Number	ID	MP Start	MP End	303(d) Listed?	Eco Sig?
1	GOM	n/a	Onshore	n/a	n/a
2	GIWW	0.5	0.6	No	No
3	Old Brazos River	4.3	4.4	No	No
4	Dow Barge Canal	5.3	5.3	No	No
5	East Union Bayou	6.4	6.4	No	No
6	Oyster Creek	9.3	9.3	No	No
7	Ditch/Canal	11.8	11.8	No	No

Table 3.10-1 Waterbodies crossed by the proposed Project

Number	ID	MP Start	MP End	303(d) Listed?	Eco Sig?
8	Big Slough	12.7	12.7	No	No
9	Tributary from Big Slough	14	14	No	No
10	Tributary from Bastrop Bayou	14.4	14.4	No	No
11	Tributary from Bastrop Bayou	15.6	15.6	No	No
12	Bastrop Bayou	15.7	15.8	No	Yes
13	Austin Bayou	19.5	19.5	No	Yes
14	Ditch/Canal	19.7	19.7	No	No
15	Ditch/Canal	21.3	21.3	No	No
16	Ditch/Canal	21.7	21.7	No	No
17	Ditch/Canal	23.1	23.1	No	No
18	Ditch/Canal	23.2	23.2	No	No
19	Ditch/Canal	23.6	23.6	No	No
20	Ditch/Canal	23.6	23.6	No	No
21	Ditch/Canal	23.7	23.7	No	No
22	Ditch/Canal	24.3	24.3	No	No
23	Ditch/Canal	24.4	24.4	No	No
24	Ditch/Canal	24.6	24.6	No	No
25	Ditch/Canal	24.6	24.6	No	No
26	Ditch/Canal	24.7	24.8	No	No
27	Ditch/Canal	25.0	25.0	No	No
28	Ditch/Canal	25.6	25.6	No	No
29	Ditch/Canal	26.4	26.5	No	No
30	Chocolate Bayou	27.5	27.7	No	Yes
31	Ditch/Canal	29.2	29.3	No	No
32	Ditch/Canal	29.4	29.5	No	No
33	Ditch/Canal	30.4	30.4	No	No
34	Ditch/Canal	30.5	30.5	No	No
35	Ditch/Canal	31.0	31.0	No	No
36	Ditch/Canal	31.5	31.5	No	No
37	Ditch/Canal	31.6	31.6	No	No
38	Ditch/Canal	32.0	32.0	No	No
39	Ditch/Canal	32.1	32.1	No	No
40	Persimmon Bayou	32.2	32.3	No	Yes
41	Ditch/Canal	32.4	32.4	No	No
42	Ditch/Canal	32.5	32.5	No	No
43	Ditch/Canal	33.0	33.0	No	No
44	Halls Bayou	34.4	34.4	No	Yes
45	Ditch/Canal	38.0	38.0	No	No
46	Ditch/Canal	38.1	38.2	No	No

Table 3.10-1 Waterbodies crossed by the proposed Project

Number	ID	MP Start	MP End	303(d) Listed?	Eco Sig?
47	Ditch/Canal	38.4	38.4	No	No
48	Ditch/Canal	38.5	38.6	No	No
49	Ditch/Canal	38.6	38.7	No	No
50	Diversionary Canal/Basford Bayou	40.8	41.0	No	No
51	Ditch/Canal	44.6	44.6	No	No
52	Tributary of Highland Bayou	44.7	44.7	No	No
53	Tributary of Highland Bayou	45.6	45.6	No	No
54	Canal	45.7	45.7	No	No

Mudflats – A desktop analysis of color infrared aerial photography suggests that there are no mudflats in proximity to the Project area. TOPS will supplement this finding with additional information as the environmental surveys are completed.

Coral Reefs – Coral reefs are found within the GOM, but only far south of the Project area.

Managed Areas – MMAs are places in the ocean, coastal, and estuarine ecosystems where vital natural and cultural resources are given greater protection than in surrounding water (MPA 2006). These sensitive marine habitats are managed by federal, state, or local agencies. There are more than 1,500 MMAs in the U.S., 321 of which are in the GOM (MPA 2006). The GOM MMAs include NMSs, Federal Fishery Management Zones, National Wildlife Refuges (NWRs), National Estuarine Research Reserves, and Artificial Reefs. These habitats are offered varying degrees of protection from applicable regulatory agencies such as NOAA Ocean Services, NOAA Fisheries, USFWS, the National Park Service (NPS), and the USCG, as well as state agencies. The proposed Project does not cross any MMAs. The closest MMA to the Project is a sunken Liberty Ship, *George Vancouver*, more than three miles from the preferred Offshore Pipeline alignment (see Figure 3.10-2).

Areas along the GOM coastline that are within approximately 50 miles (64 km) of the proposed landfall of the Offshore Pipeline include Audubon sanctuaries, NWRs, state parks, and Wildlife Management Areas (WMA) (Table 3.10-2). For a description of each resource area listed in Table 3.10-2, see the DWP application Topic Report 7, "Land Use, Recreation, and Aesthetics".

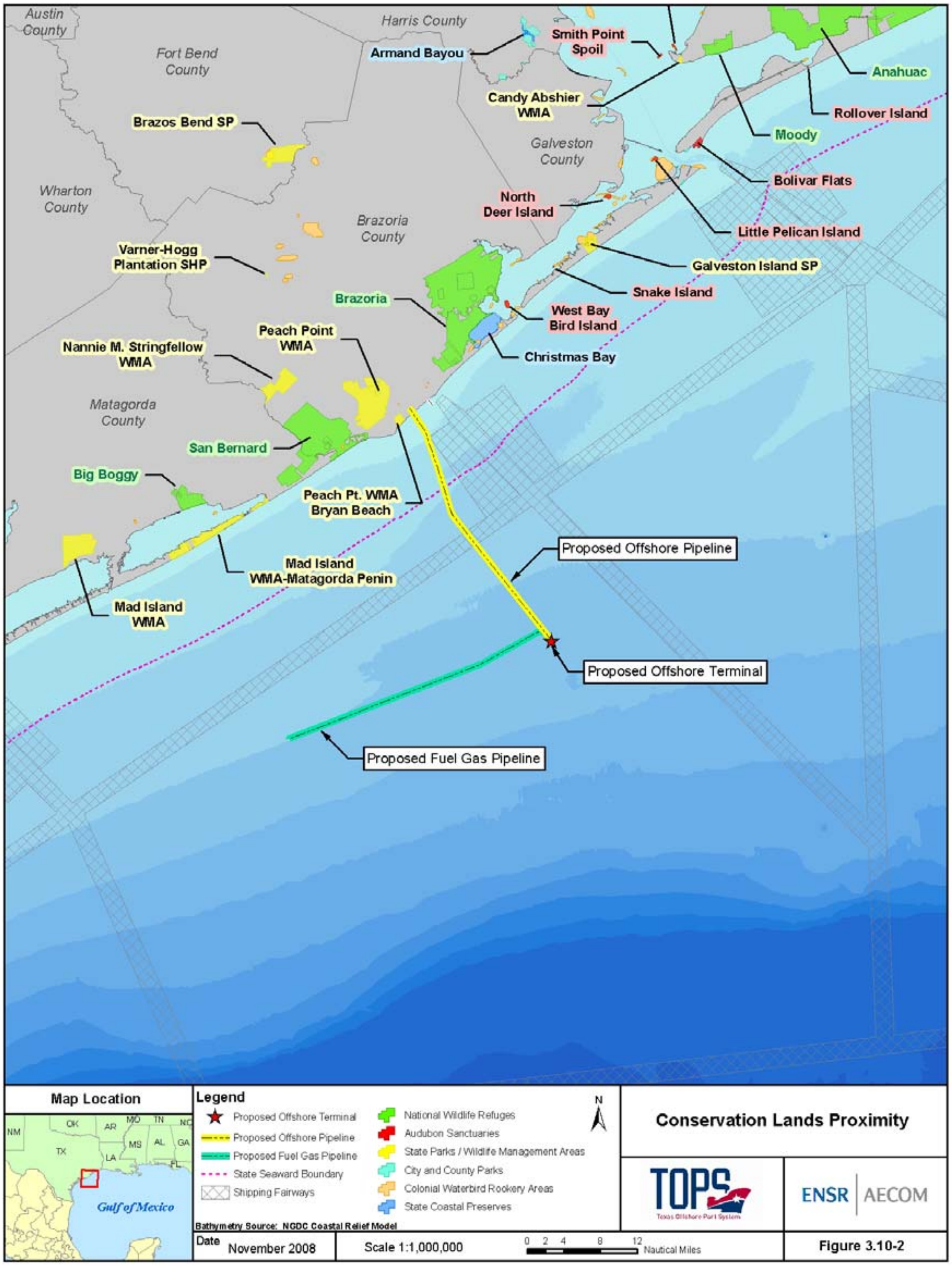
The closest NMSs to the proposed project area are the East and West Flower Garden Banks NMS, and the Stetson Bank NMS. The two Flower Garden Banks are 12 miles apart and located 100 - 115 miles directly south of the Texas/Louisiana border. Stetson Bank is located about 70 miles south of Galveston, Texas. The East Flower Garden Banks NMS is located approximately 98 miles SE of the proposed project, the West Flower Garden Banks NMS is located approximately 88 miles SE of the proposed project, and the Stetson Bank NMS is located approximately 52 miles SE of the proposed project.

Brazoria NWR and Justin Hurst WMA, as described in Section 3.2.1, are located near the Project in Brazoria County. Brazoria NWR is located adjacent to the Onshore Pipeline near Austin Bayou and south of FM 2004. The proposed ROW lies several hundred feet to the north of the northern boundary of the refuge and north of the ROW for FM 2004. Justin Hurst WMA managed by TPWD is located approximately 1.5 miles to the west of the proposed Onshore Pipeline alignment. Other managed areas, including Galveston Bay, Christmas Bay, Galveston Island State Park, San Bernard NWR, and the West Bay Bird Island detailed in Table 3.10-2 are 2 miles or more from the proposed Onshore Pipeline alignment and beyond the scope of additional detailed impact analysis carried forward.

Table 3.10-2 Protected Nearshore Habitats within 50 Miles

Resource Area	Managing Authority	Description/ Comments	Approximate Distance of the Onshore Approach (miles)
Galveston Island	TPWD	State Park	8.1
Galveston Bay	TCEQ	National Estuary Program	2.0
West Bay Bird Island	Audubon	Audubon Sanctuary	5.2
Christmas Bay	TPWD	Texas Coastal Preserve	6.8
Brazoria NWR	USFWS	National Wildlife Refuge	0.1
Justin Hurst WMA (Bryan Beach)	TPWD	Wildlife Management Area	1.5
San Bernard NWR	USFWS	National Wildlife Refuge	6.4
Mad Island WMA	TPWD	Wildlife Management Area	42.7

Figure 3.10-2 Proximity of the Project to Conservation Lands



Essential Fish Habitat – EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding and growth to maturity. Commercial and recreational fisheries resources in the Federal waters of the GOM are managed by the Gulf of Mexico Fishery Management Council (GMFMC) and NOAA Fisheries. Fishery management plans (FMPs) developed by the GMFMC include:

- Shrimp Fishery of the Gulf of Mexico, U.S. Waters;
- Red Drum Fishery of the Gulf of Mexico;
- Reef Fish of the Gulf of Mexico;
- Coastal Migratory Pelagic Resources (mackerels) in the Gulf of Mexico;
- Stone Crab Fishery of the Gulf of Mexico and South Atlantic;
- Spiny Lobster in the Gulf of Mexico and South Atlantic; and
- Coral and Coral Reef of the Gulf of Mexico.

EFH for highly migratory species (HMS) is described in separate FMPs, including Final Fishery Management Plan for Atlantic Tuna, Swordfish, and Sharks (NMFS 1999a), and Amendment I to the Atlantic Billfish Fishery Management Plan (NMFS 1999b). Some species inhabit EFH for only a particular life history stage. In general, for each species managed by GMFMC, inshore EFH is the estuaries where the species are “common,” “abundant,” and “highly abundant,” and offshore EFH is adult areas, spawning areas, and nursery areas for each species.

EFH is present in the Project area for numerous species, as determined by analysis of maps provided by the NMFS Fisheries Ecology Branch and the NOS-SEA Division. Species listed with EFH in the Project area and their affected life stages are presented in Table 3.10-3. In addition to the information herein, Appendix 3.B of Topic Report 3, “Biological Resources” (Appendix C), contains an assessment of the Project’s potential impacts on EFH.

Table 3.10-3 Species Listed with EFH in Project Area and Affected Life Stages

SPECIES	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Brown Shrimp	■	■	■	■	■
White Shrimp	■	■	■	■	■
Pink Shrimp	■	■	■	■	■
Red Drum	■	■	■	■	■
Red Grouper		■	■	■	
Scamp Grouper				■	
Red Snapper	■	■	■		
Lane Snapper	■	■	■	■	■
Greater Amberjack	■	■	■	■	■

Table 3.10-3 Species Listed with EFH in Project Area and Affected Life Stages

SPECIES	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Lesser Amberjack			■	■	
Stone Crab			■	■	
King Mackerel	■	■	■	■	■
Spanish Mackerel	■	■	■	■	■
Cobia	■	■	■	■	■
Dolphin	■	■	■	■	■
Lemon Shark			■		
Blacktip Shark			■		
Bull Shark			■		
Bonnethead Shark			■	■	
Atlantic Sharpnose Shark			■	■	

3.10.2 Coastal Habitats

In addition to the habitats described in Section 3.10.1, Special Aquatic Sites/Protected Habitats, the following habitats may be found in the coastal region of the Project area.

Soft-Bottom Habitats — Soft bottom habitats are unvegetated water bottoms with unconsolidated sediments comprised of sands, silts, and clays. Coarse sediments make up the very shallow nearshore bottoms from the Rio Grande River to central Louisiana and comprise the dominant bottom type from shore to deeper water in the vicinity of the Project. In general, infaunal density decreases with a combination of increasing percent of fine sediments and increasing depth.

Meiobenthos species inhabiting the soft bottom can be either permanent or temporary residents of the sediment, and include nematodes, kinorhynchs, polychaetes, harpacticoid copepods, some foraminifera, and other large protozoans. The density of meiofauna typically increases with depth and is closely correlated with sediment grain size (Phillips and James 1988). Meiofaunal abundance generally is higher when the sand content is greater than 60 percent, and the interstitial spaces are large and well oxygenated. There is a trend toward decreasing abundance with depth on the Texas–Louisiana Continental Shelf, which may represent a trend from high to low sand content. Nematodes numerically dominate at all depths, followed by harpacticoid copepods, polychaetes, ostracods, and kinorhynchs (Phillips and James 1988).

Macrobenthic species of soft bottom communities include polychaetes, crustaceans, and mollusks. Polychaetes dominate the macrobenthos, with peak densities occurring in January. Macrobenthic densities off the proposed study area tend to be much higher on both the shelf and slope, compared to south Texas but lower than peak values recorded off Louisiana (Phillips and James 1988). In the Bucaneer Gas and Oil Field Study off Galveston, macrobenthic densities ranged from 4,400 individuals/m^2 to 7,300 individuals/m^2 (Phillips and James 1988).

Artificial Reefs — Artificial reefs generally are comprised of various materials such as shell, limestone, concrete rubble, and metal debris (MDMR 1999). In the northern Gulf, manmade structures like jetties, pilings, groins and breakwaters provide habitat for intertidal invertebrate species and associated fishes that were essentially absent, especially west of the Mississippi River (Britton and Morton 1989). In Texas, there are eight large inlets or ship channels protected by jetties and many smaller boulder jetties and concrete and/or rubble breakwaters along bay and barrier island shorelines. The flora and fauna of jetties is a combination of epibenthic organisms from nearby offshore areas and oyster reefs, and tropical species that prefer artificial substrates (Britton and Morton 1989). The transitional character of the area coupled with low tidal ranges and the short time the community has had to develop has resulted in one of the simplest rocky shore communities anywhere in the world.

3.10.3 Offshore Habitats

Offshore habitats in the GOM include soft bottom communities, hard/live bottom habitats, artificial reefs, Sargassum mats, and the water column itself. The following paragraphs summarize each of these different habitats that may be expected in the vicinity of the proposed offshore Project area.

Water Column — The biota found in the pelagic, offshore water column include phytoplankton, bacteria, zooplankton and larger animals such as fish, reptiles, cephalopods, crustaceans, and marine mammals. In general, the diversity of planktonic species decreases with decreased salinity and biomass decreases with distance from shore. Temperature, salinity, and nutrients limit the geographical and vertical ranges of many biota.

Sargassum — Sargassum is an essential component of the water column habitat in the GOM. Sargassum is a brown alga that forms dense floating mats in tropical Atlantic waters and the GOM. The floating mat provides habitat to a wide range of species in the pelagic water column (MMS 2002). Animals associated with Sargassum include hydroids, copepods, fish (54 species), crab, gastropods, polychaetes, bryozoans, anemones, sea spiders, and stages of sea turtles. Sargassum acts as a vehicle for dispersal of some of its inhabitants and might be important in the life histories of many species of fish. It provides its inhabitants with a substrate, protection against predation, and concentration of food in the open GOM (GMFMC 2004). Large predators associated with the Sargassum complex include amberjacks (*Seriola dumerili*), dolphin (*Coryphaena hippurus*), and almaco jacks (*S. rivoliana*).

Soft Bottom — The major benthic habitat of the northern GOM consists of a soft muddy bottom, dominated by polychaetes (bristleworms). The soft bottom sediments of the northwestern Gulf shelf represent a complex array of particle size distribution patterns with much local variation. Polychaete worms, followed by crustaceans and mollusks generally dominate infaunal communities on the GOM continental shelf. Epifaunal communities include crustaceans, echinoderms, mollusks, hydroids, sponges, and soft and hard corals. Shrimp and demersal fish also are associated closely with the benthic community (MMS 2002). The distributions of these animals are influenced not only by sediment composition and grain size, but also by temperature, salinity, and distance from shore (MMS 2002). Illumination, food availability, currents, tides, and wave shock also play a role in the distribution of benthic fauna.

Hard/Live Bottom — Hard bottom refers to areas with consolidated sediments consisting of limestone, siltstone, sandstone, coral, or shell and shell fragments. Live bottoms are hard bottoms with an associated epifauna of sponges, hydroids, corals, and sea whips, and a dense fish population (Cummins et al. 1962). The closest major hard bottom habitat is the East and West Flower Garden Banks National Marine Sanctuary located more than 88 miles (130 km) southeast of the proposed offshore Terminal location. The Stetson bank is located 52 miles to the southeast of the offshore Terminal location.

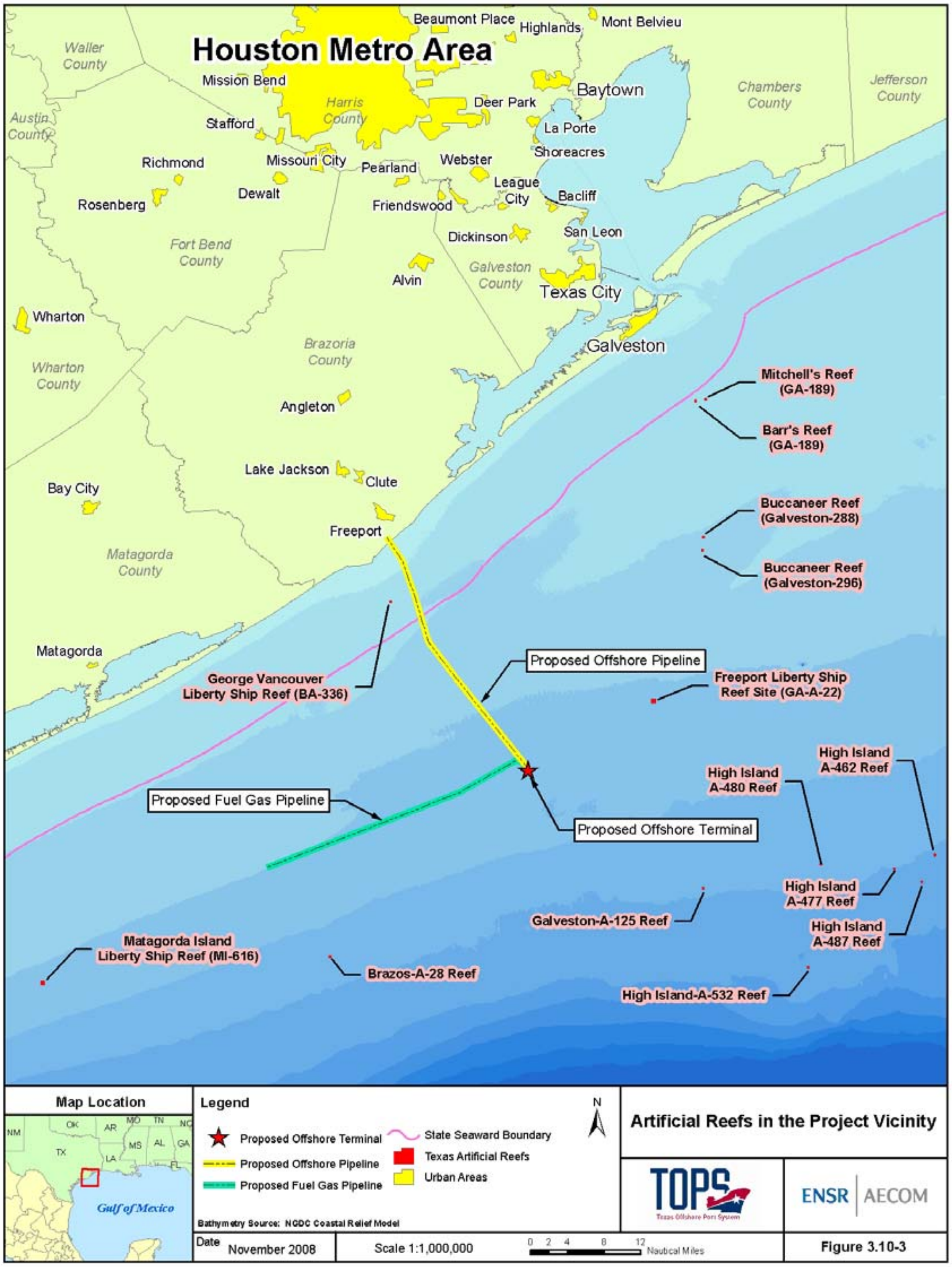
Artificial Reefs —In the central and western GOM, approximately 4,000 oil-drilling platforms (oil rigs) add considerable structure to a region of typically soft bottom with low relief (MMS 2000). Using Shinn's (1974) estimate of 8,000 m^2 of hard substrate for every 30 m of submerged structure, Beaver (2002) calculated that Gulf platforms represent 9,835 ac (3,980 ha) of hard substrate in shallow waters (30 m or less) available for colonization by sessile organisms.

Texas artificial reefs are mostly retired oil and gas platforms, liberty ships, and military hardware (battle tanks and armored vehicles) (MMS 2007). Each reef encompasses on average an area of approximately 0.06 square miles. Artificial reefs in the general area of the proposed Project are depicted in Figure 3.10-3. Additional discussion of the Project's location relative to artificial reefs can be found in Topic Report 7, "Land Use, Recreation and Aesthetics", of the DWP application.

Anthropogenic structures and artificial reefs can have positive ecological impacts in the GOM. Structures placed for the purposes of oil and gas production that, unintentionally, are acting as artificial reefs for the concentration of fish communities, as well as intentionally placed artificial reefs, are being given serious attention as contributing to fishery habitat enhancement in the National Fishing Enhancement Act of 1984.

Cryptic fish such as blennies, as well as grazers (butterfly fish and sheepshead) appear trophically dependent upon the biofouling community of the artificial reef for food or cover. Atlantic spadefish, lookdown, Atlantic moonfish, red snapper, large tomtate, large groupers, and the creole-fish are trophically independent of platforms but often represent most of the fish biomass around the platforms (GMFMC 2004). Most of the large predators around petroleum platforms are believed to be highly transient. Both pelagic prey and predator species are attracted to structures.

Figure 3.10-3 Artificial Reefs in the Project Vicinity



4.0 Potential Impacts to the Environment

The proposed Port, Platforms, Pipelines, and Onshore Facilities have been sited and designed to avoid and minimize impacts to protected biological and cultural resources to the extent practicable. The depth of the Port and SPMs was selected so that the facility can service deep draft vessels currently unable to visit shoreside facilities. Pipeline operations also will avoid the risk of nearshore vessel collision and resultant spills. More than 90 percent of the Onshore Pipeline has been sited within or adjacent to existing ROWs or previously impacted areas. The anticipated long-term impacts of the proposed Project include preemption of substrate by anchors which secure the SPMs and piling supports for the associated offshore Platforms, wetland fill associated with the tank terminal, and the conversion of forested wetlands to herbaceous wetlands associated with pipeline installation. Short-term and temporary impacts of vessel traffic, water discharge, turbidity, wetland fill, noise, and lighting will occur during installation of the proposed Port and Pipelines. The use of HDD for the shoreline approach and onshore portions of the pipeline will significantly reduce potential impacts to aquatic and shorebird habitat. Vessel traffic, water intake and discharge, lighting, and air emissions will also cause minor, long-term impacts during the operational phase of the proposed Port. Installation and operations are detailed in Section 2.

The significance of environmental impacts discussed in this section is based on:

- The relative and overall importance of a given resource and whether it is of recreational, ecological, or legal significance;
- The proportion of the resource that would be affected relative to its abundance in the region;
- The sensitivity of the resource to activities associated with the proposed Project; and
- The duration of the ecological impacts associated with effects.

The following criteria are used to determine the significance of impacts. Impacts are considered significant if:

- Any part of the population of a listed, proposed, or candidate threatened or endangered species, under either the Texas Endangered Species Act or Federal ESA, is directly or indirectly affected by reducing its numbers, altering behavior, reproduction, or survival; or if its habitat is lost, disturbed, or restricted in range. Any loss of designated or proposed critical habitat for a listed species would be a significant adverse impact.
- A substantial loss occurs in the population, natural community, or habitat of any native fish, wildlife, or vegetation, or if there is an overall loss of biological diversity or a measurable change in species composition. Substantial is defined as any change that could be detected over natural variability.
- The movement or migration of fish or wildlife is substantially impeded. Substantial impedance would include preventing or severely restricting passage over an area of at least several hundred feet for a period of a week or more.
- Nesting migratory birds, including raptors, protected under the MBTA or BGEPA are directly affected.

- Existing, noxious weed and animal species are introduced, or their range is expanded.
- There is a long-term adverse effect on federally protected wetlands, as defined by Section 404 of the CWA.
- A net loss occurs in the functional habitat value of a sensitive biological habitat, including saltwater marsh, freshwater marsh, brackish water marsh, river mouth, coastal lagoon or estuary, subtidal hard-bottom habitat, major marine mammal haul out or breeding area, major seabird rookery, or Area of Special Biological Significance (ASBS).
- There is a substantial permanent adverse effect on a species or sensitive habitat (e.g., wetland or riparian) identified in Federal, State, local or regional plans, policies, ordinances, statutes, or regulations.

This section describes the potential impacts to land use/land cover, recreation and aesthetics, navigation, shoreline erosion and accretion, water quality, geology, historic properties and cultural resources, socioeconomics, biological resources, and habitats and water resources from the construction and operation of the TOPS Project, and identifies conservation measures that TOPS will implement to avoid and minimize potential impacts.

4.1 Land Use

4.1.1 Construction

The temporary nature of the Offshore construction of platforms and pipelines, and Onshore pipeline installation should not alter land use/land cover distribution in the Project area. Similarly, construction of the proposed surface facilities, including valve site and the Booster Pump Station are cumulatively minor in extent such that these facilities should not contribute to an alteration of land use/land cover class distribution. In addition, surface facilities such as the Texas City Crude Storage Terminal are in existing industrial land use areas and will not alter land use distribution in the Project area.

4.1.2 Operation

Operation of the Project will not alter land use/land cover within the Project area. Facilities have been sited in or adjacent to existing ROWs and previously impacted utility and road corridors. The additional surface facilities, including the Booster Pump Station, valve sites, and tank terminal are small in size or located within existing sites such that land use/land cover will not be impacted.

4.2 Recreation and Aesthetics

4.2.1 Construction

Construction of the TOPS Project will have negligible impact on recreation in the Project area. The Onshore approach and construction of the Onshore FVS should not interrupt beach access or use. The proposed HDD at the shoreline crossing is anticipated to avoid and minimize disturbance to recreational users. Existing access roads will be utilized and only temporary disturbance to the areas at the HDD entry location are anticipated. No impacts to the public boat ramps at Chocolate Bayou or Halls Bayou are anticipated as the pipeline will also be installed by HDD beneath these waterways.

Project construction will impact the aesthetic value of the beach area; however, these impacts are anticipated to be short in duration and temporary as the installation of the pipeline will include restoration of the area. Additional facilities and onshore pipeline construction are likewise anticipated to have minimal short duration and temporary effect on the aesthetic value of the Project area.

4.2.2 Operation

Operation of the Project should have negligible impact on recreational uses. The offshore platforms associated with the Project will be part of a safety zone and recreational fishing around these structures will be prohibited. Given the distance from shore, it is anticipated that few recreational boaters would attempt to utilize the offshore platforms for fishing. Aesthetically, these platforms are too far from shore to interrupt viewshed or site lines from the coastal counties and Project operation will not impact these areas. Onshore, the operation of the pipeline and facilities should not impact recreation in the area as most of the Project components will be buried and co-located in existing corridors. Project operation will not impact the aesthetic value of the area as most of the facilities are buried and co-located in existing corridors.

4.3 Navigation

4.3.1 Construction

Support vessels such as helicopters and supply boats will be utilized for transporting personnel and equipment from the mainland to the Terminal site. Pipeline construction vessels will include barges and tugs. Heightened transportation activity will occur during installation. During operation of the DWP, it is anticipated that there will be one helicopter trip made per day, and support vessel trips will occur as needed. The support vessels will follow recognized shipping routes when traveling between the shore base and the Port Terminal. Increased traffic during installation will be short term and TOPS will attempt to avoid congested traffic times within the GOM.

The Offshore Pipeline route will cross the Coastwise Safety Fairway with a minimum burial depth of 10 feet (3 m). There will not be any permanent obstruction of vessel traffic within the Fairway. TOPS will also coordinate with the USCG throughout construction to ensure that temporary construction activity does not obstruct vessel traffic within the Fairway.

4.3.2 Operation

The increase in vessel traffic due to operation of the proposed Port will result in a negligible contribution to OCS-related vessel traffic in navigation routes (see DWP License application, Topic Report 7, “Land Use, Recreation and Aesthetics”, Appendix 7.A, Marine Traffic and Navigation Report). A maximum of seven carriers, in addition to necessary supply and support vessels, may be present in the Terminal area at any one time. A supply and crew boat will visit the facility at least once a week. The proposed Port will be designed to offload a maximum of two vessels at a time at a maximum design rate of approximately 100,000 BPH. While one or two vessels are offloading, another vessel could be mooring at a free SPM. An anchorage area, located south of the proposed Terminal, can accommodate four anchored ships. The SPMs will be designed to offload the entire contents of ULCCs, VLCC, Aframax, and Suezmax vessels within approximately 24 to 36 hours.

All of the inland waterways are being crossed by bore or HDD. While detail design of the HDD has not been complete, the Projects depths will be in accordance with USACE, Galveston District, policy for crossings of the GIWW and other federally maintained waterways. A minimum depth of cover of five feet is anticipated for crossings of smaller, non-federally maintained waterways. Therefore, no impacts are anticipated related to the Onshore Pipeline construction and operation on inland waterway navigation.

4.4 Shoreline Erosion and Accretion

Potential impacts to shoreline erosion will be negligible as the use of HDD places the onshore entry location of the pipeline at least 1,000 feet shoreward of the MHWM. Additional use of HDD technology at all of the major water crossings crossed by the Project will avoid issues of shoreline retreat and substantially reduce the risk of pipeline exposure. Minor stream crossings that are completed by conventional trench and backfill method will include bank stabilization measures such as vegetation, concrete mat, or riprap to stabilize the slopes and decrease the chance of exposing the pipeline.

4.5 Water Quality

4.5.1 Construction

For detailed discussion of the anticipated impacts to water quality associated with the construction of the offshore structures please refer to Topic Report 2, “Water Use and Quality”, in the DWP application.

Routine discharges from marine construction vessels and potential spills of construction-related fuels and chemicals can potentially result in adverse impacts to local water quality. Each of the vessels involved with installation phase of the proposed Project will operate in accordance with USCG and International Maritime Organization (IMO)–International Convention for the Prevention of Pollution from Ships (MARPOL) requirements to minimize the potential for a release of oils and/or chemicals to the GOM. A project-specific spill response plan will be developed once contractors have been selected, which will be the basis for all offshore installation activities. Each vessel operator will monitor its own operation and will have sorbent materials available to contain and clean up a release, should one occur. Therefore, significant impacts related to spills and releases are not anticipated. In the highly unlikely event of a diesel spill during construction/installation, the diesel fuel immediately would begin dissipating. Because diesel fuel is a mixture of relatively light hydrocarbons, spreading, evaporation, dispersion, and dissolution would occur rapidly, and virtually the entire volume of fuel would have dissipated within 12–24 hours, resulting in minimal impacts to biological resources (ITOPF 2002).

Installation of the Offshore Pipeline will include jetting activities that will displace bottom sediments and result in temporary water column and seafloor disturbances. This procedure is expected to cause minimal local and short-term effects due to the rapid and efficient nature of the method. Biological resources, particularly benthos, in the immediate vicinity of the jetting area are likely to be lost, and the adjacent seafloor will be disturbed; however, the benthos is expected to rapidly recover following construction.

Water quality impacts resulting from onshore construction could include increased surface water runoff, turbidity, and erosion and sedimentation. These issues arise when construction exposes previously undisturbed soils to stormwater or increased surface flows through clearing and grading during site preparation or when restoration does not include timely re-vegetation or soil stabilization measures.

4.5.2 Operation

For detailed discussion of the anticipated impacts to water quality associated with the operation of the offshore terminal please refer to Topic Report 2, "Water Use and Quality", in the DWP application.

As described on the USEPA website (www.epa.gov/owowwtr1/oceans/discharges/403.html), Section 403 of the CWA provides that point source discharges to the territorial seas, contiguous zone, and oceans are subject to regulatory requirements in addition to the technology- or water quality-based requirements applicable to typical discharges. The Section 403 requirements are intended to ensure that no unreasonable degradation of the marine environment will occur as a result of the discharge and to ensure that sensitive ecological communities are protected. These requirements can include ambient monitoring programs designed to determine degradation of marine waters, alternative assessments designed to further evaluate the consequences of various disposal options, and pollution prevention techniques designed to further reduce the quantities of pollutants requiring disposal and thereby reduce the potential for harm to the marine environment.

Wastewater discharges from the proposed port facility will be subject to a NPDES wastewater discharge permit, as issued by the USEPA in accordance with Section 403 of the CWA. A copy of the NPDES permit application filed with USEPA will be provided to USACE upon request.

The NPDES permit that will be issued by USEPA Region 6 will address the various operational discharges from the Project platforms (cooling water, water treater brine and filter backwash, grey and black water discharges, discharges from the open drain system, etc.) and discharges associated with hydrostatic testing of the various project pipelines. Permit conditions and monitoring requirements will be established for the discharges based on its anticipated characteristics.

Operational water discharges from the onshore facilities will be limited. Wastewater will be discharged to an approved municipal treatment facility for the necessary sanitation facilities at the Booster Pump Station and Texas City Crude Terminal.

A TCEQ permit will be necessary for the intake of hydrostatic test waters. A RRC permit will be required for the discharge of this water and for construction-related stormwater runoff.

4.5.3 Mitigation

Measures implemented by TOPS to ensure maintenance of state surface water quality standards include minimization of the project ROW in sensitive habitats including wetlands and waterbodies, use of HDD technology to avoid disturbance to such sites, co-locating the pipeline within previously impacted ROW to the maximum extent practicable, the development and implementation of spill response and stormwater management plans, and construction best management practices (BMPs). BMPs to be utilized in the construction and post-construction phases of the project will include, but not be limited to, stockpiling of topsoil for revegetation of grasslands and wetland areas, silt fencing, straw/hay bales, rock dams, temporary vegetation, compost or mulch filter berms or socks, and bank stabilization, including the use of concrete mats or riprap. Temporary construction matting will be utilized in saturated soils to minimize the impacts on wetland areas. A SWPPP will be developed to detail the BMPs that will be utilized for the maintenance of surface water quality. Appendix B contains typical BMP details TOPS anticipates utilizing during Project construction and for post-construction stabilization.

An assessment of oil spill frequency and environmental risk associated with operation of the Onshore Pipeline has been prepared specifically for the TOPS Project (Appendix I) and a discussion of consequences of a spill on biological communities can be found in Section 4.9. In the unlikely event of a release of drilling fluid associated with the approximately twenty HDDs proposed, TOPS has included a HDD Contingency Plan (Appendix H) that will serve as a response and recovery plan.

4.6 Geology

A discussion of the Project impacts related to offshore geologic hazards is detailed in Topic Report 6, “Geology and Sediments”. Onshore impacts arising from geologic hazards are not anticipated; however, detailed design of the pipeline and surface features will take in to account hazards including faulting and subsidence.

4.7 Historic Properties and Cultural Resources

The results of geophysical surveys, including bathymetry, magnetometer, side-scan sonar, sub-bottom profiler surveys conclude that the vast majority of the Project area sonar contacts and magnetic anomalies identified were interpreted as probable modern debris. A total of four unidentified sonar contacts and 13 unidentified magnetic anomalies were recorded in the preferred alignment. Avoidance of these contacts and anomalies by a distance of at least 200 feet is the recommended action.

No sites potentially eligible for listing on the National Register of Historic Places were identified within the Onshore portion of the Project. However, additional information will be provided in areas where survey access has not yet been obtained and these findings will supplement the cultural resources report prepared in coordination with the USACE staff archeologist and SHPO. TOPS will continue coordination with USACE, SHPO, USCG, and MMS regarding the Project’s compliance with NHPA.

4.8 Socioeconomics

While there may be socioeconomic impacts on adjacent counties in Texas associated with the labor force, material purchases, and other items, impacts are expected to be concentrated in Brazoria and Galveston Counties, though minor impacts will be expected along the Gulf Coast from Freeport to Port Arthur. An analysis of the economic impact to the study area of Brazoria and Galveston Counties is provided in Topic Report 5, “Socioeconomics”, of the DWP application. TOPS will result in the creation of hundreds of temporary construction jobs associated with the Offshore and Onshore facilities and the creation of more than 80 permanent jobs related to the Offshore operations and Onshore support. There are no business or residential displacements proposed as part of the Project.

4.9 Biological Resources

Aspects of construction and operation that have the potential to impact the biological resources in the Project area are described in this section. While a summary is provided below, a more detailed discussion of the biological impacts specifically related to the Project’s impacts to the marine environment can be found in the DWP application’s Topic Report 3, “Biological Resources”.

Similarly, a detailed discussion of the Project's impacts upon water use and water quality specifically related to the construction and maintenance of the offshore facilities can be found in Topic Report 2, "Water Use and Quality". Details regarding the construction and operation of the TOPS Project are presented in the DWP environmental report's Topic Report 1. "General project Description and Location".

4.9.1 Construction

Offshore structures

Construction of the offshore structures, including the placement of the SPMs and platforms, associated pile driving activities, and maneuvering and anchoring of construction support vessels, will result in unavoidable but minor impacts to the biological resources in the area, particularly the benthic community. TOPS anticipates that any non-motile biological resources in the footprint of the structures will be lost and approximately 1.15 acres (0.46 hectares) of soft-bottom habitat will be permanently displaced by the Terminal footprint. Mobile organisms that are displaced during construction are expected to quickly return following construction. With the exception of the benthic community underlying the Port's footprint, the benthos are expected to rapidly recover following construction (Brooks et al. 2006). Construction impacts of the proposed platforms beyond the permanent footprint are anticipated to be temporary and short-term.

Benthic invertebrates will be affected primarily by the direct preemption of habitat within the permanent footprint of the Terminal and Pipeline. The area of impact is relatively small, and the disturbance is relatively minor, so it is not expected to have a significant effect on the benthic invertebrate community as a whole.

The Project location was selected to occur within soft-bottom habitat, which is relatively robust and recovers rapidly following a disturbance. Recolonization and recruitment will rapidly restore the short-term disturbance caused by construction (e.g., pipeline trenching, anchoring).

Planktonic invertebrates will be affected by entrainment, water discharge, lighting, and the potential spills. The number of impacted zooplankton will represent a minute fraction of the population, and because of the immense reproductive capacity of plankton, no significant impacts are anticipated.

Installation of the SPMs and Platforms will have no effect on shorebird populations. Because offshore birds are highly mobile, they are expected to leave the immediate work area during installation and avoid any direct effects. It is possible that migratory birds would occasionally utilize the structures as fall-out points on their migratory paths. While the existence of the structures could potentially benefit such species, TOPS will implement a policy to preclude the harassment or interaction with birds on the inhabited platform under such circumstances.

Marine mammals are not likely to be impacted by construction of offshore structures. The dolphins expected in the Project area are capable swimmers and are likely to avoid the Project area during construction and installation of the offshore structures and pipeline, should conditions become unfavorable. Of the protected whales observed in the GOM, only the sperm whale is known to have resident populations in the GOM. Because the sperm whale typically favors water depths much greater than those in the Project area, the likelihood of impacts from construction is minimal. The manatee only rarely ventures as far west as the Project area and is a shallow water species. Thus, it is highly unlikely to be impacted by construction of offshore structures. The applicant is aware that explosive removal of structures typically used for decommissioning operations will require initiation of Section 7 consultation with the Protected Resources Division of NOAA Fisheries.

Installation of offshore platforms and SPMs will have no effect on nesting or newly hatched sea turtle populations because the activities will occur far from potential nesting sites. Juvenile and adult turtles are highly mobile. They are expected to leave the work area and avoid any direct effects during installation, though there is potential for accidental direct or indirect impacts, such as collisions with construction vessels or oil spills from these vessels. Displacement from the Project area would constitute a minor, short-term impact.

One potential benefit associated with installation of the offshore Terminal is the anticipation that the Terminal will function as artificial hard-bottom, providing a large surface area for epifaunal colonization. In the northern GOM manmade structures like jetties, pilings, groins and breakwaters provide a unique habitat for hard-bottom taxa and associated nekton, particularly in areas previously void of hard substrate (Britton and Morton 1989). Oil and gas platforms in marine waters have been found to be colonized by a diverse array of microorganisms, algae, and sessile invertebrates including barnacles, oysters, mussels, soft corals (bryozoans, hydroids, and octocorals), sponges, and hard-corals (Sammarco et al. 2005). In addition, the diverse hard-bottom community provides habitat and food for many mobile invertebrates and fishes.

Offshore and Onshore Pipelines

The construction of offshore structures will not have a direct impact on coastal habitats though the selection of the offshore pipeline alignment necessarily impacts, to some degree, selection of an onshore pipeline alignment and its resultant impacts. A discussion of the impacts associated with the pipeline installation follows.

Installation of the proposed Offshore Pipeline will result in unavoidable impacts to marine fauna within the construction footprint. The Pipeline will be transported in sections to the conventional pipelay barge, assembled, and placed on the sea floor. The Pipeline will be buried a minimum of three feet below the GOM sediment surface by trenching and jetting and allowed to naturally backfill. Trenching and jetting activities will displace bottom sediments and result in temporary water column and seafloor disturbances. This procedure is expected to cause minimal local and short-term effects due to the rapid and efficient nature of the method. Biological resources, particularly benthos, in the dredged/backfilled area are likely to be lost, and the adjacent seafloor will be disturbed; however, the benthos are expected to rapidly recover following construction. Mobile organisms displaced during construction are expected to quickly return and benthic communities disturbed by pipeline dredging have been found to recover rapidly following construction (Lewis et al. 2002).

The closest identified hard-bottom area along the pipeline route is Freeport Rocks, located in 62 feet of water approximately 7.5 miles offshore. The proposed pipeline has been routed to the east of Freeport Rock on smooth seafloor and clear of any surficial hard bottom areas by nearly 100 feet on either side. Currents in the vicinity of the Freeport Rocks can be expected to flow generally alongshore (i.e., parallel to the coast). During much of the year currents flow "downcoast" towards the Freeport Rocks (generally towards the west), except during the summer months when currents tend to reverse and flow "upcoast" (towards the east) away from the rocks. Currents near the seafloor would be strongest during the late-fall and winter (average 10 to 15 cm/s) and less the remainder of the year (average 3 to 6 cm/s). If possible, construction should be conducted during the summer when currents are weaker and away from the Freeport Rocks area.

The most sensitive portion of the Pipeline route is nearshore, where it passes through shallow water and makes landfall. To avoid impact to this area, the Pipeline will be installed by HDD which disturbs only the entry and exit points of the Pipeline and not the intervening distance (MMS 2002). HDD will be initiated from an onshore entry pit with the drill bit punching out from the sea floor at a pre-excavated offshore exit pit located at the approximate 18 foot contour. The offshore exit hole and transition trench will be dredged to allow the pipeline to return to a horizontal position for tie-in to the offshore pipeline at the proper depth. Excavated material from the exit pit will be placed on either side of the hole and on the shoreward side. The use of HDD is expected to avoid impacts to nearshore species such as shorebirds, manatees and sea turtles.

In the event of a marine frac-out, where HDD drilling mud forces through fractures in the overlying material and discharges into the sea, drilling mud could be deposited onto the seafloor over the path of the HDD pipeline segment. HDD drilling mud is a benign, non-toxic substance composed primarily of bentonite clay. The substance is more dense than seawater and would settle on the sea floor after discharge. The primary mechanisms by which it could adversely affect biological resources are through smothering of benthic resources and clogging gills (ENSR 1998). Mitigative measures could be taken to excavate the drilling mud if sensitive marine resources would be adversely impacted over the long term. However, oyster beds, SAV, and other sensitive marine resources are not expected to be encountered along the pipeline route, and excavation or vacuuming drilling mud likely would cause more turbidity problems to the local ecosystem than just leaving the drilling mud on the sea floor. In the unlikely event of a release of drilling mud associated with the onshore HDD construction, TOPS has incorporated a contingency plan for detection, corrective action and reporting (Appendix H).

Onshore pipeline construction impacts to biological communities will consists largely of temporary disturbance to habitat. Many of the animals likely to be found within the Project area are those that are adapted to living in proximity to human disturbance. These animals are, in general, mobile, and will simply avoid the area during construction. As much of the preferred onshore route lies within existing ROW or previously impacted areas, the impact to these animals is anticipated to be minimal. Similarly, plant communities within the Project area will be temporarily disturbed by construction activities, but should return following restoration of the area.

Water Intake

The proposed Pipelines will be hydrostatically tested following construction. Each test of the Pipelines will include flooding of the pipeline with test water and subsequent discharge of the water. A filter train will be installed in the open end of the pipeline prior to placing the pipeline in the water. These filters will prevent debris, sediment and larger aquatic organisms from entering the pipeline. It is not anticipated that treatment chemicals (e.g., corrosion inhibitors, biocides, or oxygen scavengers) will be added to the filtered seawater as the pipeline is filled.

The water intake that will occur during hydrostatic testing of the proposed HDDs and Pipeline will result in a one time entrainment of invertebrate eggs and larvae. The water uptake is not expected to impact invertebrate populations due to the immense volume of the GOM and the high fecundity of invertebrates.

The Onshore Pipeline segments and storage tanks will likewise be hydrostatically tested following construction. Water for the testing of the Onshore Pipeline will be obtained from the GIWW and discharged there following completion of the hydrostatic test. Water for the testing of the storage tanks will be obtained from the adjacent lagoon, which has been previously used for this purpose. The intake and discharge rate of test water will be regulated to minimize the potential for erosion or safety issues at the intake/discharge site. The water used for the hydrostatic test will not be discharged into a watershed other than the one it was taken from. A specific implementation plan for the hydrostatic test of the Onshore Pipeline and Crude Storage Terminal tanks is being developed.

Water Discharge

After the completion of testing of the various pipeline segments, the pipeline will be dewatered. Seawater from the Offshore Pipeline test will be discharged at the Platform. The water purged from the Pipelines is expected to be at the same general temperature as the surrounding ambient seawater near the seafloor. Although the DO concentration of the discharged seawater likely will be lower than surrounding seawater, mixing of this water with the surrounding seawater during the dewatering process is expected to rapidly eliminate any DO deficit. It is not expected that the discharge would contain any significant quantities of solids or oil residue or levels of treatment chemicals in concentrations that would be deleterious to marine life.

Discharge of the hydrostatic test water for the Onshore Pipeline and Texas City Crude Terminal will return the water back to the intake waterbody. In the case of the Onshore Pipeline, it is anticipated that approximately 16 MG of brackish water will be returned to the GIWW. Rate of the discharge will be regulated to minimize the potential for localized erosion or navigation impacts. Likewise, the Texas City Crude Terminal hydrostatic test water will be returned to the intake source upon completion of the test. The seven proposed tanks, including six 600,000 barrel and one 300,000 barrel tanks will be tested sequentially to minimize the volume of water necessary to test the tanks. Discharge of the test water will be regulated to minimize erosion and turbidity in the intake source. A specific implementation plan for the hydrostatic test of the Onshore Pipeline and Crude Storage Terminal tanks is being developed.

Turbidity

Increased turbidity and sedimentation from clearing and grubbing, excavation (i.e., trench construction, HDD pit construction), anchoring, and backfilling activities could result in direct and indirect impacts on the habitat of demersal and pelagic fish, spawning and nursery areas, and sessile organisms. The Pipeline route was selected to avoid or minimize disturbance to sensitive biological resources, such as oysters, SAV, and wetlands. During siting of the pipeline it was determined that seagrass habitat and oyster reefs are not present in the Project area. As a result, no oyster or seagrass beds are anticipated to be impacted by either construction or operation of the proposed TOPS. Wetland impacts have been avoided and minimized to the greatest extent practicable through the co-location of facilities, use of HDD technology, and the selection of the onshore alignment.

Turbidity will decrease water clarity, which could affect foraging behavior of visual predators and filter feeders. It is expected that, in marine waters, mobile species, potentially including sea turtles, dolphins and porpoises, will be displaced temporarily from the habitat but will return to the area almost immediately following construction. Coastal and marine bird prey species would likewise temporarily be displaced, but no adverse long-term impacts to birds are expected. In marine and estuarine waters temporary effects on the soft-bottom community will occur due to the removal and burial of organisms during dredging of the pipeline trench in areas not scheduled for installation by HDD. However, because recolonization is expected to occur after construction, no long-term effects on the community are expected from construction or operation of the pipeline. For Onshore Pipeline installation, control of turbidity will be minimized through the use of HDD at locations detailed previously, the use Best Management Practices and in accordance with the Project's

SWPPP. Overall, adverse construction impacts due to turbidity are expected to be short-term and minor.

Noise

Installation of the proposed Terminal and Pipeline will not require use of explosives. The most likely source of noise impacts will occur during installation of the support piles at the Terminal. Pile driving by either a steam or hydraulic hammer will be required, and it is possible that these activities could produce high-pressure sound waves. Noise from construction activities can mask sounds important to marine fauna and may mobile organisms in the vicinity of the Terminal to change their behavior or avoid the area temporarily. Noise-attenuation and/or exclusion-zone protocols acceptable to NMFS will be employed if necessary in order to prevent hearing loss or damage to marine mammals, sea turtles, and fish within the construction area. Marine birds are expected to temporarily vacate the construction area. Noise derived from pile driving activities will be intermittent and of short duration, allowing dislocated fauna to return immediately following construction. Impacts to coastal birds will be minimized through use of HDD; however, these birds may also temporarily vacate the area.

Increased vessel traffic will generate noise within the Project area. Although noise levels will be well below those found to cause lasting damage to marine organisms, behavioral effects (i.e., disruption of foraging activities) are possible. However, vessel noise is expected to be minimal while vessels are in the Project area because of their very low speeds.

Construction of the onshore pipeline will be accomplished largely within existing pipeline ROW and adjacent to existing roadways. A portion of the Onshore Pipeline will be installed near the northern boundary of the Brazoria NWR; however, the pipeline ROW and construction footprint lies to the north of FM 2004 in this area. FM 2004 is a major transit route and noise generated from the construction of the Project will be during daylight hours and temporary in nature. It is anticipated that the construction of the pipeline will represent a minimal, short duration annoyance to resident fauna.

Lighting

Some installation activities will continue 24 hours a day and require continuous lighting. Lights in the form of navigational beacons also will be required. As a precaution, lighting will be designed in consultation with NMFS and FWS, if necessary, to minimize changes in animal behavior. The lighting and navigational beacons associated with Port construction and operations may attract zooplankton, which may in turn attract feeding fish and dolphins. However, since no subsurface lighting is planned for the Proposed Terminal, impacts on fish and dolphins are expected to be minor. Migratory birds are known to be attracted to certain lights, resulting in mortality or injury from collision or disruption of bird migration patterns. However, the operational lights and navigational beacons required during installation will be of short duration and unlikely to have a significant impact on marine birds. The planned water-to-shore HDD also will avoid the need for excessive lighting in any potential sea turtle nesting areas.

Surface facilities onshore will not typically require illumination during construction and installation of the pipeline. The impacts associated with any such lighting are anticipated to be temporary and of minimal impact to animals in the project area. Operational impacts of facility lighting, particularly with respect to avian species are discussed in the next section.

Vessel traffic

Installation of the SPMs, Platforms, and Pipeline will require increased vessel traffic in the Project vicinity, thereby increasing the potential risk of a collision with marine fauna. The marine fauna present within the proposed Project area are all either mobile enough to actively avoid vessel traffic or in such high abundance that insignificant effects are anticipated.

Increased vessel traffic will result in an increased need for intermittent vessel mooring. Anchoring activities will result in temporary increases in turbidity and localized die-offs of benthic infauna. However, due to the immense reproductive capabilities of the infauna, long-term impacts are not anticipated.

Increased vessel traffic could lead to additional pollution within the water column. However, it is illegal to dump plastic, dunnage, lining, packing materials that float, and all other trash if not ground to less than 1 in. within 12 miles offshore. No oil or mixtures containing more than 15 parts of oil per million may be discharged within 50 miles offshore (MARPOL 73/78). No solid debris may be discharged from OCS structures and vessels (30 CFR 250.40 and MARPOL, Annex V, Public Law 100-220 [101 Statute 1458]). Therefore, although additional debris may enter the water column incidentally, the anticipated amount is expected to be extremely small.

Air Emissions

Impacts related to the Offshore construction are discussed in Topic Report 8, “Air and Noise Quality”, of the DWP application. As discussed therein, air emissions from the construction of the pipeline and Texas City Crude Terminal will be applied for under the USEPA’s new source review (refer to DWP License application, Exhibit Q).

4.9.2 Operation

Water intake

During facility operations, vessels will require the intake of seawater for ballast during the discharge of product and cooling to supply the ships’ cooling water intakes. The water intakes generally are located in several sea chests (the number of which depends on ship size), which resemble large steel boxes inset into the side of the ship below the light draft waterline. Each sea chest is protected by a heavy steel grating bolted into the hull forming the outer wall of the sea chest. This grating is designed to keep large debris away from the valves and intakes within the sea chest. This grating will exclude large macrophytes, fish, and invertebrates; however, it will allow the entrainment of phytoplankton, zooplankton, and ichthyoplankton.

Entrainment of eggs and larvae during ballast and cooling water uptake is not expected to impact fisheries resources due to the immense volume of the GOM and the high fecundity of fish. Impingement of adult and juvenile fish also could occur during ballast water and cooling water uptake.

Water uptake for the operation of the onshore facilities will be limited. Water for maintenance of the firewater pond for firefighting use at the Texas City Crude Terminal will be obtained either from onsite conservation of stormwater runoff, a municipal source, or by water appropriation permit through the TCEQ.

Water discharge

The carriers will take ballast on board while unloading their cargo, so there will be no discharge of ballast water by the carriers at the Port. Vessels will be equipped with water and wastewater treatment systems that will ensure that discharges comply with applicable USCG and MARPOL requirements for marine vessel discharges. The discharged water, cycled through the ships for the purposes of cooling equipment and conditioning spaces, is approximately 3.6ºF (2ºC) higher than the ambient water temperature at intake. The discharge is expected to be intermittent, minimal, and quickly returned to ambient temperature. Dilution and dispersion will limit the impacts from discharge to minor and localized impacts. The minor cooling water discharge from a large vessel may raise the temperature of the sea water locally, but the vast cooling capacity of the ocean will quickly dissipate any effect. Water discharge is not expected to negatively impact fauna in the Project area.

Noise

Noise associated with operation of the proposed Project includes the operation of fixed structures such as offshore platforms, and helicopter and service-vessel traffic. Noise generated from helicopter and service-vessel traffic is transient in nature and extremely variable in intensity. Helicopter sounds contain dominant tones (resulting from rotors) generally below 500 Hz (Richardson et al. 1995). Helicopters often radiate more sound forward than backward; thus, underwater noise is generally brief in duration, compared with the duration of audibility in the air. In addition to the altitude of the helicopter, water depth and bottom conditions strongly influence propagation and levels of underwater noise from passing aircraft. Lateral propagation of sound is greater in shallow than in deep water. Helicopters, while flying offshore, generally maintain altitudes above 700 ft during transit to and from the working area and an altitude of about 500 ft while between platforms.

Service vessels transmit noise through both air and water. The primary sources of vessel noise are propeller cavitation, propeller singing, and propulsion; other sources include auxiliaries, flow noise from water dragging along the hull, and bubbles breaking in the wake (Richardson et al., 1995). Propeller cavitation is usually the dominant noise source. The intensity of noise from service vessels is roughly related to ship size, laden or not, and speed. Large ships tend to be noisier than small ones, and ships underway with a full load (or towing or pushing a load) produce more noise than unladen vessels. Broadband source levels for most small ships (e.g., support and supply ships) are ~170-180 dB re 1 µPa (Richardson et al. 1995). Given the amount of vessel traffic from all sources in the GOM, it is concluded that the contribution of noise from offshore service vessels is a minor component of the total ambient noise level (MMS 2004). Vessel noise should not be of concern while vessels are within the Port area, due to lessened hull and propeller cavitation noise at very low speeds. It is anticipated that mobile marine fauna within the Project area would be able to adjust to the intermittent vessel noise. Anticipated effects of noise on birds, marine mammals, and sea turtles are discussed in more detail below.

The degree of disturbance exhibited by birds to the presence of traffic or platform equipment is highly variable, depending upon the bird species, type of vehicle/equipment, altitude or distance of the vehicle, the frequency of occurrence of the disturbance, and the season. Helicopter and service vessel traffic could sporadically disturb feeding, resting, or nesting behavior. The effect of low-flying aircraft within the vicinity of aggregations of birds on the ground or on the water typically results in mass disturbance and abandonment of the immediate area. Compliance to the specified minimum altitude requirements greatly reduces effects of aircraft disturbance on coastal and marine birds. Routine presence of aircraft at sufficiently high altitudes results in acclamation of birds to routine noise (MMS 2007). Disturbance can also lead to permanent desertion of active nests, or of critical or preferred habitat, which could contribute to the relocation of a species or group to less favorable areas or to a decline of species through reproductive failure resulting from nest abandonment (MMS 2007). However, because the Project site contains no nesting areas or other unique resources for coastal and marine birds, the increase in noise associated with operation of the Port will not cause long term, adverse impacts to coastal and marine birds.

Increased noise associated with Platform operations may affect the ability of marine mammals to communicate and to receive information about their environment (Richardson et al. 1995). Such noise may interfere with or mask the sounds used and produced by these animals and thereby interfere with their natural behavior. These sounds may frighten, annoy, or distract marine mammals and lead to physiological and behavioral disturbances. Sounds can cause reactions that might include disruption of marine mammals' normal activities (behavioral and/or social disruption) and, in some cases, short- or long-term displacement from areas important for feeding and reproduction (Richardson et al. 1995). Although tolerance to noise is often demonstrated, the mammals may become stressed over time, making them more vulnerable to parasites, disease, environmental contaminants, and/or predation (MMS 2007). Impacts to marine mammals from noise associated with operation of TOPS will be similar to those addressed for construction; however, no pile driving activities are expected to occur during operation, so the potential for damage to hearing will be reduced. Unlike construction, operations activities will be long-term. Any avoidance during this period will be localized.

Noise from vessel traffic and helicopter overflights may elicit a startle reaction from sea turtles, which may result in a short-term disruption of movement patterns and behavior (NMFS 2002). The most likely impacts would be short-term behavioral changes such as evasive swimming, disruption of activities, or departure from the area of disturbance. Sea turtles might avoid areas with heavy vessel traffic, although generally most species appear to exhibit considerable tolerance to noise. Overall, localized avoidance is expected to constitute a minor impact. The Project site contains no nesting areas or other unique resources, and noise impacts are expected to be insignificant.

Noise impacts from the operation of the onshore facilities would primarily result from vehicle access of the facilities. TOPS anticipates that the noise created by vehicle traffic within the onshore facilities would be negligible.

Lighting

The Port will require operational lighting for 24 hour operations. In addition, the Port facilities will require navigational beacons. Port lighting may cause behavior changes in organisms associated with or transient to the proposed Platform; however, lighting will be designed in consultation with NMFS, if necessary, to minimize changes in animal behavior. The lighting and navigational beacons associated with Port operations may attract zooplankton, which may in turn attract feeding fish, and, in turn, piscivores. However, since no subsurface lighting is planned for the Proposed Terminal, impacts on fish are expected to be minor.

Proposed Booster Pump Station and Texas City Crude Terminal lighting would have minor, adverse impacts on trans-Gulf migratory birds. The proposed Booster Pump Station and Texas City Crude Terminal would be in a common migratory pathway across the GOM and thus may be encountered by migrants. These birds are known to be attracted to artificial lighting on offshore and onshore facilities, which can seriously disrupt bird migration patterns. However, measures will be taken to minimize the amount of total lighting used by the proposed Port. Lighting has be designed in consultation with the USFWS to minimize changes in animal behavior. Furthermore, the use of solid red or pulsating red lights will be avoided and the amount of light would be minimized during the height of the transmigratory period. To reduce the disruptive effects of lighting, all lighting on the proposed Port and at onshore facilities would be downshielded to prevent the lights from shining skyward, instead directing the light to shine only on work areas. These measures would minimize impacts from the Proposed Booster Pump Station and Terminal lighting on migratory birds such that adverse impacts would be minor.

Air emissions

Natural gas has been selected to power the proposed TOPS Project, reducing the potential for harmful emissions. The levels of emissions expected in the Project area are not anticipated to have detrimental effects upon biological resources. Air emissions will be permitted and controlled in accordance with the Clean Air Act to minimize potential impacts. Though unlikely, air emissions from the Port could cause local avoidance by some migratory or marine birds. However, any localized avoidance is expected to be minor.

Emissions from the onshore crude oil terminal are provided in the air permit application (see Volume 4 of the DWP application). Additional information on this topic, and largely associated with the Texas City Crude Storage Terminal, will be provided when available.

Vessel traffic

Impacts from increased vessel traffic associated with operation of the proposed Port are expected to be similar to those described for construction, which are expected to be minor and short-term and result in an overall net decrease in traffic from lightering trip reductions. Mobile organisms are expected to temporarily vacate the area during vessel passage. Increased traffic will increase the possibility of accidental collision with sea turtles or sperm whales. However, the potential for impacts due to vessel collision are minimal due to the strict control of navigation within the safety zones, including the slow speeds required in the Project area.

Oil Spills

Detailed discussions of the potential for oil spills at the proposed port, its associated platforms, the offshore and onshore pipeline routes, and the onshore facilities, and the potential consequences of such spills are provided in a separate Consequence Assessment Report and a separate Ecological Risk Assessment (Topic Report 11, “Safety and Reliability”, in the DWP License application and herein in Appendix I).

The history of similar pipeline (e.g., Cameron Highway Oil Pipeline System) and DWP (e.g., LOOP) projects in the GOM suggests that the likelihood of a significant oil spill or release due to leaks/spills during unloading activities, leaks/spills at pumping platforms, and/or releases from subsea pipelines is very small.

As discussed in Section 2.3.6 and at length in the DWP License application, structural (e.g., secondary containment on platforms) and administrative/procedural (e.g., implementation of the TOPS Facility Response Plan, Appendix 11.B of Topic Report 11, “Safety and Reliability”), measures will be in-place to minimize the potential of an oil spill, minimize the quantity released should a spill occur, and ensure that spills are detected early, contained and cleaned up. This combination of structural and administrative/procedural measures is expected to significantly reduce the possibility that an oil spill will result in significant adverse impacts to biological and water resources and the aquatic environment.

Historically, the most significant risk associated with operating a crude oil pipeline is the potential for third-party excavation damage. The pipelines will be built within an approved ROW and markers will be installed at all road, railway, and water crossings. Certain key waterways will be horizontal directional drilled, thereby virtually eliminating the risk of excavation damage and the overburden would significantly reduce the probability that a pipeline release under the river could affect the sensitive aquatic resources in the waterway and downstream into the coastal environment. TOPS also will mitigate third-party excavation risk by implementing a comprehensive Integrated Public Awareness program focused on education and awareness in accordance with 49 CFR Part 195.440 and API RP1162. Further, TOPS' operating staff will complete regular visual inspections of the ROW (at least once every 3 weeks and a minimum of 26 times per year) as per 49 CFR Part 195.412 and monitor activity in the area to prevent unauthorized trespass or access.

The system is designed with appropriate safeguards resulting in a minimal chance of spill during the lifetime of the facility. The probability of a major crude oil spill is extremely low. The major elements of the Project that could leak crude oil include: SPMs, the Pumping Platform, the pipelines linking the SPMs to the Pumping Platform, the pipeline linking the pumping platform to the onshore valve station, and the onshore pipeline from the FVS to the Booster Pump Station and to the Texas City Crude Storage Terminal. The estimated frequency of crude oil spills from the Project facilities was estimated in a Consequence Assessment and the probability of a spill contacting a given environmental resource was evaluated in an Ecological Risk Assessment of Offshore Oil Spills. Assessments related to the Offshore Facilities are summarized in Topic Report 11, “Safety and Reliability”, of the DWP License application. Assessments related to the Onshore Project can be found in Appendix I. The results of the Risk Assessment are considered in the evaluation of operational impacts below.

If an oil spill were to occur, sea turtles, marine mammals, coastal birds, EFH, and commercial and recreational fisheries would be at high risk. Incident frequencies were estimated from publicly available historical data (PHMSA 2008) and modified by project-specific adjustment factors for the Project system (please refer to Appendix I). Based on the available information, TOPS conservatively estimates an incident frequency of 0.0003 incidents per mile per year, equivalent to 1.4 spills in 100 years for the 47.6 miles of the Project. For any 1-mile segment, this probability is equivalent to 1 spill every 3,300 years.

Actual frequency may differ from the predicted values of the incident frequency analysis and TOPS believes that the actual number of incidents will be substantially lower than estimated for this analysis. Further, the number of spills on crude oil pipelines has substantially declined in recent years with the implementation of USDOT's Integrity Management Rule. To minimize the risk of a release and the resultant damage if a spill were to occur, TOPS has incorporated design and operations measures including automated leak detection and shutdown systems.

Further support for the highly conservative reporting of maximum spill volumes is provided by PHMSA's incident database (2008). Examination of the current PHMSA dataset (2002 to present) indicates that the vast majority of actual pipeline spills are relatively small, with 50 percent of the spills consisting of 3.0 barrels or less. In 85 percent of the cases, the spill volume was 100 barrels or less, and less than 1,000 barrels in over 95 percent of the time. Oil spills of 10,000 barrels or greater only occurred in 0.5 percent of cases. These data demonstrate that most pipeline spills are small and very large releases of 10,000 barrels or more are extremely uncommon.

Of the postulated maximum of 1.4 spills along the Project during a 100-year period, these PHMSA-derived spill volume statistics suggest that approximately 0.7 spill would be 3 barrels[1] or less; 0.5 spill would consist of between 3 and 100 barrels; 0.1 spill would consist of between 100 and 1,000 barrels; 0.06 spill would consist of between 1,000 and 10,000 barrels; and 0.007 spill would contain more than 10,000 barrels.

Summary of Impacts to Threatened and Endangered Species

A discussion of anticipated impacts of the construction and operation of the Project to threatened and endangered species is interwoven into the subsections above. Table 4.9-1 explicitly states predicted impacts to each threatened and endangered species with any likelihood of occurring within the project area.

Table 4.9-1 Threatened and Endangered Species (Federal) with the Potential to Occur Within the Project Area and Anticipated Impacts of the Proposed TOPS Project

Common Name	Status	Anticipated Occurrence within the Project Area	Anticipated Level of Project Impact
Plants			
Texas prairie dawn	Endangered	Not known to occur in project area counties; however, the species is found in similar habitat on sandy soils in neighboring counties.	Not Likely to Adversely Affect
Sea Turtles			
Green Sea Turtle	Threatened	Foraging adult or juvenile – Occasional but anticipated to avoid the project area. Nesting female and hatchling – Unlikely and will be avoided by water-to-shore HDD and beach workspace setback.	Not Likely to Adversely Affect
Kemp’s Ridley Sea Turtle	Endangered	Foraging adult or juvenile – Occasional but anticipated to avoid the project area. Nesting female and hatchling – Unlikely and will be avoided by water-to-shore HDD and beach workspace setback.	Not Likely to Adversely Affect

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[1] A barrel of oil equals 42 gallons.

Table 4.9-1 Threatened and Endangered Species (Federal) with the Potential to Occur Within the Project Area and Anticipated Impacts of the Proposed TOPS Project

Common Name	Status	Anticipated Occurrence within the Project Area	Anticipated Level of Project Impact
Loggerhead Sea Turtle	Threatened	Foraging adult or juvenile – Occasional but anticipated to avoid the project area. Nesting female and hatchling – Unlikely and will be avoided by water-to-shore HDD.	Not Likely to Adversely Affect
Hawksbill Sea Turtle	Endangered	Foraging adult or juvenile – Unlikely and anticipated to avoid the project area. Nesting female and hatchling – Very Unlikely and will be avoided by water-to-shore HDD.	Not Likely to Adversely Affect
Leatherback Sea Turtle	Endangered	Foraging adult or juvenile – Occasional but anticipated to avoid the project area. Nesting female and hatchling – Very Unlikely and will be avoided by water-to-shore HDD.	Not Likely to Adversely Affect
Marine and Coastal Birds			
Bald Eagle	Threatened	Offshore – Occasional Nearshore – Occasional but avoided by water-to-shore HDD Onshore – Occasional in Brazoria County, but avoid known nests.	Not Likely to Adversely Affect
Brown Pelican	Endangered	Offshore – Unlikely Nearshore – Occasional but avoided by water-to-shore HDD Onshore – Common but avoid known nests in West Galveston Bay	Not Likely to Adversely Affect
Piping Plover	Threatened	Onshore – Occasional but avoided by water-to-shore HDD	Not Likely to Adversely Affect
Whooping Crane	Endangered	Onshore – Unlikely but avoided by water-to-shore HDD. Potential habitat impacts minimized through restoration measures	Not Likely to Adversely Affect

Table 4.9-1 Threatened and Endangered Species (Federal) with the Potential to Occur Within the Project Area and Anticipated Impacts of the Proposed TOPS Project

Common Name	Status	Anticipated Occurrence within the Project Area	Anticipated Level of Project Impact
Marine Mammals			
Florida manatee	Endangered	Unlikely – Generally only found east of the proposed Project Area. If observed it will be within shallow-water.	Not Likely to Adversely Affect

4.9.3 Mitigation

TOPS has made every reasonable effort to co-locate the onshore pipeline within existing pipeline or utility corridors to minimize the impacts of the project upon existing infrastructure, water quality and fish and wildlife resources. More than 90 percent of the 47-mile Onshore Pipeline is co-located with existing facilities or adjacent to existing ROWs. While this approach is desirable for project safety and economics it also has the benefit of reducing disturbance to new areas, including biological communities.

4.10 Water Resources and Protected Habitats

4.10.1 Construction

SPM and Anchor Lines

Seafloor displacement and permanent requirements for each SPM will be limited to the area occupied by the PLEM skid, which will be approximately 1,345 feet^2 (125 m^2). Each SPM will be anchored radially by a set of six anchors, each approximately 4.0 feet (1.2 m) in diameter and approximately 1,500 feet (457.2 m) from the SPM. Each anchor will occupy approximately 12.6 feet^2 (1.17 m^2) of the sea floor, or a total of 75.4 feet^2 (7.0 m^2) for each SPM set. Consequently, the total seafloor displacement for each SPM will be 1,420 feet^2 (132 m^2) of seafloor displacement, or a total of 2,840 feet^2 (264 m^2) or 0.065 acres (0.026 ha) for the two SPMs. When the future third SPM is installed, the seafloor displacement will increase by approximately 1,420 feet^2 (131.9 m^2).

Offloading Lines

The two parallel offloading pipelines will be spaced at a centerline-to-centerline distance of approximately 75 feet (23 m). Assuming that the permanent ROW for these dual pipelines will be established the same way as the proposed construction ROW (i.e., 100 feet [30.5 m] on either side of the pipeline), the permanent ROW for these parallel pipelines will be 275 feet (83.8 m) wide. The permanent requirements for the three pairs of 4,000 feet (1,219 m) long parallel offloading pipelines serving the three SPMs will be 77.6 acres (31.4 ha). However, Since the offloading pipelines will be buried such that the top of pipe is below the seafloor, it will result in no permanent seafloor displacement.

Pumping Platform GA A56-A

PP GA A56-A will have three level decks (refer to Appendix B). The largest of the three decks will be the cellar deck, with approximate dimensions of 120 feet by 280 feet (37 m by 85 m) or approximately 0.77 acre (0.31 ha). This area does not represent sea floor impact, because the deck structures are supported by a pile-anchored jacket structure. The total permanent disturbance (displacement) of the sea floor, associated with the Platform's eight jacket legs (each approximately 6 feet [1.8 m] in diameter), will be approximately 226 feet^2 (21 m^2) or 0.005 acre (0.002 ha).

The bridge that will be constructed to connect PP GA A56-A to Quarters/Control Platform GA A56-B will be 150 feet (46 m) long by 15 feet (5 m) wide, or approximately 0.05 acre (0.02 ha); however, this suspended bridge will result in no impact to the seafloor.

Quarters/Control Platform GA A56-B

QP GA A56-B will have two level decks and a third smaller helideck located on the roof of the quarters building (refer to Appendix 1.A, Figures 1.A-4, 1.A-6, 1.A-10 and 1.A-11). The larger of the two decks will be the main deck, with approximate dimensions of 84 feet by 80 feet (26 m by 24 m), or approximately 0.15 acre (0.06 ha). This 0.15-acre (0.06-ha) area does not represent sea floor impact, because the deck structures are supported by a pile-anchored jacket structure. Total permanent disturbance (displacement) of the sea floor, associated with the Platform's four jacket legs (each approximately 6.0 feet [1.8 m] in diameter), will be approximately 113.1 feet^2 (10.5 m^2) or 0.0029 acres (0.0012 ha).

Fuel Gas Pipeline

Similar to the Offshore Pipeline, the Fuel Gas Pipeline will be buried to a minimum depth of 3.0 feet (0.9 m) below the seafloor after installation. Since the pipeline will be buried, its presence will not result in permanent seafloor displacement. The permanent ROW for the Fuel Gas Pipeline is assumed to be 200 ft (61.0 m). The permanent requirement associated with the pipeline ROW will be 879.5 acres (356.1 ha).

Offshore Pipeline

The Project's Offshore Pipeline will consist of approximately 35 miles (56 km) of 42-inch OD crude oil transmission pipeline that will run from PP GA A56-A to the FVS. The pipeline will be installed both in Federal waters of the GOM and in Texas state waters and will be buried to a minimum depth of 3.0 feet (0.9 m) below the seafloor after installation except for at the Coastwise Safety Fairway crossing, where the pipeline will be buried to a minimum depth of 10.0 feet (3.0 m) below the seafloor. Since the pipeline will be buried, it will result in no permanent seafloor displacement.

The permanent ROW for the Offshore Pipeline (offshore of the MHWM) is assumed to be the same as the proposed construction ROW for the pipeline, which is 200.0 feet (61.0 m). The permanent requirement associated with the pipeline ROW offshore of the MHWM (i.e., 34.2-mile [55.0 km] long segment) will be 829.1 acres (335.5 ha).

HDD Shoreline Crossing - Exit

Sediment displacement will also occur via dredging of the HDD exit trench approximately 3,500 feet from shore at the 18 feet depth contour. As explained in Section 2.1.1 above, the area will be dredged using a spud barge with a bucket dredge. The excavated material will be side-cast to both sides of the trench, and to the shore side. At all times, the side-cast material will remain within the existing 200-foot (61 m) wide ROW. The size of the trench is still to be determined, but is estimated to be approximately 300 feet (91 m) long by 50 feet (15 m) wide, and approximately 10-feet (3 m) deep. The exit angle will be based on the geographical area of the shore approach, and can vary from 6 to 12 degrees from the horizontal. Sediments dredged and sidecast during construction are anticipated to be returned to the HDD excavation trench and pit largely by natural processes of sediment transport and slumping of the material such that the impacts to the seafloor would be temporary.

Approximately 20,000 cubic yards of excavated material will be side-cast to both sides of the trench, and to the shore side. At all times, the side-cast material will remain within the existing 200-foot (61 m) wide right-of-way. The side-cast material will act as a temporary “berm” to help protect the trench from being silted-in during the works. The size of the trench is still to be determined, but is estimated to be approximately 500 feet (152 m) long with a width varying from 50 feet (15 m) to 110 feet (33 m), and approximately 16-feet (5 m) deep.

HDD Shoreline Crossing - Entry

An area of approximately 200-feet by 200-feet will be temporarily impacted for the HDD entry point. Dredging and temporary placement of dredged material and fill will be necessary for excavation of the entry pit and stockpiling of this material. It is anticipated that the existing road could be utilized to access the proposed drill site; however, the remaining area filled or impacted by construction matting are necessary for site access and construction workspace. The area is shallow open water and herbaceous wetlands and may contain SAVs. The construction footprint would be 90,000 square feet or 2.1 acres (0.83 ha). Restoration of the area to pre-construction elevations should result in no permanent impact to the area.

Freeport Valve Site

The FVS will be located at the transition from the Offshore Pipeline and Onshore Pipelines at Bryan Beach, south of the GIWW. The permanent footprint of this facility will consist of a fenced, elevated valve site occupying approximately 0.1-acres (0.4 ha).

Onshore Pipeline

The Project’s Onshore Pipeline will consist of approximately 47 miles of 42-inch OD crude oil transmission pipeline running form the FVS to the Texas City Crude Terminal. The pipeline will be installed with a minimum of 3 feet of cover. Depth of cover will vary at HDD and other crossings, as necessary, to minimize the risk of exposing the pipeline. The crossing of the GIWW and other navigable channels will be installed and marked in accordance with Galveston District burial policy for pipeline and cables. Currently the required depth of cover for GIWW crossings is -25 feet mean low tide (MLT).

The permanent ROW for the Onshore Pipeline, initially proposed for up to 50 feet, has been reduced to a proposed 30 feet in an effort to minimize the permanent footprint of the Project. In addition, the temporary ROW is proposed for 125 feet in upland areas. This will be reduced to 85 feet in wetland and other sensitive habitats in order to reduce the temporary impacts of the Project. Additional valve stations are located intermittently along the pipeline route for operational and safety reasons. All practicable measures will be made to site these facilities outside of jurisdictional areas.

Onshore Pump Station

The Onshore Pump Station location has yet to be determined; however, this facility will consist of a permanent, approximately 5-acre facility. This facility will consist of buildings to house the pumps and associated control and support facilities, an access road, utility service, a fire water pond, and will be contained within a fenced perimeter on an approximate 5-acre pad site. Hydraulic requirements for maintenance of pressure in the pipeline are among the design considerations, but all practicable efforts will be made to site the facility outside of jurisdictional wetlands.

Texas City Crude Terminal

This approximate 100-acre facility has already largely been permitted (see discussion of alternatives in Section 2.10). The remaining 1.82 acres of wetlands within the site are proposed to be filled for construction of additional storage tanks and will require Department of the Army permit.

Table 4.10-1 is a summary of the anticipated surface and sediment impacts from project construction and operation.

Table 4.10-1 Summary of Surface/Sediment Impacts for Project Components

	Total Surface Area (acres)	Temporary Impact Area (acres)	Permanent Impact Area (acres)	Impact type
Safety Zone (includes 3rd SPM)	1,103	0	0	Restriction on vessel traffic only
Anchorage Area	3,240	varies	0	Temporary seafloor disturbance associated with vessel anchoring
Area to be Avoided	9,600	0	0	Restriction on vessel traffic only
SPM and Anchor Lines	0.1	0.1	0.1	Restriction of vessel traffic; displacement of seafloor
Offloading Lines	77.6	77.6	0	Temporary disturbance to seafloor for construction
Pumping Platform	0.77	0.77	0.005	Support jacket piles will displace seafloor
Quarters Platform	0.15	0.15	0.003	Support jacket piles will displace seafloor
Fuel Gas Pipeline	879.5	879.5	0	Temporary seafloor disturbance associated with pipeline installation
Offshore Pipeline	829.1	829.1	0	Temporary seafloor disturbance associated with pipeline installation
Onshore HDD – Exit In GOM	1.3	1.3	0	Dredge and sidecast of material for HDD exit location
Onshore HDD - Entry	0.9	0.9	0	Construction access for HDD entry location
Freeport Valve Site	0.1	0	0 anticipated; not more than 0.1 worst case	Elevated surface facility
Onshore Pipeline	759.4	744.29	2.52	Temporary disturbance to construction corridor; conversion of forested wetlands to PEM

Table 4.10-1 Summary of Surface/Sediment Impacts for Project Components

	Total Surface Area (acres)	Temporary Impact Area (acres)	Permanent Impact Area (acres)	Impact type
Onshore Pump Station	3 to 5	0	0 anticipated; supplemental information will be provided	Surface facility for operation of booster pumps
Texas City Crude Terminal	100	0	1.82	Permanent wetland fill for storage tanks

Submerged Aquatic Vegetation

There are currently no verified SAVs within the Project area; however, as described in Section 3 and discussed in the wetland delineation report (Appendix E), aerial photography suggests the presence of SAVs in the shallow waters near the HDD entry location at Bryan Beach. The impacts here are estimated at 0.3 acre from a desktop analysis utilizing GIS. TOPS will supplement this information as survey access becomes available.

Wetlands and Waterbodies

Installation of the Onshore Pipeline will directly and temporarily impact 256.6 acres within the 125-foot construction ROW. As detailed in Section 2, the Onshore Pipeline work is anticipated to begin in February 2010 and be complete by August of 2010. Table 4.10-2 is a summary of the anticipated impacts, both temporary and permanent, to wetland and waterbodies from construction of the Project. Areas within the proposed workspace and additional temporary workspaces are detailed. The impacts referenced here should also be interpreted with care as the information is based on a conservative estimate of the extent of the wetlands based partly upon a GIS-based desktop analysis of the area. TOPS will supplement the information herein as additional environmental surveys are completed.

Table 4.10-2 Wetland and Waterbody Impacts From Onshore Pipeline Construction

NWI Wetland Class	Area (acres) within 125-ft Construction Corridor	Area (acres) within Additional Temporary Workspace	Temporary	Permanent
Estuarine Emergent Wetlands	55.34	3.36	58.70	0
Palustrine Emergent Wetlands	163.40	10.53	173.93	1.82
Palustrine Scrub/Shrub Wetlands	16.98	0.63	17.61	0
Palustrine Forested Wetlands	9.22	0	0	Conversion of 2.52 ac to PEM
SAV	0.31	0	0.31	N
Other Waters	20.31	0.86	6.05	0
TOTALS	**265.28**	**15.38**	**256.6**	**4.34**

Additional Temporary Workspaces

Onshore fabrication site and contractor bases will be utilized only temporarily for the construction of the Terminal and associated offshore facilities components, and existing infrastructure will be utilized. It is anticipated that the contractor yards will be located along the Gulf Coast. Similarly, TOPS will utilize existing infrastructure for the operations base which is anticipated to be located in the Freeport, Texas area. The specific location for each of these facilities will be determined at a later time, but because they will utilize existing infrastructure they are not anticipated to contribute to any significant impacts.

In general, TOPS will utilize existing access roads, fabrication facilities, and the temporary construction ROW to the maximum extent practicable. In some areas additional workspace outside the 125-foot temporary ROW, or so-called false ROW, may be necessary, as with the need for pipe laydown areas for the HDDs. A total of 37.6-acres of temporary workspace will be necessary for construction access, laydown areas, parking, and staging. Of this, approximately 15.4-acres are in environmentally sensitive habitats such as wetlands, waterbodies, or forested areas.

Other Protected Habitats

Other protected habitats including, oyster reef, coral reef, artificial reefs, mudflats and managed areas have not been identified within the Project area. No impacts to these resources are anticipated from construction or operation of the Project. Hard bottom areas identified in the Project area include the area know as the Freeport Rocks. This area of consolidated mud, clay, and shell has been avoided through routing of the offshore pipeline. Impacts associated with the installation in this area are anticipated to be temporary disturbance to the seafloor associated with pipeline jetting.

4.10.2 Operation

Safety Zone and Area to be Avoided

For security reasons, TOPS is requesting that the USCG establish a safety zone around the proposed Platforms GA A56-A and B and around each of the SPMs. Figure 2.1-1 presents the proposed safety zone that will exist when no crude carrier vessel is moored at the DWP. As shown in Figure 2.1-1, a 1,640.4-foot (500.0-m) radius safety zone will be established around proposed Platforms GA A56-A and B and around each of the SPMs. A 1,640.4-foot (500.0 m) wide safety zone will also run along either side of each of the subsea offloading pipeline loops, centered between the looped pipes. The safety zone for the platform and for two SPMs will encompass approximately 827 acres (335 ha). With the future addition of a third SPM, the safety zone would increase by approximately 276 acres (112 ha). Vessel traffic unrelated to Port operations will be prohibited within the safety zone areas at all times. Other vessel traffic will be limited to a speed of three knots.

As shown in Figure 2.1-1, when a crude carrier is positioned at an SPM, the safety zone radius will be extended an additional 1,640.4 feet (500.0 m) from the stern of the ship. The total radius of the resultant safety zone will be the sum of the SPM swing radius (30 feet [9 m]), plus the vessel length (ranging from 780 feet to 1,260 feet [237 m to 384 m], depending on the type of vessel , plus 1,640 feet (500 m). When the largest vessel (ULCC) is positioned at an SPM, the safety zone for the platform and two SPMs will encompass approximately 1,188 acres (481 ha). When ULCC's are positioned at both SPMs, the safety zone for the platform and two SPMs will encompass approximately 1,549 acres (627 ha).

In accordance with 33 CFR 148.5, TOPS also is requesting the designation of an "Area to be Avoided" in the waters surrounding entire Offshore Terminal. Vessels traveling within this "recommendatory" area would be advised to proceed with caution. TOPS is requesting that a 3.0-mile (4.8-km) by 5.0-mile (8.0-km) Area to be Avoided, encompassing approximately 9,600 acres (3,885 ha), be established around the proposed Offshore Terminal area.

Anchorage Area

As described in more detail in Topic Report 1, "General Project Description and Location", TOPS will also establish an Anchorage Area south of the proposed Offshore Terminal, in the southern portion of MMS Block GA A56 and the northern and central portion of Block GA A59. The anchorage area will accommodate approximately four anchored ships, and will be designated as a 2.25-mile by 2.25-mile (3.62-km by 3.62-km), 3,240 acre (1,311 ha) area. Vessels will be encouraged to utilize this Anchorage Area unless they are proceeding directly to moor upon arrival. The vessels themselves will not create any seafloor impacts. However each moored vessel will create indirect temporary impacts due to anchoring.

The locations of the Safety Zones, Area to be Avoided and Anchorage Area and navigation to the Port and the proposed Safety Zones and Anchorage Area are discussed further in the DWP application's Topic Report 1, "General Project Description and Location", and in Topic Report 11, "Safety and Reliability".

Risk Assessment

As discussed in Section 4.9.2 above, the primary potential operational impact for pipelines is the result of a release of crude oil into the environment. TOPS conducted a site specific risk assessment and environmental consequence analysis for both the offshore terminal and pipeline and for the onshore pipeline and surface facilities (Topic Report 11, "Safety and Reliability", in the DWP License application and herein in Appendix I, respectively). In summary, these conservative analyses of the proposed Project show that the predicted frequency of incidents is low, the probability of a large spill occurring is very low, and, consequently, risk of environmental impacts is minimal. Compliance with regulations, application of TOPS' Integrity Management Program (IMP), FRP, and Emergency Response Plan, as well as adherence to safety procedures will help to ensure long-term environmentally sound and safe operation of the pipeline.

High Consequence Areas

The Pipeline Hazardous Materials Administration (PHMSA) within USDOT is the enforcement agency that regulates the safety and integrity of interstate crude oil pipelines. The primary federal regulation ensuring the safe operation of petroleum product pipelines through design, construction, and operation standards is 49 CFR Part 195 – Transportation of Hazardous Liquids by Pipeline: Minimum Federal Safety Standards. Other pertinent regulations include 49 CFR Part 194 (federal requirements for response plans for onshore oil pipelines) and 40 CFR Parts 109, 110, 112, 113, and 114 (federal requirements for Spill Prevention, Control, and Countermeasures Plans). The Oil Pollution Act (OPA 90) and the Oil Pollution Liability and Compensation Act of 1989 are federal laws providing cleanup authority, penalties, and liability for oil spills. TOPS will meet or exceed all applicable regulatory requirements.

Consequences of inadvertent releases from pipelines can vary greatly, depending on where the release occurs. Pipeline safety regulations use the concept of high consequence areas (HCAs) to identify specific locales and areas where a release could have the most significant adverse consequences. HCAs include populated areas, drinking water, and unusually sensitive ecologically resource areas (USAs) that could be damaged by a hazardous liquid pipeline release. ***Due to Homeland Security reasons, the precise risk for specific locations of HCAs is highly confidential. TOPS is therefore providing a confidential preliminary evaluation of risk to HCAs for federal agencies (Appendix I)***. This analysis includes discussion of HCAs in the unlikely event of a spill. Estimated spill frequencies were based upon similar facilities and taking into account specific safety and design features planned for the TOPS Project. Many of these safety and design features meet or exceed federal regulatory standards and make the likelihood of a spill within the anticipated operational lifespan of the Project remote.

4.10.3 Mitigation

Table 4.10-2 contains a summary of the aquatic habitat types and impact areas. Use of HDD technology and BMPs for the control of erosion and stormwater and for the maintenance of water quality will minimize and avoid project impacts. However, TOPS is aware that some of the sensitive habitats, especially wetlands in the vicinity of the Freeport Valve Site and the Texas City Crude Terminal are potentially susceptible to post-construction settlement if care is not taken to re-establish proper post-construction elevations. As such, in areas that will be unavoidably impacted, TOPS proposes to restore these areas in accordance with our Onshore Project Execution Plan found in Appendix F.

This restoration effort will establish pre-construction elevations within the ROW. Potential actions include the restoration of pre-construction elevations utilizing clean non-native soil, the excavation of excess material if settlement is less than anticipated, the planting of native wetland plants if re-colonization is slower than anticipated, the control of non-native species (e.g., Chinese tallow, *Triadica sebifera*) within impacted portions of the ROW. Overall, adverse biological impacts of pipeline installation are anticipated to be minimal, localized, and short-term. The conversion of 2.52 acres of forested wetlands for ROW clearing in the vicinity of Oyster Creek has been minimized through utilization of HDD.

In summary, the installation, construction, and operation of the TOPS Project will include numerous measures, both structural and administrative/procedural, to mitigate potential impacts to water resources. A summation of such mitigation measures includes the following:

- Performance of oil offloading activities following a well-conceived Operations Manual, approved by USCG and designed to minimize the potential for releases of oil and/or other pollutants during mooring, offloading, departing, and crude oil transmission activities;

- A TOPS specific FRP (refer to Appendix 11.B of DWP License application, Topic Report 11, “Safety and Reliability”). The FRP includes a comprehensive program on monitoring and inspections designed to rapidly detect potential leaks in Project components (pipelines, valves, pumps, etc.) and minimize the potential release of oil. The Plan also provides for rapid response should a spill occur and a program for tracking, containing and cleaning up spills;

- Pipeline leak detection systems to detect pressure drops in pipelines and allow for a rapid response should a leak be detected;

- Secondary containment and an open drain system on the Project platforms to capture deck runoff and remove oil prior to discharge. Containment areas under equipment with the potential to leak oil (e.g., turbines, pumps, etc.) will be connected to the open drain system as will deck drains throughout the platforms. Curbed secondary containment also will be provided in certain chemical storage areas;

- A HDD Fluid Release Contingency Plan (refer to Appendix H). This contingency plan includes provisions for the detection, response, and cleanup in the unlikely event of a release of drilling fluids associated with HDD;
- Appropriate treatment of sanitary wastewater, in accordance with applicable regulations, prior to discharge;
- Compliance with the NPDES discharge permit issued for construction phase discharges of hydrostatic test water and operation phase discharges from the PP and QP;
- Best Management Practices for the management of stormwater runoff and erosion control for the Onshore Pipeline and Facilities. A Stormwater Pollution Prevention Plan (SWPPP) will be implemented in accordance with TCEQ permit requirements;
- Restoration of Project area wetlands and waterbodies in accordance with the Onshore Project Execution Plan (Appendix F); and
- Compensatory mitigation for unavoidable Project impacts. Details of the mitigation plan will be formulated in cooperation with the natural resource agencies and based upon a replacement of wetland functions.

Compensatory Mitigation

The objective of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Toward achievement of this goal, the CWA prohibits the discharge of dredged or fill material into wetlands, streams, and other waters of the U.S. unless a permit issued by the USACE under CWA Section 404 authorizes such a discharge. When there is a proposed discharge, all appropriate and practicable steps must first be taken to avoid and minimize impacts to aquatic resources. For unavoidable impacts, compensatory mitigation is required to replace the loss of wetland, stream, and/or other aquatic resource functions. The USACE is responsible for determining the appropriate form and amount of compensatory mitigation required. Methods of providing compensatory mitigation include aquatic resource restoration, establishment, enhancement, and in certain circumstances, preservation. Recent USACE rules regarding compensatory mitigation for losses of aquatic resources (33 CFR Parts 325 and 332) establish clear preferences for the use of mitigation banks over in-lieu-fee programs or permittee-responsible mitigation.

Many of the design features, construction techniques, and operational measures detailed in previous sections of this application and the attached appendices are considered mitigation and are part of the sequence of avoidance, minimization, and finally, compensation. However, for those impacts arising from Project implementation that are unavoidable and typically, permanent, including above grade wetland fill and conversions of forested wetland habitat to different wetland types, additional mitigation to replace lost functions is generally required. TOPS has undertaken early pre-application planning and incorporated this information into the preliminary Project design such that the permanent fill of wetlands and the conversion of wetland forest to other wetland types will be minimal. Surface facilities potentially unavoidably located in wetlands due to engineering constraints or technological limitations, for example a valve site, will be mitigated for at a site and quantity commensurate with the level of impacts and in accordance with applicable USACE regulations. In addition to the restoration measures currently incorporated into the Project design, TOPS will continue to work with the resource agencies to identify potential compensatory mitigation opportunities.

5.0 Water Quality Certification

Under Texas Natural Resources Code, Title 3, and the Texas Water Code, Chapter 26, the Railroad Commission of Texas (RRC) has responsibility for the prevention of pollution that might result from activities associated with the exploration, development, and production of oil. The RRC is responsible for issuing Clean Water Act Section 401 water quality certificates (WQC) for federal permits related to these activities. TOPS requests that USACE submit a request for certification to the RRC. TOPS will comply with all requirements of the WQC.

6.0 Texas Coastal Management Program Compliance

In January 1997, the state of Texas received federal approval of its Coastal Management Program (CMP). As the TOPS Project lies wholly within the Texas coastal zone and requires multiple federal permits for activities in or affecting the coastal zone, the Project must be consistent with the goals and policies identified in 31 TAC Chapter 501. TOPS will comply with the relevant enforceable policies of the Coastal Management Program, and the proposed project will be conducted in a manner consistent with such policies, as stated in the signed statement included in Appendix D.

7.0 References

Bates, R. L. and J. A. Jackson. 1984. "Dictionary of Geologic Terms," Prepared by the American Geological Institute.

Beaver, C.R. 2002. "Fishery Productivity and Trophodynamics of Platform Artificial Reefs in the Northwestern Gulf of Mexico." Texas A&M University. College Station, TX. 139 pp.

Blatt, H., G. Middleton, and R. Murray. 1980. Origin of Sedimentary Rocks, Second Edition, Prentice-Hall, Inc., Englewood Cliffs, NJ.

Britton, J.C. and B. Morton. 1989. "Shore ecology of the Gulf of Mexico". University of Texas Press. Austin, Texas. 387 pp.

Brooks, R.A., C.N. Purdy, S.S. Bell, K.J. Sulak. 2006. The benthic community of the eastern US continental shelf: A literature synopsis of benthic faunal resources. Continental Shelf Research 26:804-818.

Bureau of Economic Geology (TBEG). 2008. Texas Shoreline Change Project. http://coastal.beg.utexas.edu/website/uppercoast/viewer.htm

Campbell, Linda. 2003. "Endangered and Threatened Animals of Texas. Their Life History and Management." Texas Parks and Wildlife, Wildlife Division, Austin, TX.

Chandler, C.R., R.M. Sanders, Jr., and A.M. Landry, Jr. 1985. "Effects of Three Substrate Variables on Two Artificial Reef Fish Communities." Bull. Mar. Sci. 37(1):129-142.

Cummins, R., Jr., J.B. Rivers, and P. Struhsaker. 1962. "Snapper Trawling Explorations along the Southeastern Cost of the United States." Comm. Fish. Rev. 24:1-7.

Davis, R.W., W.E. Evans, and B. Wursig, eds. 2000. "Cetaceans, Sea Turtles and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations." Volume I: Executive Summary. Prepared by Texas A&M University at Galveston and the National Marine Fisheries Service. U.S. Department of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0006 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-002.

Dellapenna, T. M., Allison, M., Seitz, W**.,** 2002. Final Report for CMP Cycle 5- Sand Resources and Movement Off of Surfside Beach, for the Coastal Management Program, Texas General Land Office, available at http://coastal.tamug.edu.

Energy Information Administration (EIA). 2006. Crude Oil Production. <http://www.eia.doe.gov/neic/infosheets/ crudeproduction.html>. Accessed December 2006.

Energy Information Administration. 2008. Annual Energy Outlook 2008 with Projections to 2030 (Revised Early Release). The Department of Energy, Report No. DOE/EIA-0383(2008).

ENSR. 1998. Evaluating the Effects of Muds on Wetlands from Horizontal Drilling Literature Survey. Prepared for Gas Research Institute. Report No. GRI-98/0190.

Fritts, T.H., R.P. Reynolds, C. E. Keller, and D.M. Smith. 1981. "Pilot Study of the Marine Mammals, Birds, and Turtles in the OCS Areas of the Gulf of Mexico." U.S. Department of Interior, Bureau of Land Management Fish and Wildlife Service FWS/OBS 81/36.

Gallaway, B.J. 1981. "An Ecosystem Analysis of Oil and Gas Development on the Texas-Louisiana Continental Shelf." FWSiOBS-8 1 i27. Washington, DC: United States Department of the Interior, Fish and Wildlife Service, Office of Biological Services.

Gibeaut, J. C., Tremblay, T. A., and White, W. A., 2000, Coastal hazards atlas of Texas: a tool for hurricane preparedness and coastal management-volume 1, the southeast coast: The University of Texas at Austin, Bureau of Economic Geology, final report prepared for the Texas Coastal Coordination Council, pursuant to National Oceanic and Atmospheric Administration Award No. NA770Z0202, 69 p.

Gibeaut, J. C., Waldinger, Rachel, Hepner, Tiffany, Tremblay, T. A., and White, W. A., 2003, Changes in bay shoreline position, West Bay system, Texas: The University of Texas at Austin, Bureau of Economic Geology, report of the Texas Coastal Coordination Council pursuant to National Oceanic and Atmospheric Administration Award No. NA07OZ0134, under GLO contract no. 02-225R, 27 p.

Gulf of Mexico Fishery Management Council (GMFMC). 2004. "Final Environmental Impact Statement for the Generic Essential Fish Habitat Amendment to the following fishery management plans of the Gulf of Mexico (GOM): Shrimp Fishery of the Gulf of Mexico, Red Drum Fishery of the Gulf of Mexico, Reef Fish Fishery of the Gulf of Mexico, Stone Crab Fishery of the Gulf of Mexico, Coral and Coral Reef Fishery of the Gulf of Mexico, Spiny Lobster Fishery of the Gulf of Mexico and South Atlantic Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic." March 2004.

Gunter, G. 1967. "Some Relationships of Estuaries to the Fisheries of the Gulf of Mexico." In Estuaries [papers] edited by G. Lauff. Conference on Estuaries, Jekyll Island, 1964. Washington, DC: American Association for the Advancement of Science.

Holliman, D.C. 1979. The status of Marine mammals in the coastal zone and a proposed resource plan for their management. In: Symposium on the Natural resources of the Mobile Estuary, Alabama. H. A. Loyacano Jr. and J. P. Smith, eds.

International Tanker Owners Pollution Federation Limited (ITOPF). 2002. "Fate of Marine Oil Spills." Technical Information Paper. No. 2. Available online: <http://www.itopf.com/tip2.pdf>.

Klima, E.F. and D.A. Wickham. 1971. "Attraction of Coastal Pelagic Fishes with Artificial Structures." Trans. Am. Fish. Soc. 100(1):86-99.

Lewis, L.J., Davenport, J., and T.C. Kelly. 2002. "A Study of the Impact of Pipeline Construction on Estuarine Benthic Invertebrate Communities." Estuarine, Coastal and Shelf Science 55:213-221.

Lore, G. L., K. M. Ross, B. J. Bascle, L. D. Nixon, and R. J. Klazynski. 1999. "Assessment of Conventionally Recoverable Hydrocarbon Resources of the Gulf of Mexico and Atlantic Outer Continental Shelf as of January 1, 1995." U.S. Department of the Interior, Mineral Management Service. OCS Report, MMS 99-0034.

Minerals Management Service (MMS). 2007. "Gulf of Mexico OCS Oil and Gas Lease Sales: 2007-2012, Western Planning Area Sales 204, 207, 210, 215, and 218, Central Planning Area Sales 205, 206, 208, 213, 216, and 222." Final Environmental Impact Statement. Volume I: Chapters 1-8 and Appendices. U.S. Department of Interior, Minerals Management Service. OCS EIS/EA, MMS 2007-018.

MMS. 2002. "Gulf of Mexico OCS Oil and Gas Lease Sales: 2003-2007, Central Planning Area Sales 185, 190, 194, 198, and 201, Western Planning Area Sales 187, 192, 196, and 200." Final Environmental Impact Statement. Volume I: Chapters 1-10. U.S. Department of Interior, Minerals Management Service. OCS EIS/EA, MMS 2002-052.

MMS. 2001. Proposed Use of Floating Production, Storage, and Offloading Systems on the Gulf of Mexico Outer Continental Shelf: Western and Central Planning Areas. Final Environmental Impact Statement. U.S. Department of the Interior. Minerals Management Service. Gulf of Mexico Outer Continental Shelf Region. Outer Continental Shelf EIS/EA, MMS 2000-090.

MMS. 1998a. Texas-Louisiana Shelf Circulation and Transport Processes Study: Synthesis Report. Commonly referred to as the "LATEX A" study. U.S. Dept. of the Interior. Minerals Management Service. Gulf of Mexico Outer Continental Shelf Region. MMS 98-0035 (Technical Report) and MMS 98-0036 (Appendices).

MMS. 1998b. An Observational Study of the Mississippi-Atchafalaya Coastal Plume, Final Report. Commonly referred to as the "LATEX B" study. U.S. Dept. of the Interior. Minerals Management Service. Gulf of Mexico Outer Continental Shelf Region. MMS 98-0040.

MMS. 1996. Gulf of Mexico Sales 166 and 168: Central and Western Planning Areas. Draft Environmental Impact Statement. U.S. Dept. of the Interior. Minerals Management Service. Gulf of Mexico Outer Continental Shelf Region. Outer Continental Shelf EIS/EA, MMS 96-0007.

Monroe, J. S. and R. Wicander. 2001. The Changing Earth, Exploring Geology and Evolution, Third Edition. Brooks/Cole, 511 Forest Lodge Road, Pacific Grove, CA 93950. Copyright 2001. The Wadsworth Group, a division of Thomson Learning, Inc.

National Data Buoy Center (NDBC) website <www.ndbc.noaa.gov>. Accessed February 2008.

National Marine Fisheries Service (NMFS), Fisheries Statistics Division. 2007. <http://www.st.nmfs.gov/st1/commercial/index.html>.

NMFS. 2006. "List of Threatened Species." Federal Register May 9, 2006 in Vol. 71, No. 89 pg 26852. <http://www.nmfs.noaa.gov/pr/species/esa.htm>. Accessed January 2007.

NMFS. 1999a. "Final Fishery Management Plan for Atlantic Tuna, Swordfish, and Sharks." NOAA NMFS Highly Migratory Species Management Division._____. 1999b. "Amendment 1 to the Atlantic Billfish Fishery Management Plan." NOAA NMFS Highly Migratory Species Management Division.

NMFS. 1999b. "Amendment 1 to the Atlantic Billfish Fishery Management Plan." NOAA NMFS Highly Migratory Species Management Division.

NOAA National Coastal Data Development Center (NCDDC). 2008. “Coastal Ecosystems.” <http://www.ncddc.noaa.gov/ecosystems/GISMapping/document_view>. Accessed February 2008.

National Oceanic and Atmospheric Administration (NOAA). 2008. “Tides and Currents” Website: <www.tidesandcurrents.noaa.gov>. Accessed January 2007.

NOAA. 2006. “Right Whales Seen Off Florida Gulf Coast, Mariners Asked to Use Caution and Keep Sharp Lookout”. NOAA Magazine. Available Online: http://www.noaanews.noaa.gov/stories2006/s2587.htm

NOAA. 2003. “Sperm Whale (*Physeter macrocephalus*) Northern Gulf of Mexico Stock.” http://www.nefsc.noaa.gov/nefsc/publications/tm/tm182/125.pdf. Accessed January 2007.

Pipeline and Hazardous Materials Safety Administration (PHMSA). 2008. PHMSA Pipeline Incident Statistics. Website: <http://primis.phmsa.dot.gov/comm/reports/safety/PSI.html>.

Phillips, N.W. and B.M. James. 1988. “Offshore Texas and Louisiana Marine Ecosystem Data Synthesis”. OCS Study/MMS 88-0066. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, LA. 48 pp.

Plummer, C.C., D. McGeary, and D.H. Carlson. 2003. Physical Geology, Ninth Edition. McGraw-Hill, 1221 Avenue of the Americas, New York, NY 10020.

Rooker, J. R., A. M. Landry, Jr., B. W. Geary, and J. A. Harper. 2004. Assessment of a shell bank and associated substrates as nursery habitat of postsettlement red snapper. Estuarine, Coastal and Shelf Science 59: 653-661.

Sammarco, P.W. A. D. Atchison, and G. S Boland. 2005. Distribution of corals colonizing platforms in the northwestern Gulf of Mexico: A preliminary report. p. 429-236. In: McKay, M. and J. Nides, eds. 2005. Proceedings: Twenty-third Gulf of Mexico information transfer meeting, January 2005. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, La. OCS Study MMS 2005-066. 612 pp.

Shinn, E.A. 1974. “Oil Structures as Artificial Reefs”. Pages 91-96 in Proceedings of the International Conference on Artificial Reefs. Houston, Texas.

Texas Commission on Environmental Quality (TCEQ). 2004. Surface Water Quality Data. Brazos River Basin: 2004 Assessment. <http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/04twqi/basins/brazos.html>.

TCEQ. 2002. Surface Water Quality Data. Brazos River Basin: 2002 Assessment. <http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/02twqi/basins/brazos.html>.

Thurman, C. L. 1981. Uca marguerita, a new species of fiddler crab (Brachyura: Ocypodidae) from eastern Mexico. Proceedings of the Biological Society of Washington 94: 169–180.

Texas Parks and Wildlife Department (TPWD). 2008a. Brazoria National Wildlife Refuge. http://www.tpwd.state.tx.us/learning/webcasts/seacenter/txhab2.phtml. Accessed: May 2008.

TPWD. 2008b. Justin Hurst Wildlife Management Area. <http://www.tpwd.state.tx.us/huntwild/hunt/wma/find_a_wma/list/?id=41>. Accessed: May 2008.

Texas Colonial Waterbird Census (TCWC). 1973-2005. "Texas Colonial Waterbird Database." http://www.fws.gov/texascoastalprogram/TCWC.htm. Accessed April 2008.

Texas Water Development Board (TWDB). 2008. “Water Well Data Viewer.” <http://wiid.twdb.state.tx.us/ims/wwm_drl/viewer.htm?>

Texas Water Development Board. 2006. “2006 Water Development Plan for Region H.” <http://regionhwater.org/downloads/planningdocs.html>.

University of Michigan Museum of Zoology (UMMZ). 2006. “Pelicanus occidentalis: Information”. <http://animaldiversity.ummz.umich.edu>. Accessed November 2006.

United States Army Corps of Engineers (USACE). 2008. Navigation Data Center, Waterborne Commerce Statistics Center. <http://www.iwr.usace.army.mil/ndc/wcsc/wcsc.htm>.

United States Coast Guard (USCG). 2003. “Final Environmental Impact Statement for the Port Pelican LLC Deepwater Port License Application.” Docket Number USCG-2002-14134.

United States Fish and Wildlife Service (USFWS 2008). Whooping crane census flight data, winter 2007-2008. Personal communication.

United States Geological Survey (USGS). 2004. “National Assessment of Shoreline Change: Part 1, Historical Shoreline Changes and Associated Coastal Land Loss Along the U.S. Gulf of Mexico." Open File Report 2004-1043.

USGS. 2000. “Seismicity in the United States from 1990-2000.” Source: <http://earthquake.usgs.gov/regional/states/seismicity>. [Access on February 20, 2007].

U.S. Environmental Protection Agency (USEPA). 2003. Regional Implementation Agreement for Testing and Reporting Requirements for Ocean Disposal of Dredged Material off the Louisiana and Texas Coasts Under Section 103 of the Marine Protection, Research and Sanctuaries Act. Prepared cooperatively with the U.S. Army Corps of Engineers.

Wellner, J. S. and J. Anderson. 2003. Evaluation of Beach Nourishment Sand Resources along the Central Texas Coast. Report to the Texas General Land Office by Department of Earth Science, Rice University.

White, W.L., T.A. Tremblay, R.L. Waldinger, T.L. Hepner, and T.R. Calnan. 2005. Status And Trends Of Wetland And Aquatic Habitats On Barrier Islands, Freeport to East Matagorda Bay, and South Padre Island. Final Report. Prepared for the Texas General Land Office and National Oceanic and Atmospheric Administration (GLO Contract No. 04-044 and 045). Bureau of Economic Geology, The University of Texas at Austin <http://www.glo.state.tx.us/coastal/statustrends/freeport-spi/index.html>.

Appendices