Deepwater Port License Application for the

Texas Gulf Terminals Project

Volume II – Environmental Evaluation (Public)

Section 7:
Wildlife and Protected Species

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

°	degrees
°C	degrees Celsius
°F	degrees Fahrenheit
>	greater than
µPa	micro Pascal
ac	acre
Applicant	Texas Gulf Terminals Inc.
bbl	barrel(s)
BCC	Bird(s) of conservation concern
BGEPA	Bald and Golden Eagle Protection Act
BMP	Best Management Practice
BOEM	Bureau of Ocean Energy Management
bph	barrels per hour
CALM	Catenary Anchor Leg Mooring
CFR	Code of Federal Regulations
cm	centimeters
CO2	carbon dioxide
dB	decibels
DOT	Department of Transportation
DPS	distinct population segments
DWH	Deepwater Horizon
DWP	deepwater port
DWPA	Deepwater Port Act of 1974, as amended
DWPL	Deepwater Port License
EFH	essential fish habitat
e.g.	exempli gratia [Latin for '*for example*']
ESA	Endangered Species Act
et al.	et alia [Latin for *'and others'*]
et seq.	et sequentes [Latin for *'and the following'*]
FMP	fishery management plan
ft.	feet
GIWW	Gulf Intracoastal Waterway
GMFMC	Gulf of Mexico Fishery Management Council
GOM	Gulf of Mexico
ha	hectare
HAPC	habitat areas of particular concern
HDD	Horizontal Directional Drilling
i.e.	id est [Latin for *'in other words'*]
IMO	International Maritime Organization
km	kilometer
m	meter

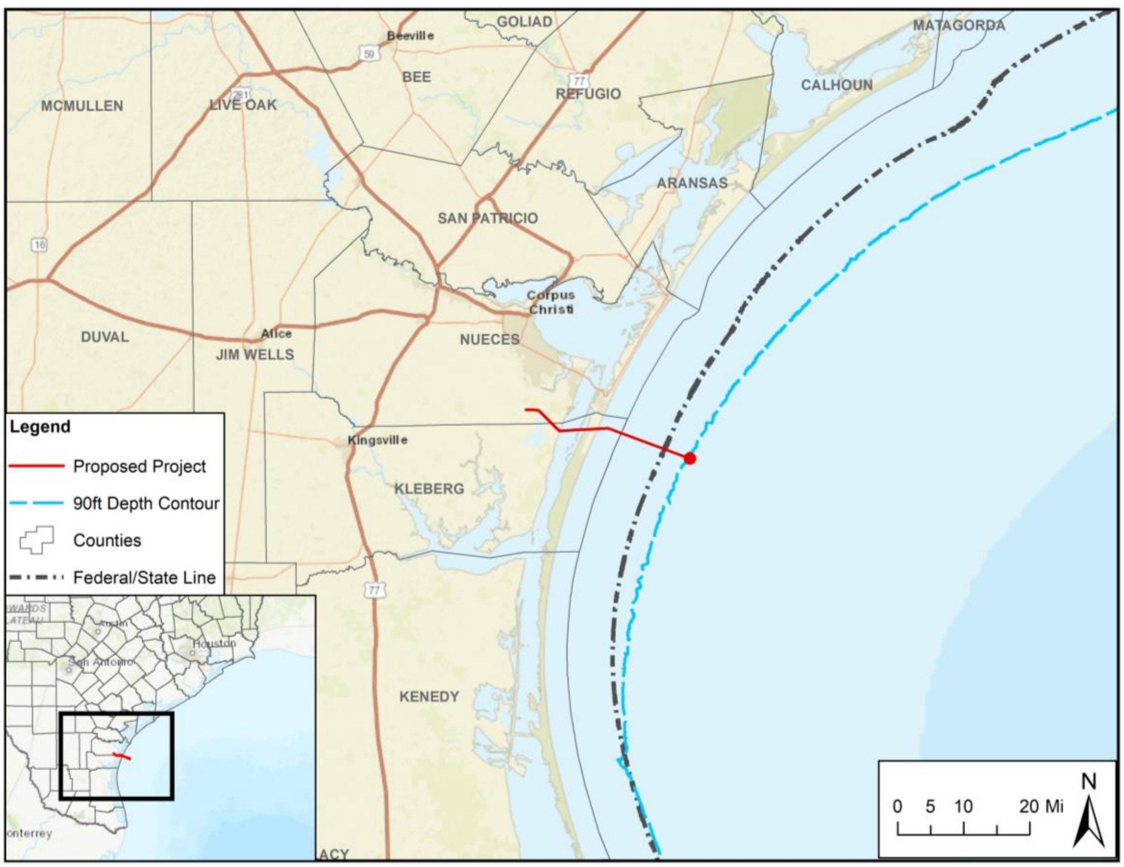
MAOP	maximum allowed operating procedure
MARAD	Maritime Administration
MARPOL	The International Convention for the Prevention of Pollution from Ships
MBTA	Migratory Bird Treaty Act
MHT	mean high tide
mi	miles
mm	millimeter
MMPA	Marine Mammal Protection Act
MMS	Mineral Management Service
m/s	meters per second
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NCR	National Research Council
nm	nautical miles
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRC	National Research Council
NRDA	Natural Resource Damage Assessment
NTL	Notices to Lessees
NWR	National Wildlife Refuge
OCS	Outer Continental Shelf
OSTF	onshore storage terminal facility
PLEM	pipeline end manifold
PINS	Padre Island National Seashore
POCC	Port of Corpus Christi
Project	Texas Gulf Terminals Project
PTS	permanent threshold shifts
RMS	root mean square
ROW	right-of-way
SAV	submerged aquatic vegetation
SEAMAP	Southeast Area Monitoring and Assessment Program
SEL	sound exposure levels
SPCC	Spill Prevention, Control, and Countermeasure
SPM	single point mooring
sq.	square
SWCA	SWCA Environmental Consultants
SWPPP	Stormwater Pollution Prevention Plan
TDA	Texas Department of Agriculture
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TTS	temporary threshold shifts
TWS	temporary workspace
TXNDD	Texas Natural Diversity Database
U.S.	United States [of America]
USACE	United States Army Corps of Engineers

U.S.C.	United States Code
USCG	United States Coast Guard
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VLCC	very large crude carrier
WBNP	Wood Buffalo National Park
WOTUS	Waters of the United States
ZOI	zone of influence

PROJECT OVERVIEW

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

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



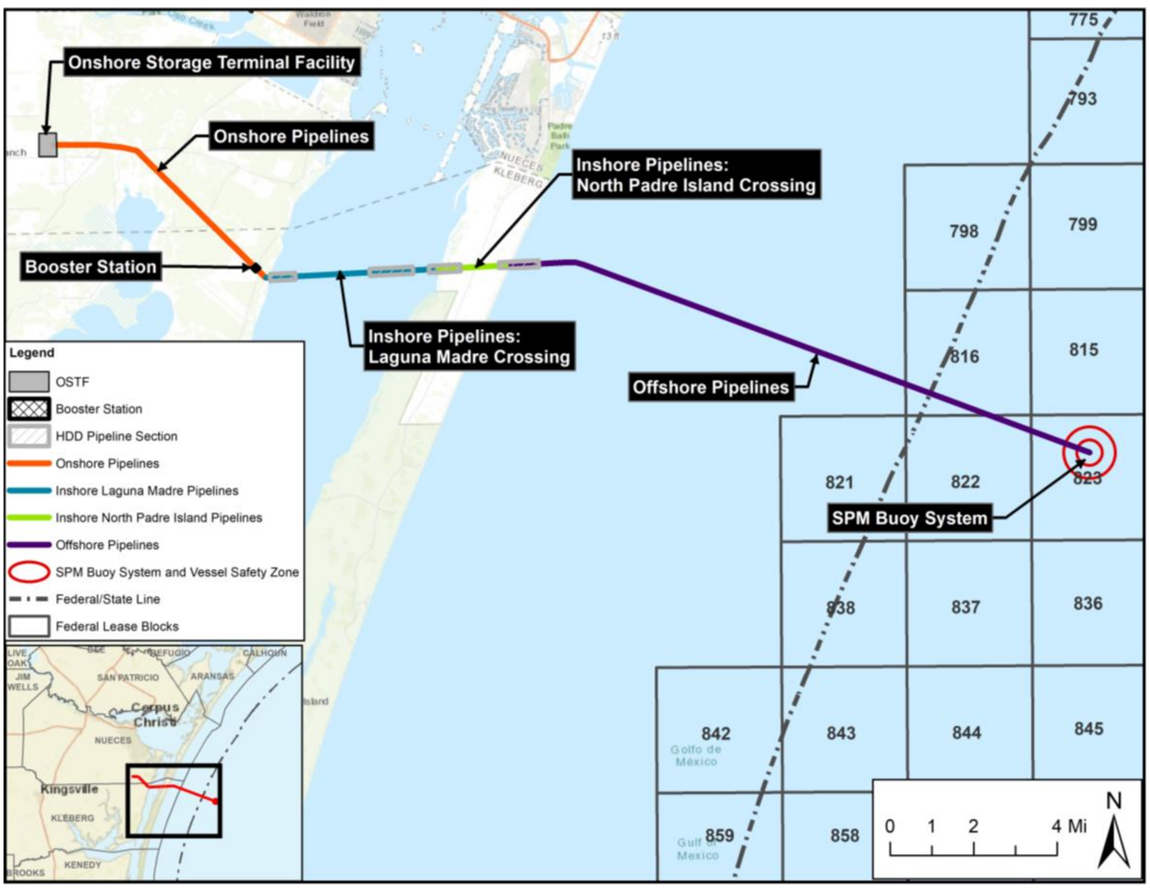
Vicinity Map

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

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

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

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



Project Component Map

7.0 WILDLIFE AND PROTECTED SPECIES

The wildlife and protected species that occur in the Project area include both terrestrial and aquatic species. Wildlife and protected resources that occur in the Project area are grouped as onshore, inshore, or offshore for the assessment of Project impacts. However, many of these species can be found in multiple habitats (e.g., inshore species can also use offshore areas). This section describes the various aquatic habitats and the potential Project impacts on these resources, and is structured as follows:

Section 7.1 Applicable Laws and Regulations: Background on relevant regulatory laws for consideration;
Section 7.2 Existing Conditions: Information on the existing wildlife and protected species environment in the Project vicinity;
Section 7.3 Environmental Consequences: An analysis of environmental consequences;
Section 7.4 Cumulative Impacts: An analysis of cumulative impacts;
Section 7.5 Mitigation Measures: Proposed mitigation measures;
Section 7.6 Summary of Potential Impacts: A summary of potential impacts; and
Section 7.7 References.

7.1 Applicable Laws and Regulations

The nature and scope of the proposed Project requires the compliance of federal laws during construction and operation. Avoidance and minimization of environmental impacts must be considered during all phases of the Project. Several wildlife, both terrestrial and avian, as well as some plant species are eligible for protection under various federal laws. The Endangered Species Act (ESA) of 1973, Marine Mammal Protection Act of 1972 (MMPA), Pub. L. 92–522, 16 U.S.C. 1361, Invasive Species E.E. 13112, Magnuson-Stevens Fishery Conservation and Management Act as amended through October 11, 1996, 16 U.S.C. 1801, et. seq., the Migratory Bird Treaty Act (MBTA) of 1918, the Bald and Golden Eagle Protection Act (BGEPA) of 1940, and National Environmental Policy Act of 1969 (NEPA), Pub. L. 91–190, 42 U.SC. 4321, *et.* seq. has elements that relate directly to the Project and must be evaluated during planning, construction, and operation. A summary of each is given below.

7.1.1 Endangered Species Act

The ESA provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. A species is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become an endangered species within the foreseeable future. All species of plants and animals, except pest insects are eligible for listing as endangered or threatened. Congress defined species to include subspecies, varieties, and for vertebrates, distinct population segments (DPS). The ESA is administered by the U.S. Fish and Wildlife Service (USFWS) and the Commerce Department's National Marine Fisheries Service. The USFWS has authority over terrestrial and freshwater organisms, while the National Marine Fisheries Services (NMFS) are mainly marine. The USFWS is a bureau with the Department of the Interior. Their mission is to work with others to conserve, protect and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people. Within the scope of this Project, they are responsible for enforcement of the ESA and MBTA. Other functions include enforcing federal wildlife laws, protecting endangered species, managing migratory birds, and conserving and restoring wildlife habitat such as wetlands.

The ESA also requires the designation of "critical habitat" for listed species. Critical habitat includes geographic areas that contain the physical or biological features that are essential to the conservation of the species and that may need special management or protection. Critical habitat may include areas that are not occupied by the species at the time of listing but are essential to its conservation.

The species evaluated in this report were based on a list of federally threatened and endangered species for Kleberg and Nueces County, Texas, available at the USFWS Information for Planning and Conservation website (USFWS 2018a) (Appendix H and I) in order to facilitate compliance with the ESA, as amended. The Project area was also evaluated for potential habitat for bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) as they are protected by the BGEPA. The Texas Parks and Wildlife Department (TPWD) Texas Natural Diversity Database (TXNDD) was also assessed, which provides known occurrence records for listed species (TXNDD 2018). The USFWS Critical Habitat Map was also utilized, which provides spatial data for active proposed and final critical habitat for threatened and endangered species (USFWS 2018b). The potential for occurrence within the Project area for the species addressed in this report was based on: 1) documented occurrences; 2) existing information on distribution; and 3) qualitative comparisons of the habitat requirements of each species with vegetation communities or landscape features observed within the Project area. Possible impacts to these species resulting from construction of the proposed Project were evaluated based on reasonably foreseeable Project-related activities.

The potential for occurrence of each federally listed species was summarized according to the categories listed below. In the evaluation, the rationale for category assignment is provided after each category in Table 1. Potential for occurrence categories are as follows:

- *Known to occur*—the species has been documented in the Project area by a reliable observer.
- *May occur*—the Project area is within the species' currently known range, and habitat types within the Project area resemble those known to be used by the species.
- *Unlikely to occur*—the Project area is within the species' currently known range, but habitat types within the Project area do not resemble those known to be used by the species.
- *Does not occur*—the Project area is clearly outside the species' currently known range.

Those species listed as a candidate for federal listing, threatened, or endangered by the USFWS were assigned to one of three or one of two categories of possible effect, following USFWS recommendations. The evaluation of impact to species is limited to the Project area and does not assess the impacts to the species or their habitats at regional or global levels. The effects determinations recommended by USFWS (USFWS 2018a) include:

- *May affect, is likely to adversely affect*—adverse effects to listed species may occur as a direct or indirect result of the proposed Project, and the effect is not discountable, insignificant, or beneficial.
- *May affect, is not likely to adversely affect*—the proposed Project may affect listed species and/or critical habitat; however, the effects are expected to be discountable, insignificant, or completely beneficial.
- *No effect*—the proposed Project will not affect federally listed species or critical habitat.

SWCA conducted a field reconnaissance of the Project area from January 18-19, 2018. SWCA used global positioning system data uploaded with the Project area for general orientation and locating the Project boundaries. The survey corridor was 500 ft. The field reconnaissance consisted of pedestrian visual surveys to evaluate the absence or presence of suitable habitat and occurrences of listed species within the Project area. SWCA was not contracted to, nor conducted, tailored presence/absence surveys specific for individual species during the January 18-19, 2018 habitat evaluation. The Threatened and Endangered Species Report for the inshore project area can be referenced as Appendix H.

In addition to the file reviews, LEI ecologists conducted field surveys from May 22 to May 24, 2018 within the proposed project onshore components project areas for the federally-listed threatened and endangered species and their associated habitats known or suspected to occur within Nueces and Kleberg Counties. The Threatened and Endangered Species Report for onshore components can be referenced in Appendix I.

7.1.2 Marine Mammal Protection Act

Under the Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. 1361 et seq.), the Secretary of Commerce is responsible for the protection of all cetaceans (whales, porpoises, and dolphins) and pinnipeds (seals and sea lions), except walruses, and has delegated authority for implementing the MMPA to National Oceanic and Atmospheric Administration (NOAA) NMFS. Under Section 3 of the MMPA, all marine mammals are protected from "take" which is defined as "harass, hunt, capture, or kill or attempt to harass, hunt, capture, or kill any marine mammal," and "harassment" is defined as "any act of pursuit, torment, or annoyance that has the potential to injure marine mammal stock in the wild; or has the potential to disturb a marine mammal or marine mammal stock in the wild by disrupting behavioral patterns, including migration, breathing, nursing, breeding, feeding, or sheltering."

Substantial amendments were made to the MMPA in 1994 that allow for the incidental take of small numbers of marine mammals. NOAA identifies incidental take as activities other than commercial fishing that effect a small number, have no more than a negligible impact, and not have an unmitigated adverse impact on the stock for subsistence uses. Activities that are frequently identified as incidental take and therefore authorized include oil and gas development, geophysical surveys, and military training exercises.

7.1.3 Invasive Species, E.O. 13112, 64 FR 6183

This Executive Order was issued to amend the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, as amended (16 U.S.C. 4701 et seq.), Lacey Act, as amended (18 U.S.C. 42), Federal Plant Pest Act (7 U.S.C. 150aa et seq.), Federal Noxious Weed Act of 1974, as amended (7 U.S.C. 2801 et seq.), Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), to further prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

7.1.4 Magnuson-Stevens Fishery Conservation and Management Act - Essential Fish Habitat

The 1996 Sustainable Fishery Act amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFMCA) set forth provisions to identify and protect important habitats of federally managed marine and anadromous fish species. Under these provisions, federal agencies that fund, permit, or undertake activities that may adversely affect essential fish habitat (EFH) are required to consult with NOAA Fisheries regarding the potential effects of their actions on EFH. The MSFMCA established eight Fishery Management Councils responsible for protecting and managing certain fisheries within specific geographic jurisdictions. The councils are required to prepare fishery management plans (FMP) to regulate commercial and recreational fishing and to identify EFH for managed species. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC 1802(10)).

7.1.5 Migratory Bird Treaty Act

The GOM and coastal areas of Texas are crucial pathways for many birds along their migratory routes. The coastlines and nearby areas are known rest stops and temporary shelters during bird migrations. The MBTA makes it illegal for anyone to take any migratory bird or the parts, nests of eggs of such a bird. This extends to any species or families of birds that live, reproduce or migrate within or across any areas. The USFWS maintains a list of migratory species protected by the Act.

7.1.6 Bald and Golden Eagle Protection Act

The BGEPA prohibits anyone, without a permit, from "taking" eagle parts, nests, or eggs. The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." "Disturb" means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available an injury, decrease in productivity or nest abandonment. Although the bald and golden eagles are not listed as threatened or endangered by the ESA, they both afford certain protections by federal law.

7.1.7 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires all federal agencies to consider the potential environmental consequences of their proposals, document the environmental analysis, and make this information available to the public for comment prior to making a permit decision on any major federal action. Issuing permits for construction of the Project would qualify as a major federal action and trigger the requirement for NEPA analysis. Under the DWPA, the USCG would initiate the NEPA process and have federal jurisdiction over the entire Project under NEPA. The USCG and Maritime Administration (MARAD) have determined that an environmental impact statement (EIS) will be prepared to support the NEPA process.

7.2 Existing Conditions

7.2.1 Federally Listed Fish Species

Threatened and endangered fish that are protected under the ESA that could occur within the nearshore and offshore waters of the GOM include the oceanic whitetip shark (*Carcharhinus longimanus),* and largetooth sawfish (*Pristis pristis*) (NOAA 2014; 2016). However, species' occurrence in the Project vicinity would not be likely within the Project area (see Table 7-1 below). There is also no designated critical habitat for the listed species within the vicinity of the proposed Project.

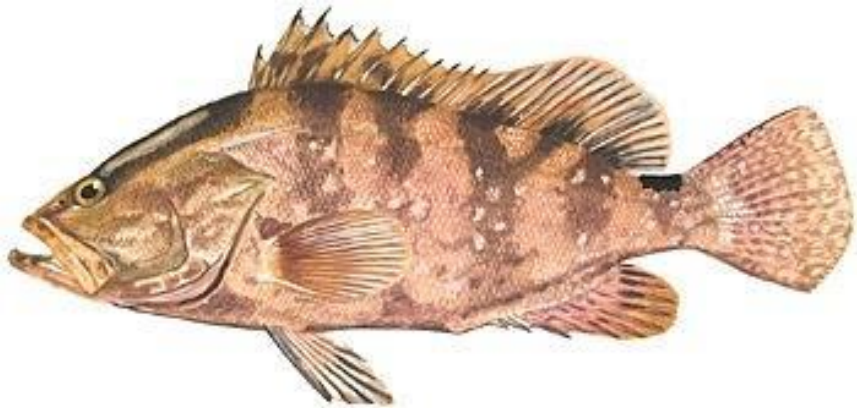
Table 7-1: Federally Listed Fish Species Potentially Occurring within the Project Area

Species	ESA-status Area	Potential Occurrence in Project	Typical Depths
Oceanic Whitetip Shark (*Carcharhinus longimanus*)	Threatened	May affect, is not likely to adversely affect; prefers open ocean off outer-continental shelf	Offshore: Deep
Nassau Grouper (*Epinephelus striatus*)	Threatened	May affect, is not likely to adversely affect; rare transient	Inshore: Shallow/Shelf
Smalltooth Sawfish	Endangered	No effect	Inshore: Shallow
Largetooth Sawfish (*Pristis pristis*)	Endangered	May affect, is not likely to adversely affect	Inshore: Shallow
Sources: NOAA 2014 and 2016			

7.2.1.1 Inshore Protected Fish Species

Nassau Grouper *(Epinephelus striatus)*
Current Federal Status: Threatened, *throughout range*

Habitat and Range Requirements: The Nassau grouper is, primarily, a shallow-water, insular species that has long been valued as a major fishery resource throughout the wider Caribbean, South Florida, Bermuda and the Bahamas (Carter et al. 1994). It has been listed as threatened since 2016 throughout its range and is an ESA Species of Concern from North Carolina to the GOM (NMFS 2013). It can be identified by interradial membranes deeply notched between spines; third dorsal spine is longer than second. There is also a dark saddle on caudal peduncle and single or double row of small black spots below and behind eye (Smith 1971).



Source: NOAA 2013

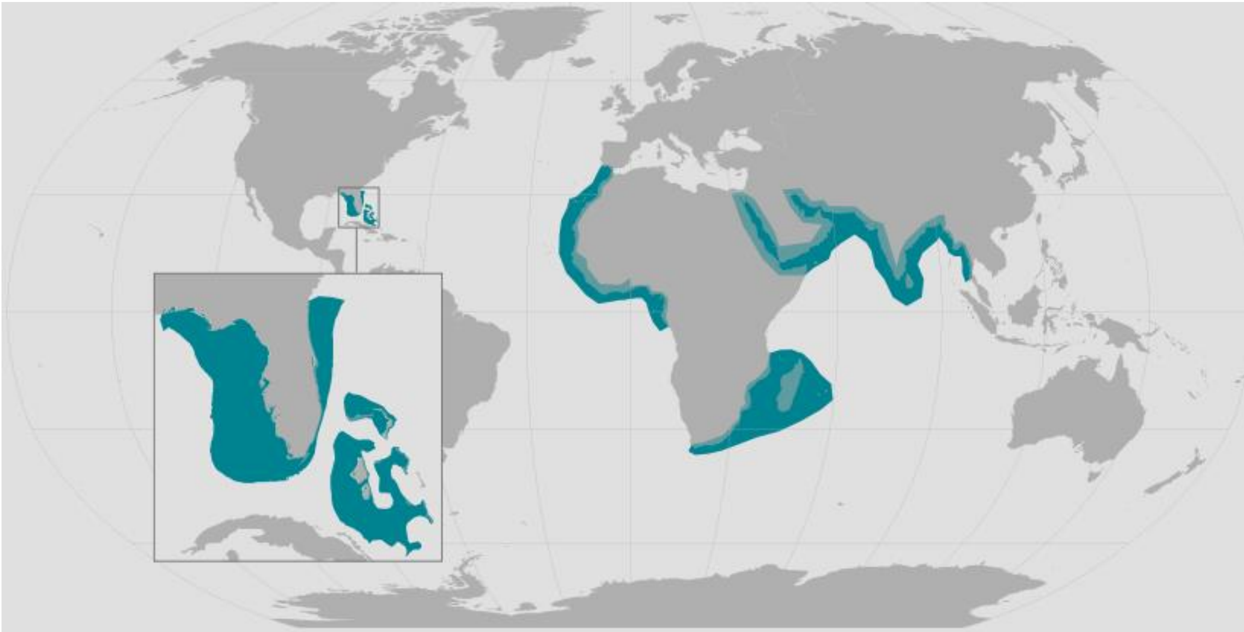
Figure 7-1: Nassau grouper adult

The Nassau grouper is considered a reef fish, but it transitions through a series of ontogenetic shifts of both habitat and diet. As larvae, they are planktonic. As juveniles, they are found in nearshore shallow waters in macroalgal and seagrass habitats. They shift progressively deeper with increasing size and maturation into predominantly reef habitat (e.g., forereef and reef crest) (NOAA 2013). The Nassau grouper has been documented in the western GOM, to the Yucatan Peninsula, Mexico, at Arrecife Alacranes (north of Progreso) (Hildebrand et al. 1964). It was cited as a rare or transient species in the northwestern GOM, off Texas (Gunter and Knapp 1951 in Hoese and Moore 1977). Foley et al. (2007) reported the first photographed and confirmed sighting in the Flower Garden Banks National Marine Sanctuary, which is located in the northwest GOM, approximately 174 mi (280 kilometer [km]) from the Project. The Nassau grouper is generally replaced ecologically in the eastern GOM by the red grouper (*Epinephelus morio)* (Smith 1971) in areas north of Key West or the Tortugas (NOAA 2013). The Nassau grouper's confirmed distribution currently includes “Bermuda and Florida (USA), throughout the Bahamas and Caribbean Sea” (Heemstra and Randall 1993).

Determination of Impact: Since the Nassau grouper has only been verified within the GOM a few times (over 10 years ago), it may occur within the Project area, but is not likely to occur. If the grouper were to occur within the Project area, it would likely be a rare transient within the area. Therefore, the Project *may affect, but is not likely to adversely affect/may impact* this species.

<u>Smalltooth Sawfish *(Pristis pectinanta)*</u>
Current Federal Status: Endangered, *within 2 distinct population segments*

Habitat and Range Requirements: The smalltooth sawfish is one of two species of sawfish that inhabit U.S. waters (the other being the largetooth sawfish, although it has not been found in the U.S. in 50 years). The body of the smalltooth sawfish is an olive grey color dorsally, with a white ventral surface. They are named after their "saws" (rostra) — long, flat snouts edged with teeth. Smalltooth sawfish have 22 to 29 teeth on each side of their snout. Smalltooth sawfish look very similar to largetooth sawfish and it can be hard to tell the two species apart (NMFS 2015d).



Source: NOAA 2015d

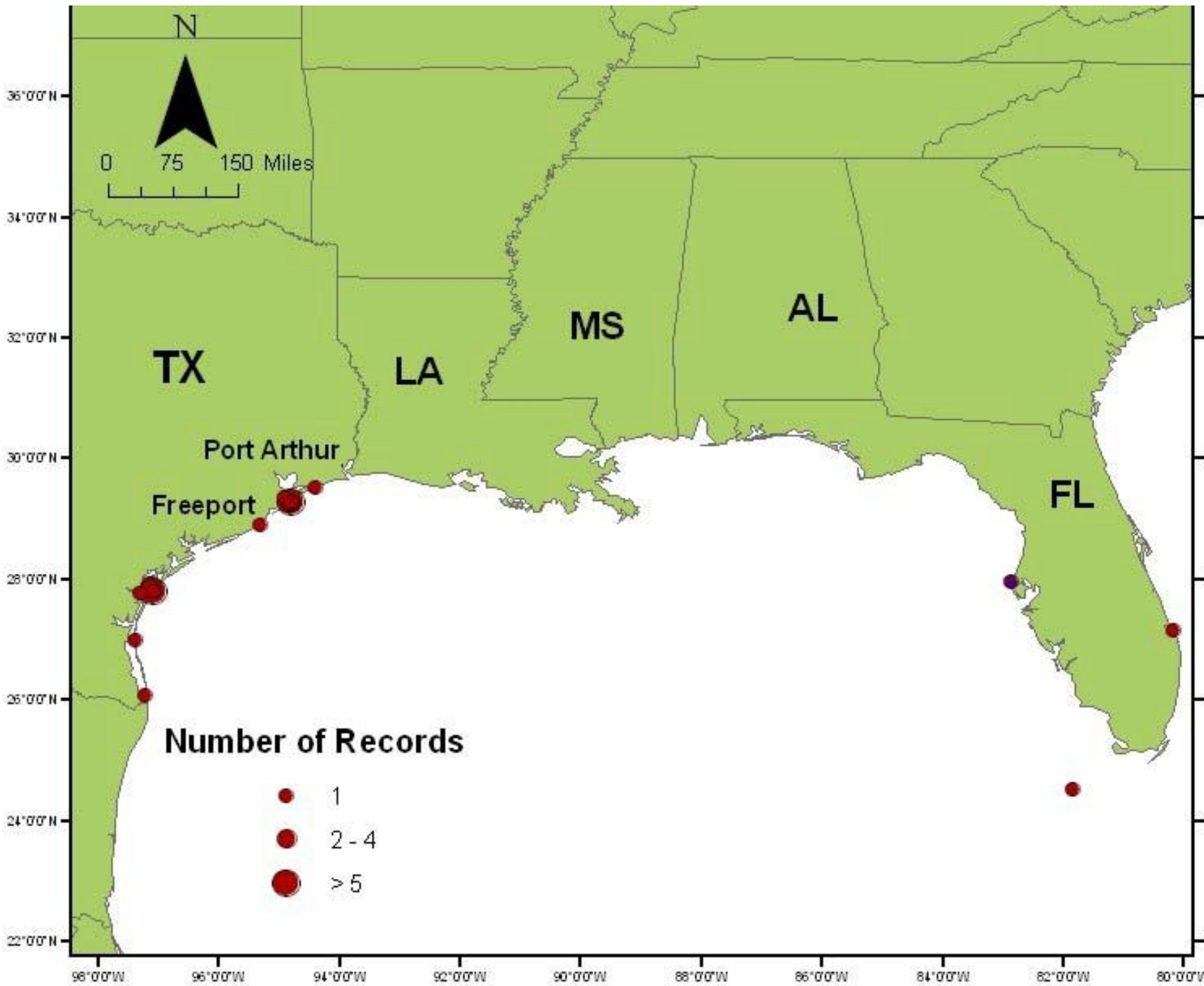
Figure 7-2: Range Map for *Smalltooth Sawfish*

In the U.S, smalltooth sawfish are most often found off the southwest coast of Florida, from about Charlotte Harbor through the Everglades region at the southern tip of the state (Figure 7-2). Outside the U.S., smalltooth sawfish have been confirmed to live in the Bahamas and Sierra Leone (a single confirmed record). According to a monitoring program specialist out of the TPWD in Corpus Christi, Texas two smalltooth sawfish were caught. One in Matagorda Bay at 5.5 feet (ft.) [1.7 m] in August 1979 and another 5 ft. [1.5 m] within a gill net in Aransas Bay in April 1984. Since then records have been scarce (Bozka 2003).

Determination of Impacts: Although sawfish have historically been documented within the Project area, based on most recent findings and research, it is believed that smalltooth sawfish are no longer along the Texas coast. The Project would have *no effect* on this species as its most recent range is along the south Florida coast.

<u>Largetooth Sawfish *(Pristis pristis)*</u>
Current Federal Status: Endangered, *throughout range*

Habitat and Range Requirements: Largetooth sawfish are easily identified by their robust rostrum, with 14 to 23 teeth per side with groves on the posterior margin (Dulvy et al. 2014' NMSF 2014). They reach lengths up 23 ft. [7 m] and can weigh 1,300 pounds [589 kilograms] (Dulvy et al. 2014; NMFS 2015b).



Source: Burgess et al. 2009

Figure 7-3: *Largetooth Sawfish R*ecords from the United States, Excluding Louisiana

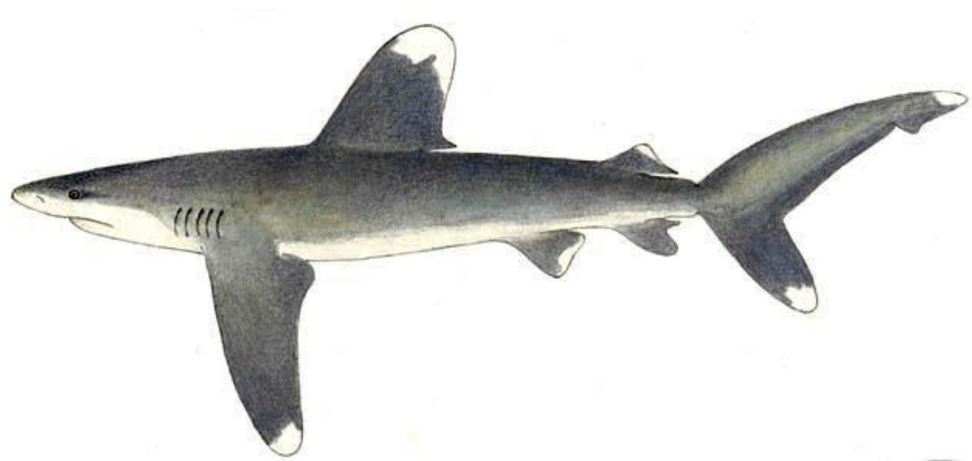
Sawfish species inhabit shallow coastal and inshore waters and have demonstrated abilities to tolerate a wide variety of salinities and have been re-listed as endangered throughout its range since 2011. Largetooth sawfish are generally restricted to shallow (less than 33 ft. [10 m]) coastal, estuarine, and fresh waters, although they have been found at depths of up to 400 ft. (122 m) in Lake Nicaragua (Burgess et al. 2009). They are often found in brackish water near river mouths and large bays, preferring partially enclosed waters, lying in deeper holes and on bottoms of mud or muddy sand. Like the smalltooth sawfish, they are highly mangrove-associated. While scientists believe they spend most of their time on the bottom, most observations occur when they are swimming near the surface in the wild (Burgess et al. 2009; NMSF 2015b). Largetooth sawfish have the largest historic range of all sawfishes (Dulvy et al 2014). The species historically occurred throughout the Indo-Pacific near Southeast Asia and Australia and throughout the Indian Ocean to east Africa. Largetooth sawfish have also been noted in the eastern Pacific Ocean from Mexico to Ecuador or possibly Peru. In the Atlantic Ocean, largetooth sawfish historically inhabited warm temperate to tropical marine waters from Brazil to the GOM in the western Atlantic, and Namibia to Mauritania in the eastern Atlantic (Burgess et al. 2009; Dulvy et al. 2014; NMSF 2015b). However, this species was once common throughout its historic range but has declined dramatically in U.S. waters over the last century (see Figure 7-3).

Determination of Impacts: Based on the historical data provided in relation to the proposed Project, the largetooth sawfish may occur but is not likely to occur, as it has not been in observed within waters of the U.S. (WOTUS) in 50 years (NOAA 2015d). Therefore, the Project *may affect, but is unlikely to adversely affect* this species.

7.2.1.2 Offshore Protected Fish Species

Oceanic Whitetip Shark *(Carcharhinus longimanus)*
Current Federal Status: Threatened, throughout range

Habitat and Range Requirements: The oceanic whitetip belongs to the genus *Carcharhinus,* which includes other pelagic species of sharks, such as the silky shark (*Carcharhinus falciformis*) and dusky shark (*C. obscuras*), and is the only truly oceanic (*i.e.,* pelagic) shark of its genus (NOAA 2016b). The oceanic whitetip shark has a stocky build with a large rounded first dorsal fin and very long and wide paddle-like pectoral fins (Lessa et al. 1999) (see Figure 7-4). The first dorsal fin is very wide with a rounded tip, originating just in front of the rear tips of the pectoral fins. The second dorsal fin originates over or slightly in front of the base of the anal fin. The species also exhibits a distinct color pattern of mottled white tips on its front dorsal, caudal, and pectoral fins with black tips on its anal fin and on the ventral surfaces of its pelvic fins (NOAA 2016b). The head has a short and bluntly rounded nose and small circular eyes with nictitating membranes. The upper jaw contains broad, triangular serrated teeth, while the teeth in the lower jaw are more pointed and are only serrated near the tip. The body is grayish bronze to brown in color but varies depending upon geographic location. The underside is whitish with a yellow tinge on some individuals (NOAA 2016b).



Source: Iziko Museums of Cape Town 2008

Figure 7-4: Oceanic Whitetip shark

As a highly migratory species, the oceanic whitetip shark was also once described as the most common pelagic shark throughout the warm-temperate and tropical waters in the Atlantic and beyond the continental shelf in the GOM (NOAA 2016b). Oceanic whitetip sharks have exhibited a range of at-vessel mortality rates in longline gear in the Atlantic Ocean between 11-34 percent (NOAA 2016b) and have been ranked as the 5th most vulnerable pelagic shark in an Ecological Risk Assessment that assessed 11 species of pelagic elasmobranchs (NOAA 2016b). The oceanic whitetip shark is usually found offshore in the open ocean, on the OCS, or around oceanic islands in deep water, occurring from the surface to at least 499 ft. (152 m) depth (NOAA 2016b).

Determination of Impacts: Based on the habitat and range requirements typical to the oceanic whitetip shark, and given that the proposed Project only reaches depths of 94 ft. (28.7 m) within the intercontinental shelf, the Project *may affect, but is unlikely to adversely affect* the oceanic whitetip shark.

7.2.1.3 Species of Concern

Species of concern are species for which there are conservation concerns regarding population status and threats, but for which insufficient information is available to indicate a need to list the species under the ESA. This status does not carry any legal protections under the ESA or other law. There are a number of fish species of concern that may occur within the vicinity of the proposed Project including: dusky shark, sand tiger shark, Warsaw grouper, speckled hind, Alabama shad (candidate species), dwarf seahorse, and opossum pipefish (NOAA 2016b; NMFS 2017d).

7.2.2 Essential Fish Habitat

As required by the MSFMCA, an EFH Assessment has been developed for the proposed Project to include a description of the South Texas Deepwater Liquids Terminal, an analysis of the potential impacts on both the managed species and their designated EFH, and proposed mitigation measures selected to minimize expected Project effects. The EFH assessment is included as Volume II Appendix G and is summarized below.

Marine fisheries in the Project area are under primary jurisdiction of the GOM Fishery Management Council (GMFMC), established under authority of the MSFMCA. The GMFMC works together with NMFS to manage commercially and recreationally important marine fish stocks and to prepare FMPs for target species. The GMFMC defines six FMPs for the GOM: shrimp, red drum, reef fish, coastal migratory pelagics, corals, and spiny lobster. In addition, NMFS' Highly Migratory Species Division manages an FMP for highly migratory species (sharks, tuna, billfish, and swordfish), as they cross domestic and international boundaries. Corals and spiny lobster do not occur in the Project area and are therefore not addressed further. Many of the managed species are economically important as commercial and recreational fisheries. Five shrimp species are managed under the Shrimp FMP, the most abundant of which are brown and white shrimp. Adult shrimp are found over soft bottom estuarine, inshore, and offshore habitats throughout the GOM. Most species occur at depths up to 328 ft. (100 m); however, royal red shrimp occur in deeper water (GMFMC 2004). Red drum occur throughout the GOM in a variety of habitats ranging from shallow estuarine waters to depths of approximately 131 ft. (40 m) offshore; they range from the Atlantic coast to Mexico. They are common in the majority of GOM estuaries, existing in a dynamic range of substrates including seagrass, sand, mud, and oyster reefs. This species can survive in waters ranging from freshwater to highly saline water; no optimum salinity has been determined. Reef fish include species that live on or near coral reef or hard bottom habitat, such as snapper, grouper, tilefish, bass, triggerfish, and other species groups (GMFMC 2004).

Coastal Migratory Pelagic species include king mackerel, Spanish mackerel, and cobia; these species occur in the coastal and continental shelf waters throughout the GOM and to the northeastern U.S. Each of these species occurs in nearshore and pelagic open water (GMFMC 2004). NMFS' Highly Migratory Species Division manages an FMP for highly migratory species (sharks, tuna, billfish, and swordfish) as they cross domestic and international boundaries. These species use a variety of habitats throughout the GOM (NOAA 2017).

Habitat areas of particular concern (HAPC) are localized areas of EFH that are ecologically important, sensitive, stressed, and/or rare areas. Although designated HAPCs have no regulatory protections above all other EFH, projects impacting HAPCs may be more scrutinized, and may be subject to additional conservation measures (NMFS 2015). The Project will not impact any designated HAPCs and the closest one (Stetson Bank) is about 174 mi (280 km) east of the SPM buoy system.

To develop EFH for the fisheries, the GMFMC and NOAA Fisheries categorized substrates and biogenic features by zone and type. Habitat zones include estuarine (bays, estuaries, and waters inshore of barrier islands), nearshore (marine waters less than 60 ft. [18 m] deep), and offshore (marine waters greater than (>) 60 ft. [18 m] deep). Habitat types are further classified into 12 categories that are distributed across the estuarine, nearshore, and offshore zones (Table 7-2) (GMFMC 2004). Based on review of publicly available data and the results of side-scan sonar, the habitats present in the Project area include submerged aquatic vegetation (SAV) and estuarine wetlands within the Laguna Madre; and *Sargassum*, soft bottoms (including sand/shell bottoms), and the water column within nearshore and offshore zones. These habitats are described in detail in Section 5.0: Inshore and Offshore Aquatic Environment and Appendix G: Essential Fish Habitat Assessment.

Table 7-2: EFH Habitat Types in the Nearshore and Offshore Waters off Padre Island

Habitat Type	Associated Terms	Description	Presence within the Project Area
SAV	Seagrasses, benthic algae	Marine and vascular plants found in shallow estuaries and some nearshore habitats (Williams and Heck 2001). Algae may be epiphytic or may grow attached to shell/rubble. This habitat provides important nursery habitat for numerous species.	Yes
Mangroves	--	Communities of halophytic trees and shrubs in typically soft sediments with regular tidal inundation, some freshwater inputs, and low to moderate wave energy. Found where the sea meets land and contain terrestrial and aquatic elements.	No
Drift algae	*Sargassum*	Floating mats of seaweed that travels through the GOM with the currents and supports a diverse assemblage of marine organisms.	Yes
Emergent marshes	Tidal wetlands, salt marshes, tidal creeks, rives/streams	Vegetated wetlands with typically soft sediments, regular tidal inundation, some freshwater inputs, and low to moderate wave energy. Found where the sea or body of water meets land and contain terrestrial and aquatic elements.	Yes
Soft bottoms	Mud, clay, silt	Areas where the bottom sediments are soft mud, clay, or silt. Shrimp and many demersal species of fish often actively select for this substrate type.	Yes
Sand/shell bottoms	Sand	Areas where the bottom sediments consist of soft sand and/or shell. Generally included in the term "soft bottom".	Yes
Hard bottoms	Live hard bottoms, low-and high-relief irregular bottoms	Subtidal hard bottom communities, usually submerged rocky outcroppings. Generally dominated by epifaunal organisms (e.g., sponges, corals, hydroids).	No
Oyster reefs	--	Aggregations of live and dead oysters with associated flora and fauna. Occur in intertidal and subtidal areas where salinities are relatively high. Estuaries with suitable substrate, calm and continuous water flow, and low sedimentation are ideal for development.	No[a]
Banks/shoals	--	Submerged ridges or bars of bottom sediment (such as sand) that rises from the water bottom to near the surface.	No
Reefs	Reefs, reef halos, patch reefs, deep reefs	Hermatypic (hard) and ahermatypic (soft) coral assemblages that dominate a habitat.	No
Shelf edge/slope	Shelf edge, shelf slope	The continental slop is a transitional environment influenced by processes of both the shelf, which ends at roughly the 200-meter (m) isobath, and the deep sea. The shelf/slope transition zone occurs between depths of 150 and 450 m.	No
Water Column Associated (WCA)	Pelagic, planktonic, coastal pelagic	Habitat within the mass of water between the surface and the substrate (ocean floor).	Yes

Source: GMFMC 2004.

[a] While oyster reefs occur in the Laguna Madre, the nearest is about 3.5 mi (5.6 km) north of the Project.

In addition to those habitat zones and types described in Table 7-2, the GMFMC divided the GOM into five eco-regions to further refine species distribution. The Project is located in the nearshore and offshore areas of Ecoregion 5, which covers an area from Freeport, Texas to the U.S./Mexico border. A total of 35 species managed by the GMFMC are identified as occurring within the nearshore and offshore habitats of Ecoregion 5, including 4 shrimp species, the red drum, 15 reef fish species, 3 coastal migratory pelagic fish species, and 12 highly migratory species (see Tables 7-3 and 7-4). An assessment of impacts on EFH for managed species and figures depicting EFH in the Project area are included in Appendix G.

Table 7-3: GMFMC Managed Fishes Identified in Ecoregion 5 by Life Stage

Common Name	Scientific Name	Life Stage				
		Eggs	Larvae	Juveniles	Adults	Spawning Adults
Shrimp						
Brown Shrimp	*Farfantepenaeus aztecus*	x	x	x	x	x
Pink Shrimp	*Farfantepenaeus duorarum*	x	x	x	x	x
White Shrimp	*Litopenaeus setiferus*	x	x	x	x	x
Royal Red Shrimp	*Hymenopenaeus robustus*	N/A	N/A	N/A	x	x
Red Drum						
Red Drum	*Sciaenops ocellatus*	x	x	x	x	x
Reef Fish						
Queen snapper	*Etelis oculatus*	--	--	--	--	--
Mutton snapper	*Lutjanus analis*	--	--	--	--	--
Blackfin snapper	*Lutjanus buccanella*	--	--	--	--	--
Red snapper	*Lutjanus campechanus*	x	x	x	x	x
Cubera snapper	*Lutjanus cyanopterus*	--	--	--	--	--
Gray (mangrove) snapper	*Lutjanus griseus*	--	--	--	x	x
Lane snapper	*Lutjanus synagris*	x	x	x	x	x
Silk snapper	*Lutjanus vivanus*	--	--	--	--	--
Yellowtail snapper	*Ocyurus chrysurus*	--	--	--	--	--
Wenchman	*Pristipomoides aquilonaris*	x	x	x	x	x
Vermilion snapper	*Rhomboplites aurorubens*	x	x	x	x	x
Speckled hind	*Epinephelus drummondhayi*	--	--	--	--	--
Goliath grouper	*Epinephelus itajara*	x	x	x	x	x
Yellowedge grouper	*Epinephelus flavolimbatus*	x	x	x	x	x
Red grouper	*Epinephelus morio*	--	--	--	--	--
Warsaw grouper	*Epinephelus nigritus*	x	x	x	x	x
Snowy grouper	*Epinephelus niveatus*	--	--	--	--	--
Nassau grouper	*Epinephelus striatus*	--	--	--	--	--
Black grouper	*Mycteroperca bonaci*	--	--	--	--	--
Yellowmouth grouper	*Mycteroperca interstitialis*	x	x	x	x	x
Gag	*Mycteroperca microlepis*	--	--	--	x	x
Yellowfin grouper	*Mycteroperca venenosa*	--	--	--	--	--
Scamp	*Mycteroperca phenax*	--	--	--	--	--
Goldface tilefish	*Caulolatilus crysops*	--	--	--	--	--

Common Name	Scientific Name	Life Stage				
		Eggs	Larvae	Juveniles	Adults	Spawning Adults
Blueline tilefish	*Caulolatilus microps*	--	--	--	--	--
Tilefish	*Lopholatilus chamaeleonticeps*	x	x	x	x	x
Greater amberjack	*Seriola dumerili*	x	x	x	x	x
Lesser amberjack	*Seriola fasciata*	x	x	x	x	x
Almaco jack	*Seriola rivoliana*	x	x	x	x	x
Ganded rudderfish	*Seriola zonata*	--	--	--	--	--
Gray triggerfish	*Balistes capriscus*	x	x	x	x	x
Hogfish	*Lachnolaimus maximus*	--	--	--	--	--
Coastal Migratory Pelagic Fishes						
King mackerel	*Scomberomorus cavalla*	x	x	x	x	x
Spanish mackerel	*Scomberomorus maculates*	--	x	--	--	--
Cobia	*Rachycentron canadum*	x	x	x	x	x

Table 7-4: Highly Migratory Species in the Project Area

Common Name	Scientific Name	Spawning/ Eggs/ Larvae[a]	Neonates[a]	Juveniles	Adults
Sailfish	*Istiophorus platypterus*	-	N/A	x[b]	x
Scalloped Hammerhead Shark	*Sphyrna lewini*	N/A	x	x	x
Blacktip Shark	*Carcharhinus limbatus*	N/A	x	x	x
Bull Shark	*Carcharhinus leucas*	N/A	x	x	x
Lemon Shark	*Negaprion brevirostris*	N/A	x	x	-
Sandbar Shark	*Carcharhinus plumbeus*	N/A	-	-	x
Spinner Shark	*Carcharhinus brevipinna*	N/A	x	x	x
Whale Shark	*Rhincodon typus*	N/A	x[b]	x[b]	x[b]
Bonnethead Shark	*Sphyrna tiburo*	N/A	x	x	x
Atlantic Sharpnose Shark	*Rhizoprionodon terraenovae*	N/A	x	x	x
Blacknose Shark	*Carcharhinus acronotus*	N/A	-	x	x
Finetooth Shark	*Carcharhinus isodon*	N/A	x	x	x

[a] The earliest life stages for billfishes are eggs and larvae; the earliest life stage for most sharks is the neonate.
[b] Although the Project does not cross EFH for this stage, it is located in immediate vicinity of the Project
N/A indicates lifestage does not occur for the selected species
Sources: NOAA 2015

7.2.2.1 Impacts of Sound on Fish

Sound can have both physical and behavioral impacts on fish. Fish produce and use sounds in a variety of behaviors, including reproduction, protection of territory, and aggression, and are able to detect a range of frequencies (Hastings and Popper 2005). Studies have shown that the sound waves from pile-driving may result in injury or trauma to fish and other animals with gas filled cavities, such as swim bladders, lungs, sinuses, and hearing structures, and may result in mortality (Popper and Hastings 2009, Hastings and Popper 2005). Other impacts of exposure to continuous and impulsive sounds may include damage to the ear, startle responses, avoidance, or lack of responsiveness to biologically relevant sounds due to masking (Hastings and Popper 2005). NOAA Fisheries uses 150 decibels (dB) at a reference pressure of

1 micro Pascal (μPa) (dB re 1 μPa) as the threshold for behavioral effects on fish species of particular concern, citing that noise levels in excess of 150 dB re 1 μPa root mean square (RMS) can cause temporary behavior changes (startle and stress) that could decrease a fish's ability to avoid predators (NMFS 2016; 2017; see Section 7.3.1.3).

7.2.3 Sea Turtles

There are five sea turtle species listed by USFWS as having the potential to occur in the counties associated with the action areas (USFWS 2018a). These five species include the Atlantic hawksbill sea turtle, the leatherback sea turtle, the Kemps' ridley sea turtle, the green sea turtle, and the loggerhead sea turtle (Table 7-5). All but the Kemp's ridley sea turtle have global distributions in either the tropics, subtropics, or temperate waters (NOAA 2016d). The Kemp's ridley sea turtle distribution is limited to the GOM, though juveniles may be found along the U.S. Atlantic coast (Meylan, 2006; NMFS et al. 2011;Dixon, 2014; TXNDD 2018). In Texas, these species can be found along South Texas inshore and nearshore coastal waters. Juveniles, males, or non-breeding females may occur all along the inshore and nearshore coastal waters. During adult non-nesting and juvenile stages, these species occur in pelagic, coral reefs, or nearshore coastal areas for foraging and breeding.

For these five species, nesting occurs on coastal beaches. Primary nesting areas for all species are located outside of Texas, however, all five species have documented nests at the Padre Island National Seashore (PINS) located approximately 40 mi (64 km) south of the coastal portion of the Project area. These species exhibit site fidelity, returning to the same nesting area annually and across generations. Although there are slight temporal differences in the specific nesting dates for each species, nesting occurs between March and November, with peak activities from May through July.

The Atlantic hawksbill sea turtle and leatherback sea turtle are rare in Texas with only one nesting record for each species located at the PINS (Dixon, 2014; TXNDD 2018). There are very few sightings of these species in nearshore marine environments (Landry no date). Each year few (0 to 6) nests of the loggerhead, and several nests of the Kemp's ridley and green sea turtles, have been documented at PINS (TXNDD 2018). The green sea and loggerhead sea turtles are known to occur in the inshore Texas waters in relative abundance (Turtle Island Restoration Network, 2018).

Table 7-5: ESA-Listed Reptile Species Occurring in within the Project Area

Species	ESA Status
Green Sea Turtle (*Chelonia mydas*)	Threatened
Hawksbill Sea Turtle (*Eretmochelys imbricata*)	Endangered
Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)	Endangered
Leatherback Sea Turtle (*Dermochelys coriacea*)	Endangered
Loggerhead Sea Turtle (Caretta caretta)	Threatened

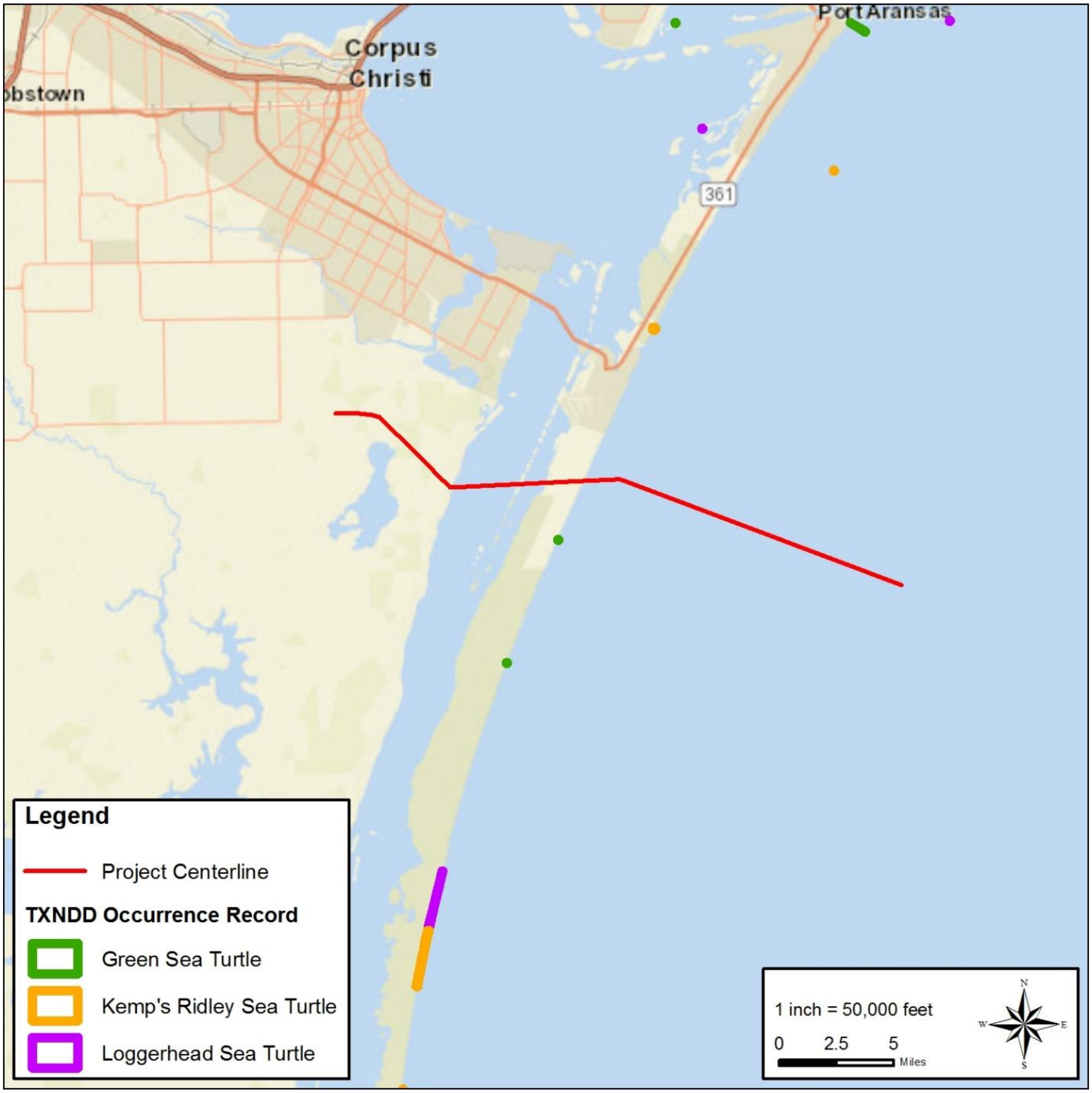


Figure 7-5: Sea Turtle Species Occurrence Map

7.2.3.1 Green Sea Turtle, *Chelonia mydas*

Current Federal Status: Threatened

Habitat and Range Requirements: The green sea turtle's life history occurs throughout three distinct habitat types. Eggs are laid on bare sanded beaches with limited vegetation cover, mature turtles will spend most of their time in shallow, coastal waterways that have ample seagrass beds, adult turtles will frequent inshore bays and lagoons (Meylan, 2006).

The green sea turtle has a worldwide distribution in tropical and subtropical waters. Major green sea turtle nesting colonies in the Atlantic occur on Ascension Island, Aves Island, Costa Rica, and Surinam (USFWS Green Sea Turtle Fact Sheet). Within the U.S., green turtles nest in small numbers in the U.S. Virgin

Islands, Puerto Rico, Georgia, South Carolina, and North Carolina, and in larger numbers in Florida and Hawaii (USFWS, 2018d). The Florida green sea turtle nesting aggregation is recognized as a regionally significant colony (USFWS, 2018d). Nest numbers in Florida have ranged from 435 laid in 1993 to 13,225 in 2010, which likely represents over 5,000 females nesting in 2010 (USFWS, 2018d). In the U.S. Pacific, over 90 percent of nesting throughout the Hawaiian archipelago occurs at French Frigate Shoals, where an average of 390 females nested annually from 2000-2009 (USFWS, 2018d). Elsewhere in the U.S. Pacific, nesting takes place at scattered locations in the Commonwealth of the Northern Marianas, Guam, and American Samoa (USFWS, 2018d). Along the coast of Texas, green sea turtles are known to nest on barrier islands on the middle coast and lower coast, especially at PINS (USFWS, 2018d). This species is common in inshore waters of Texas foraging on seagrass and algae (Dixon, 2014). During the 2018 winter, numerous greens sea turtles were found cold stunned within the Project area on both sides of the island. Many of these animals were taken to rehabilitation centers and released once temperatures were brought back to normal. The species is therefore known to exist within the Project area.

Green sea turtles primarily feed on seagrass and marine algae and will frequent seagrass beds in warm coastal waters (Meylan, 2006). The species is generally found in reefs, bays, inlets, and estuaries, especially dominated by seagrasses and algae. The green sea turtle migrates in deeper marine waters. Open beaches with gradual slopes and minimal disturbance are required for nesting (Meylan, 2006; USFWS, 2018d). Impacts to open beach areas on the GOM and the Laguna Madre side of Padre Island, have been avoided through utilizing horizontal directional drilling (HDD) technology. Temporary impacts to seagrass habitats in Laguna Madre have been minimized by using HDD technology; however, there will be temporary impacts to the seagrass, and therefore, possibly to green sea turtles, in those portions of the Laguna Madre where the pipeline will be installed via trenching. Biological monitors will be present to ensure there will be no unanticipated take of green sea turtles during inshore and offshore construction.

In the terrestrial environment, suitable beach nesting habitat is present in the Project area. However, the probability of a nesting occurrence is very low, given that PINS is the only area where nesting occurrences have been documented, and there is a significant amount of human pedestrian disturbance and vehicular traffic on the beach in the immediate Project area. The green sea turtle has been documented in the Project area, as four green sea turtle carcasses were found in the Project vicinity, in Laguna Madre along the western edge of Padre Island during the piping plover surveys conducted in February 2018. It is believed these turtles were victims of cold stunning. Thousands of sea turtles were observed going into cold shock throughout the Texas Gulf Coast Region during the winter of 2017-2018 (Turtle Island Restoration Network, 2018).

There will be no effects on beach habitat in the Project area because it will be avoided up to 1 mi (1.6 km) offshore via HDD construction methodology. In addition, offshore construction is anticipated to occur outside of sea turtle nesting season.

Determination of Impact: Based on the information presented above, the Project *may affect, but is not likely to adversely affect* the green sea turtles in the inshore estuarine, terrestrial, and offshore marine environments.

7.2.3.2 Hawksbill Sea Turtle, *Eretmochelys imbricata*

Current Federal Status: Endangered

Habitat and Range Requirements: Primarily found in tropical coral reef environments. This species is highly migratory and has been observed inhabiting a wide variety of habitats, from open ocean, lagoons, to mangrove swamps (Meylan 2006). In the terrestrial environment, suitable beach nesting habitat is present within the Project area. However, the probability of a nesting occurrence is very low given the rarity of nesting on the Texas coast and the very few sightings of these species in nearshore marine environments (Dixon 2014). There will be no effects on the beach habitat because it will be avoided up to 1 mi [1.6 km] offshore via HDD construction methods, and offshore construction is anticipated to occur outside of sea turtle nesting season.

The preferred prey species of hawksbill sea turtles, sponges, is uncommon in this portion of the GOM. Thus, construction activities are not anticipated to affect foraging activities of this species. The leatherback sea turtle prefers jellyfish, of which some species do occur in the area. As stated above the sediment plume associated with offshore construction activities will be localized, temporary, and thus not expected to affect foraging activities of these sea turtle species. Biological monitors will be present to ensure there will be no take of hawksbill sea turtles during offshore construction.

Determination of Impact: There are *no anticipated effects* of the Project's activities and environmental consequences on hawksbill sea turtles in the terrestrial and inshore environments. Any sediment plume associated with offshore construction activities will be localized, temporary, and thus not expected to affect foraging activities of the hawksbill sea turtle. Biological monitors will be present to ensure there will be no unanticipated take of hawksbill sea turtles during offshore construction. The Project *may affect, but is not likely to adversely affect* the hawksbill sea turtle in the offshore marine environment.

7.2.3.3 Kemp's Ridley Sea Turtle, *Lepidochelys kempii*

Current Federal Status: Endangered

Habitat and Range Requirements: The Kemp's ridley sea turtle is found in the GOM in Mexico and the U.S., as well as the Atlantic coast from Florida to New Jersey, with sightings as far north as Newfoundland (USFWS, 2018e). Nesting is limited to the beaches of the western GOM, primarily in the Mexican States of Tamaulipas and Veracruz, with a few historical records from Campeche. Nesting also occurs regularly along the Texas coast and infrequently in other U.S. states (Rhodin, 2005; USFWS, 2018e). Possibly precipitated by strong winds and changes in barometric pressure, the females often nest in synchronized emergences, known as arribadas or arriba zones, primarily during daylight hours (Rhodin, 2005; USFWS, 2018e). Clutch size averages 100 eggs (USFWS, 2018e). Some females breed annually and nest an average of 2.5 times in a season at intervals of 14 to 28 days (USFWS, 2018e). Sexual maturity is believed to be reached at about 12 years (Rhodin, 2005; USFWS, 2018e). This species occupies nearshore and offshore waters of the northern GOM outside of nesting season (Dixon, 2014; USFWS, 2018e).

The Kemp's ridley is one of the rarest sea turtles in the world. Its numbers precipitously declined after 1947, when over 40,000 nesting females were estimated in a single arribada (USFWS, 2018e). The nesting population produced a low of 702 nests in 1985; however, since the mid-1980s, the number of nests laid in a season has been increasing primarily due to nest protection efforts and implementation of regulations requiring the use of turtle excluder devices in commercial fishing trawls (USFWS, 2018e). In 2011, a total of 20,570 nests were documented in Mexico, 81 percent of these nests were documented along the 18.6 mi (29.9 km) of coastline patrolled at Rancho Nuevo (USFWS, 2018e). In addition, in the U.S., 199 nests were recorded in 2011, primarily in Texas (USFWS, 2018e). Known nesting areas include the PINS, as well as the Gulf-side of San Jose and Mustang Islands (Peterson 2014; USFWS, 2018e).

Outside of nesting, Kemp's ridley sea turtles are usually found in the nearshore and inshore waters of the northern GOM (Rhodin, 2005; USFWS, 2018e). Adult and sub-adult Kemp's ridleys primarily occupy nearshore habitats that contain muddy or sandy bottoms where prey can be found (Rhodin, 2005; USFWS, 2018e). Kemp's ridley hatchlings and small juveniles enter the water and quickly swim offshore to open ocean developmental habitat where they associate with floating Sargassum (*Sargassum* sp.) seaweed. They passively drift within the *Sargassum*, feeding on a wide variety of floating items (USFWS, 2018e). Some of these juvenile turtles remain within the GOM while others are swept out of the GOM and into the Atlantic Ocean by the Gulf Stream (USFWS, 2018e). This developmental period is estimated to last for a few years, at which time these sub-adult turtles return to shallow-water zones of the northern GOM or northwestern Atlantic Ocean where they feed and continue growing until they reach adulthood.

In the terrestrial environment, suitable beach nesting habitat is present in the Project area; however, the probability of a nesting occurrence is moderately low given the primary nesting areas are in Mexico and secondarily at the PINS. There will be no effects on beach habitat in the Project area because it will be avoided up to 1 m (1.6 km) offshore via HDD construction methods, and offshore construction is anticipated to occur outside of sea turtle nesting season. This species is relatively common in inshore waters of Texas and has a broad preference for hard-shelled marine invertebrates not limited to the vicinity of the Project area, and individuals would be able to continue foraging outside and after the temporary disturbance of offshore construction activities. Any sediment plume associated with offshore construction activities will be localized, temporary, and thus not expected to affect foraging activities of the Kemp's ridley sea turtle. Biological monitors will be present to ensure there will be no unanticipated take of Kemp's ridley sea turtles during offshore construction.

Determination of Impact: The Project *may affect, but is not likely to adversely affect the* Kemp's ridley sea turtle in the inshore estuarine, inshore terrestrial, and offshore marine environments.

7.2.3.4 Leatherback Sea Turtle, *Dermochelys coriacea*

Current Federal Status: Endangered

Habitat and Range Requirements: The leatherback sea turtle is the largest, deepest diving and most migratory of all sea turtles;It also has the largest range (Meylan, 2006; USFWS 2007a). Adults can reach 4 to 8 ft. (1.2 to 2.4 m) in length and weigh 500 to 2,000 pounds (227 to 907 kilograms) (Behler et al. 1996). Historical range included the GOM and Texas waters. The species has been federally listed as endangered since 1970. The only critical habitat is designated in the US Virgin Islands (USFWS, 2007a). The species is not likely to occur within the Project area.

Determination of Impact: There are *no anticipated effects* of the Project's activities and environmental consequences on leatherback sea turtles in the terrestrial and inshore environments. Any sediment plume associated with offshore construction activities will be localized, temporary, and thus not expected to affect foraging activities of the leatherback sea turtle. Biological monitors will be present to ensure there will be no unanticipated take of leatherback sea turtles during offshore construction. The Project *may affect, but is not likely to adversely affect the* leatherback sea turtle in the offshore and marine environments.

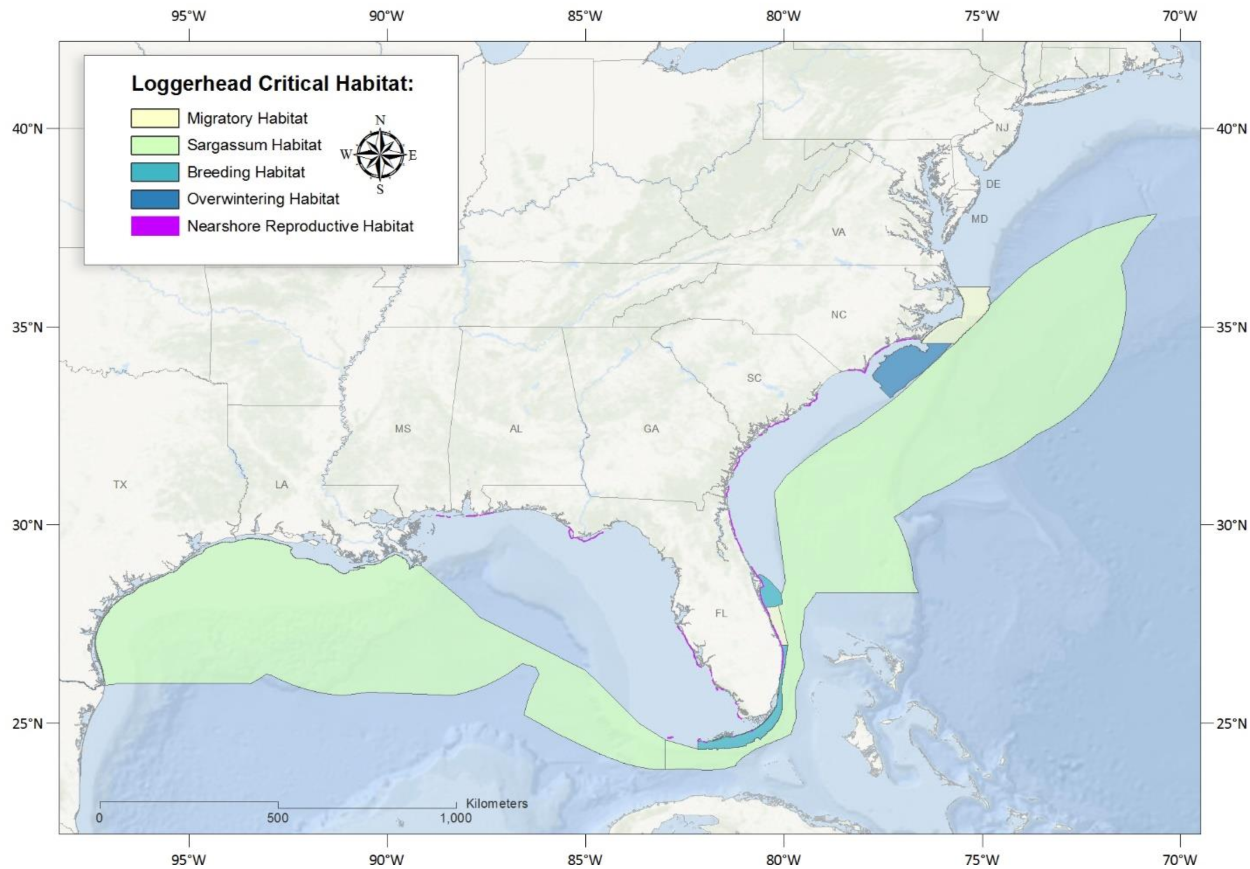
7.2.3.5 Loggerhead Sea Turtle, *Caretta caretta*

Current Federal Requirements: Endangered

Habitat and Range Requirements: Loggerhead turtles are found throughout the world in mid-latitude warm ocean waters. The turtle is found throughout the GOM, with more nesting occurring from Mississippi to Florida; occasional nesting occurs in the western GOM (Meylan, 2006; USFWS, 2018f). Adult loggerheads are known to make considerable migrations between foraging areas and nesting beaches. During non-nesting years, adult females from U.S. beaches are distributed in waters off the eastern U.S. and throughout the GOM, Bahamas, Greater Antilles, and Yucatan (Meylan, 2006). Mean clutch size varies from about 100 to 126 along the southeastern U.S. coast. Incubation duration ranges from about 42 to 75 days, depending on incubation temperatures, but averages 55 to 60 days for most clutches in Florida (Meylan, 2006; USWFS, 2018f). Hatchlings generally emerge at night. Remigration intervals of 2 to 3 years are most common in nesting loggerheads, but remigration can vary from 1 to 7 years. Age at sexual maturity is believed to be about 32 to 35 years (Meylan, 2006).

The loggerhead is widely distributed within its range. It may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers (Meylan, 2006; USWFS, 2018f). Coral reefs, rocky places, and ship wrecks are often used as feeding areas. Nesting occurs mainly on open beaches or along narrow bays having suitable sand, and it is often in association with other species of sea turtles. Most loggerhead hatchlings originating from U.S. beaches are believed to lead a pelagic existence in the North Atlantic gyre for an extended period of time, perhaps as long as 7 to 12 years, and are best known from the eastern Atlantic near the Azores and Madeira (Meylan, 2006; USWFS, 2018f). Post-hatchlings have been found floating at sea in association with *Sargassum* rafts. Once they reach a certain size, these juvenile loggerheads begin recruiting to coastal areas in the western Atlantic where they become benthic feeders in lagoons, estuaries, bays, river mouths, and shallow coastal waters (Meylan, 2006). These juveniles occupy coastal feeding grounds for about 13 to 20 years before maturing and making their first reproductive migration, the females returning to their natal beach to nest. Loggerhead sea turtles spend most of their time in open ocean and shallow coastal water habitats. Typically found along the continental shelf and within shallow coastal estuaries. Just like Kemp's ridley sea turtles, juvenile loggerhead sea turtles can be found floating within *Sargassum* seaweed patches offshore (USWFS, 2018f) (see Figure 7-6 below).

In the terrestrial environment, suitable beach nesting habitat is present in the Project area; however, the probability of a nesting occurrence is moderately low given the few (0 to 6) annual nesting occurrences documented at the PINS. There will be no effects on beach habitat in the Project area because it will be avoided up to 1 mi (1.6 km) offshore via HDD construction methods, and offshore construction is anticipated to occur outside of sea turtle nesting season. This species is relatively common in inshore waters of Texas and has a broad preference for hard-shelled marine invertebrates not limited to the vicinity of the Project area, and individuals would be able to continue foraging outside and after the temporary disturbance of offshore construction activities. As stated above the sediment plume associated with offshore construction activities will be localized, temporary, and thus not expected to affect foraging activities of the loggerhead sea turtle.



Source: NOAA 2014

Figure 7-6: Loggerhead Critical Habitat Map

Determination of Impact: Based on the previous analysis, the Project *may affect, but is not likely to adversely affect the* loggerhead sea turtles in the terrestrial, inshore, and offshore environments.

7.2.3.6 Impacts of Sound on Sea Turtles

Only a few studies exist that have examined the role of hearing ecology for sea turtles (Mrosovsky, 1972, Samuel et el. 2005, Nunny et al., 2008, Ferrara et al. 2014). As with other species of turtles that have recently been identified as using sound to communicate, sea turtles may also use sound in this manner (Ferrara et al. 2014). Very little is known about the extent to which sea turtles use their auditory environment, and the habitats in which they occur changes the passive acoustics with each ontogenetic habitat shift. For instance, the inshore environment where juvenile and adult sea turtles may reside for feeding and resting, is noisier than the open ocean habitat where hatchlings occur; this inshore environment is dominated by low frequency sound (Hawkins and Myrberg, 1983), and, in areas of high traffic, virtually constant low frequency noises from shipping, recreational boating, and seismic surveys compound the potential for acoustic impact (Hildebrand 2005).

Sound can have both physical and behavioral impacts on sea turtles. As described above for fish, studies have shown that the sound waves from pile-driving may result in injury or trauma to sea turtles and other animals with gas filled cavities, such as, lungs, sinuses, and hearing structures (Popper *et al.* 2014, Hastings and Popper 2005). Sea turtles may also exhibit startle reactions in response to noise or avoid important feeding, mating, or nesting habitat when anthropogenic noise is present in the vicinity (BOEM 2012). However, limited data are available describing the effects of intense sounds on marine turtles. A few case studies have been attempted which documented avoidance reactions to seismic signals at levels between 166 and 179 dB re 1 μPa (Moein et al., 1995; McCauley et al., 2000); however, both of these studies were completed in artificial settings that limited the turtles abilities to seek avoidance. Moein et al. (1995) did observe a habituation effect to the airguns; the animals stopped responding to the signal after three presentations. This lack of behavioral response could be a result of temporary and permanent threshold shifts (PTS) (reductions in hearing sensitivity).

Other impacts of exposure to continuous and impulsive sounds may include damage to the ear or lack of responsiveness to biologically relevant sounds due to masking (Popper *et al.* 2014). NOAA Fisheries uses 166 dB re 1 μPa as the threshold for behavioral effects sea turtles and 180 dB re 1 μPa as the threshold for injury (NMFS 2017; see Section 7.3.1.3).

7.2.4 Marine Mammals

Twenty-nine species of marine mammals (Table 7-6) are known to occur in waters of the GOM (BOEM 2017). With one species exception, all of these mammals belong to the order Cetacea. Of the 28 species of cetaceans occurring in the GOM, 7 belong to the suborder Mysticeti (baleen whales), and 21 belong to the suborder Odontoceti (toothed whales). The exception, the West Indian manatee (*Trichecus manatus*) and its subspecies, the Florida manatee (*Trichehus manatus latirostris*), belong to the order Sirenia. All of these species are protected by the MMPA, and seven are further protected by the ESA of 1973.

Table 7-6: Marine Mammals Occurring in the Northern Gulf of Mexico

Common Name	Scientific Name	Protection	Expected Occurrence in the Project Vicinity
Order Cetacea			
Suborder Mysticeti (baleen whales)			
Blue Whale	*Balaenoptera musculus*	ESA (E), MMPA	Distributed in sub-polar to sub-tropical latitudes worldwide. Migrates toward polar waters in spring. While found in coastal waters, they are thought to occur generally more offshore than other whales.
Bryde's whale	*Balaenoptera edeni*	MMPA (strategic stock), proposed endangered under the ESA	Occurs in tropical, subtropical and warm temperate waters worldwide, including the northwestern and central GOM.
Fin whale	*Balaenoptera physalus*	ESA (E), MMPA	Distributed in deep, offshore waters of all major oceans, primarily in temperate to polar latitudes; less common in the tropics. Most migrate from the Arctic and Antarctic

Common Name	Scientific Name	Protection	Expected Occurrence in the Project Vicinity
			feeding areas in the summer to tropical breeding and calving areas in the winter. .
Humpback whale	*Megaptera novaeangliae*	ESA (E), MMPA	Distributed throughout all major oceans from the equator to sub-polar latitudes. Not expected to occur in the northern and western GOM.
Minke whale	*Balaenoptera acutorostrata*	MMPA	Distributed in temperate, tropical, and high latitude waters. Common and widely distributed throughout the Atlantic EEZ. Prefer the continental shelf from spring to fall; prefer oceanic waters from fall to spring.
Sei whale	*Balaenoptera borealis*	ESA (E), MMPA	Distributed in subtropical, temperate, and subpolar waters. May unpredictably and randomly occur in a specific area, sometimes in large numbers. These events may occur suddenly and then not occur again for long periods of time. May migrate toward lower latitudes during winter and higher latitudes during summer.
Suborder Odontoceti (toothed whales and dolphins)			
Atlantic spotted dolphin	*Stenella frontalis*	MMPA	In the GOM, occur primarily along the continental shelf at 33 to 656 ft. (10 to 200 m) deep, to the continental slope at 1,641 ft. (500 m).
Blainville's beaked whale	*Mesoplodon densirostris*	MMPA	Oceanic species; prefers temperate and tropical waters > 1,641, ft. (500 m) deep.
Bottlenose dolphin	*Tursiops truncatus*	MMPA	Western coastal stock occurs outside of bays and estuaries, and in GOM waters less than 20 m deep, from the Laguna Madre to the Florida Keys.
Clymene dolphin	*Stenella clymene*	MMPA	Endemic to tropical and sub-tropical waters of the Atlantic. Prefers deep, oceanic waters off the continental shelf in the GOM, west of the Mississippi River.
Cuvier's beaked whale	*Ziphius cavirostris*	MMPA	Oceanic species; prefers waters > 1,641 ft. (500 m) deep.
Dwarf sperm whale	*Kogia simus*	MMPA	Distributed worldwide in temperate to tropical waters. Prefer oceanic waters in northern GOM.
False killer whale	*Pseudorca crassidens*	MMPA	Distributed worldwide in warm temperate and tropical oceans. In the northern GOM, this species prefers deep, oceanic waters.
Fraser's dolphin	*Lagenodelphis hosei*	MMPA	Distributed worldwide in tropical waters. In the northern GOM, this species prefers oceanic waters > 656 ft. (200 m) deep.
Gervais' beaked whale	*Mesoplodon europaeus*	MMPA	Distributed worldwide in temperate and tropical waters of the world oceans. Prefers oceanic waters in the GOM > 1,641 ft. (500 m) deep.
Killer whale	*Orcinus orca*	MMPA	Distributed worldwide from tropical to polar regions. In the northern GOM, the killer whale prefers oceanic waters ranging from 840 to 8,701 ft. (256 to 2,652 m).
Melon-headed whale	*Peponocephala electra*	MMPA	Distributed worldwide in tropical to sub-tropical waters. In the northern GOM, this species prefers oceanic waters west of Mobile Bay, Alabama that are > 2,625 ft. (800 m) deep.
Pantropical spotted dolphin	*Stenella attenuata*	MMPA	Distributed worldwide in tropical and certain sub-tropical oceans. In the northern GOM, this species prefers oceanic waters.
Pygmy killer whale	*Feresa attenuata*	MMPA	Distributed worldwide in tropical and sub-tropical waters. In the northern GOM, pygmy killer whales prefer oceanic waters.
Pygmy sperm whale	*Kogia breviceps*	MMPA	Distributed worldwide in temperate to tropical waters. In northern GOM, the pygmy sperm whale prefers oceanic waters during all seasons.
Risso's dolphin	*Grampus griseus*	MMPA	Distributed worldwide in tropical to warm temperate waters. In the northern GOM, Risso's dolphin prefers oceanic waters but is concentrated in waters along the continental slope during all seasons.

Common Name	Scientific Name	Protection	Expected Occurrence in the Project Vicinity
Rough-toothed dolphin	*Steno bredanensis*	MMPA	Distributed worldwide in tropical to warm temperate waters. In the northern GOM, this species occurs in oceanic waters averaging 640 ft. (195 m) deep and sometimes along the continental shelf.
Short-finned pilot whale	*Globicephala macrorhynchus*	MMPA	Distributed worldwide in tropical to temperate waters. In the northern GOM, the short-finned pilot whale occurs primarily on the continental slope during all seasons.
Sperm whale	*Physeter macrocephalus*	ESA (E), MMPA	Distributed worldwide, but generally prefer waters deeper than 1,641 ft. (500 m).
Spinner dolphin	*Stenella longirostris*	MMPA	Distributed worldwide in tropical to temperate oceanic waters. In the northern GOM, the spinner dolphin is located generally east of the Mississippi River.
Striped dolphin	*Stenella coeruleoalba*	MMPA	Distributed worldwide in tropical to temperate oceanic waters. In the northern GOM the striped dolphin prefers oceanic waters.
Sowerby's beaked whale	*Mesoplodon bidens*	MMPA	Prefers northern temperate waters of the northern Atlantic. In the GOM considered extralimital due to only 1 reported stranding throughout its history.
Order Sirenia (sea cows)			
Florida manatee	*Trichechus manatus latirostris*	ESA (E), MMPA	Distributed throughout the northeastern GOM. Prefers riverine and shallow nearshore waters where temperatures are above 63 degrees Fahrenheit (°F) with abundant seagrasses, water hyacinth, and aquatic weeds.
Sources: Byrnes *et al.* 2017, Hayes *et al.* 2017			

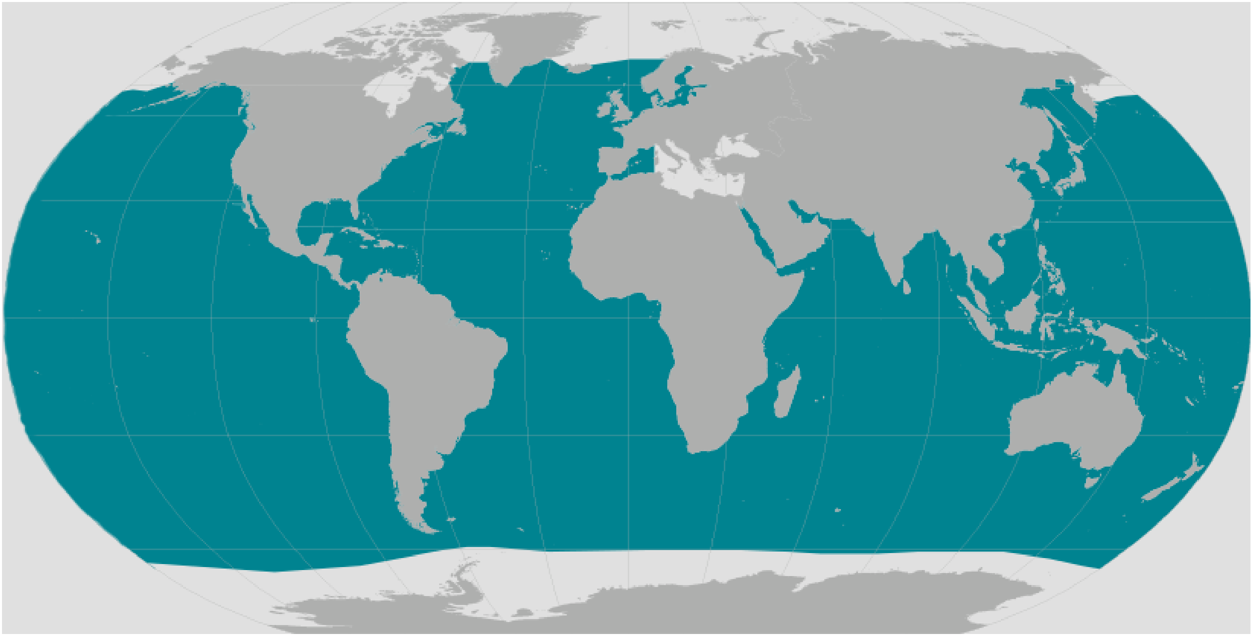
7.2.4.1 Marine Mammals Listed under the Endangered Species Act

There are a total of 6 endangered or threatened marine mammal species, as well as one species that is proposed for listing, which could occur within the proposed Project area (Table 7-6). In efforts to help protect many of these species worldwide, NMFS and other federal agencies are required to designate critical habitat or DPS within species' known habitats and ranges. Once critical habitat is designated, federal agencies must be consulted to ensure any activities they authorize, fund, or carry out are not likely to destroy or adversely modify the critical habitat (USFWS and NOAA 2016).

7.2.4.2 Sei Whale, *Balaenoptera borealis*

Current Federal Status: Endangered, *throughout range*

Habitat Range and Requirements: Sei whales have a tall, hooked dorsal fin located about two-thirds down their back. Sei whales have 219 to 410 baleen plates (long, fingernail like plates instead of teeth) that are dark in color with gray/white fine inner fringes in their enormous mouths. They also have 30 to 65 relatively short accordion-like creases, or throat grooves, that extend from below the mouth to the naval area. The number of throat grooves and baleen plates may differ depending on geographic population (NMFS 2015c). Sei whales are usually observed alone or in small groups of two to five animals. Today, there are around 8,600 sei whales in the North Pacific. This is only little more than 20 percent of the original population estimate of 42,000 for this area. The total population of sei whales in all U.S. waters is unknown (NMFS 2015c). Sei whales have a cosmopolitan distribution and occur in subtropical, temperate, and subpolar waters around the world. This species may unpredictably and randomly occur in a specific area, sometimes in large numbers. These events may occur suddenly and then not occur again for long periods of time. Populations of sei whales, like other rorquals, may seasonally migrate toward the lower latitudes during the winter and higher latitudes during the summer (NMFS 2015c).



Source: NMSF 2015c

Figure 7-7: Map of Sei Whale Range

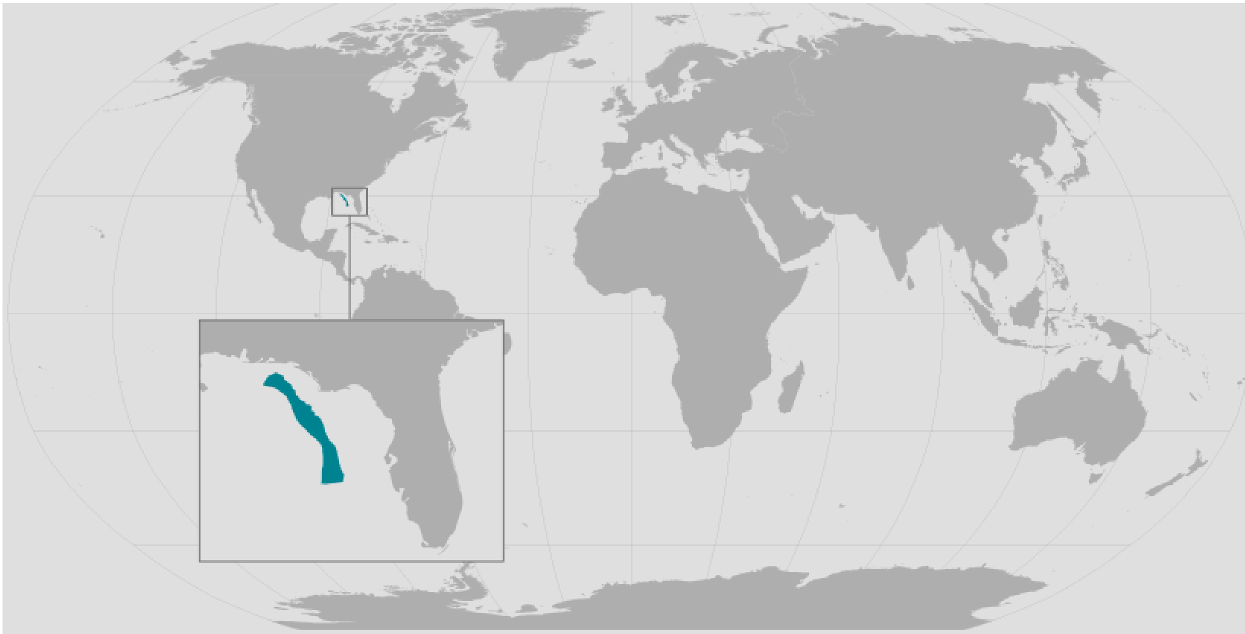
Underwater noise threatens whale populations, interrupting their normal behavior and driving them away from areas important to their survival. Increasing evidence suggests that exposure to intense underwater sound in some settings may cause some whales to strand and ultimately die (NMSF 2015c). Drilling for oil and gas generally produces low-frequency sounds with strong tonal components in frequency ranges in which large baleen whales communicate. There are few data on the noise from conventional drilling platforms, but recorded noise from an early study of one drilling platform and three combined drilling production platforms found that noise was so weak it was almost undetectable alongside the platform at Beaufort scale sea states of three or above. The strongest tones were at low frequencies, near 5 Hz (Richardson *et al*. 1995).

Determination of Impact: Based on the analysis the Project *may affect but is not likely to adversely affect* the sei whale in the marine and offshore environments.

7.2.4.3 Bryde's Whale, *Balaernoptera edeni*

Current Federal Status: *Proposed Endangered, Gulf of Mexico*

Habitat Range and Requirements: The Bryde's whale in the GOM has a streamlined and sleek body shape, a somewhat pointed, flat rostrum with three prominent ridges (*i.e.,* a large center ridge, and smaller left and right lateral ridges), a large falcate dorsal fin, and a counter-shaded color that is fairly uniformly-dark dorsally and light to pinkish ventrally (NMFS 2016c). There is no apparent morphological difference between the Bryde's whale in the GOM and those worldwide (NMSF 2016c). Stranding records from the Southeast U.S. stranding network, the Smithsonian Institution, and the literature (NMFS 2016c) include 22 Bryde's whale strandings in the GOM from 1954 to 2012, although three have uncertain species identification. Most strandings were recorded east of the Mississippi River through west central Florida, but two were recorded west of Louisiana. There are no documented Bryde's whale strandings in Texas, although strandings of fin (*B. physalus*), sei (*B. borealis*), and minke (*B. acutorostrata*) whales have been documented (Mullin et al. 2003; NMFS 2016c).



Source: NMFS 2017a

Figure 7-8: Biologically important area for Bryde's whale population in the Gulf of Mexico

Bryde's whales prefer highly productive tropical, subtropical and warm temperate waters worldwide (61 to 72°F or 16 to 20°C). The smaller form of this species may prefer waters near the coast and continental shelf (NMFS 2017a). Habitat in the north-central and western GOM, which includes the historical range of the Bryde's whale, has been significantly modified with the presence of thousands of oil and gas platforms (NMFS 2016c). Additionally, exposure to oil spills may cause marine mammals acute or chronic impacts with lethal or sub-lethal effects depending on the size and duration of the spill. For large baleen whales, like the GOM's Bryde's whale, oil can foul the baleen they use to filter-feed, decreasing their ability to eat, and resulting in the ingestion of oil (NMFS 2016c). Impacts from exposure may also include: reproductive failure, lung and respiratory impairments, decreased body condition and overall health, and increased susceptibility to other diseases (NMFS 2016c).

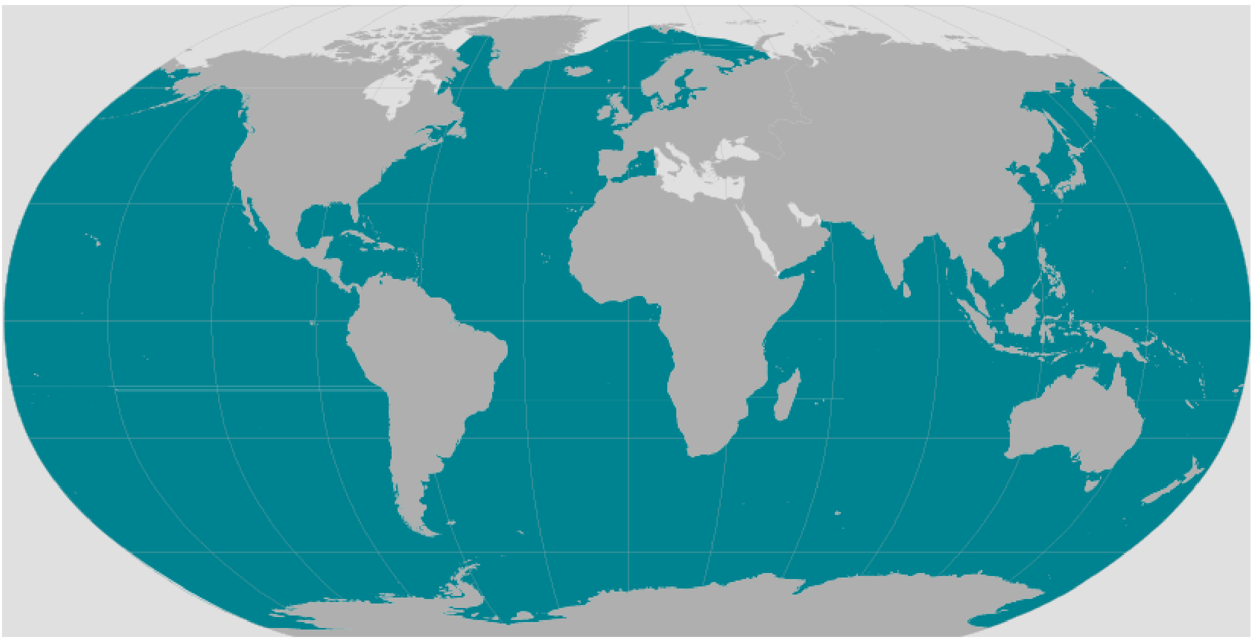
Determination of Impact: Due to most of the whale's resident population being closer to the northeast portion of the GOM, the proposed Project *has no anticipated affects* to the GOM's Bryde's whale.

7.2.4.4 Blue Whale, *Balaenoptera musculus*

Current Federal Status: Endangered, *throughout range*

Habitat and Range Requirements: The blue whale is found worldwide, from sub-polar to sub-tropical latitudes. Poleward movements in spring allow the whales to take advantage of high zooplankton production in summer. Although blue whales are found in coastal waters, they are thought to occur generally more offshore than other whales (NMFS 2016a). Blue whales in the Northern Hemisphere are generally smaller than those in the Southern Hemisphere. In the North Atlantic and North Pacific, they can grow up to about 90 ft. (27 m), but, in the Antarctic, they can reach a up to about 110 ft. (33 m) and can weigh more than 330,000 pounds (150,000 kilograms) (NMFS 2016a). Like other baleen whales, female blue whales are somewhat larger than males. Blue whales have a long-body and comparatively slender shape, a broad, flat "rostrum" when viewed from above, a proportionately smaller dorsal fin than other baleen whales, and a mottled gray color pattern that appears light blue (hence, the "blue" whale) when seen through the water. The Eastern stock is believed to spend winters off Mexico and central America, and feed during summer off the U. S. West Coast and, to a lesser extent, in the Gulf of Alaska and central

North Pacific waters (Davis et al. 2001; NMFS 2016a). Mortality and serious injury caused by ship strikes can are the primary threat to blue whales. Anthropogenic noise, habitat degradation, and vessel disturbance are additional concerns. However, there is little evidence available to describe or quantify the impacts of these threats on blue whales. For example, while anthropogenic noise may threaten other cetaceans, little is known about whether, or how, vessel noise affects blue whales. Habitat degradation (for example, chemical pollution) has occurred in some areas of the North Atlantic (like the St. Lawrence River), but the impacts of this degradation are understudied and have not been proven to affect blue whales (Reeves et al. 1998; NMFS 2016a).



Source: NMFS 2016a

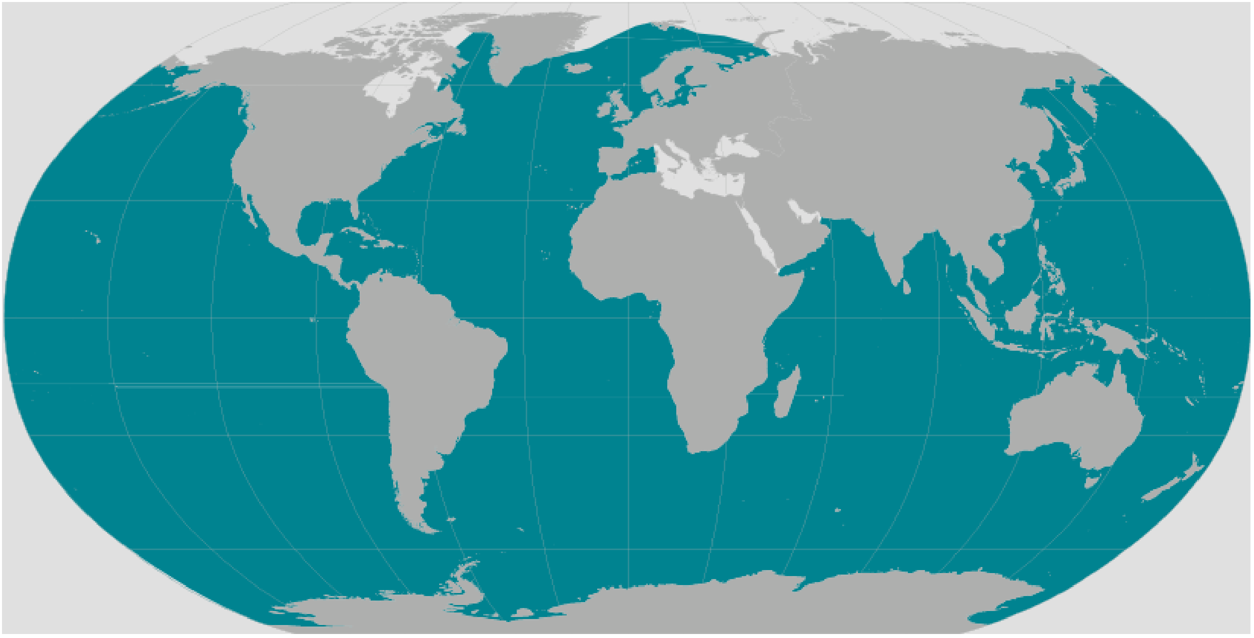
Figure 7-9: Map of Blue Whale Range

Determination of Impact: Based on the previous analysis, the Project *may affect, but is not likely to adversely affect* the blue whale in marine and offshore environments.

7.2.4.5 Fin Whale, *Baelanoptera physalus*

Current Federal Status: Endangered, *throughout range*

Habitat and Range Requirements: Fin whales are the second-largest species of whale, with a maximum length of about 75 ft. (22 m) in the Northern Hemisphere, and 85 ft. (26 m) in the Southern Hemisphere. A fin whale has a sleek, streamlined body with a V-shaped head. It has a tall, hooked dorsal fin, about two-thirds of the way back on the body, which rises at a shallow angle from the back. Fin whales have distinctive coloration: black or dark brownish-gray on the back and sides, white on the underside. Head coloring is asymmetrical—dark on the left side of the lower jaw, white on the right-side lower jaw, and the other way around on the tongue. Many fin whales have several light-gray, V-shaped “chevrons” behind their heads; on many of them, the underside of the tail flukes is white with a gray border. These markings are unique and can be used to identify Individual fin whales (NMFS 2015a).



Source: NOAA 2015

Figure 7-10: Map of Fin Whale Range

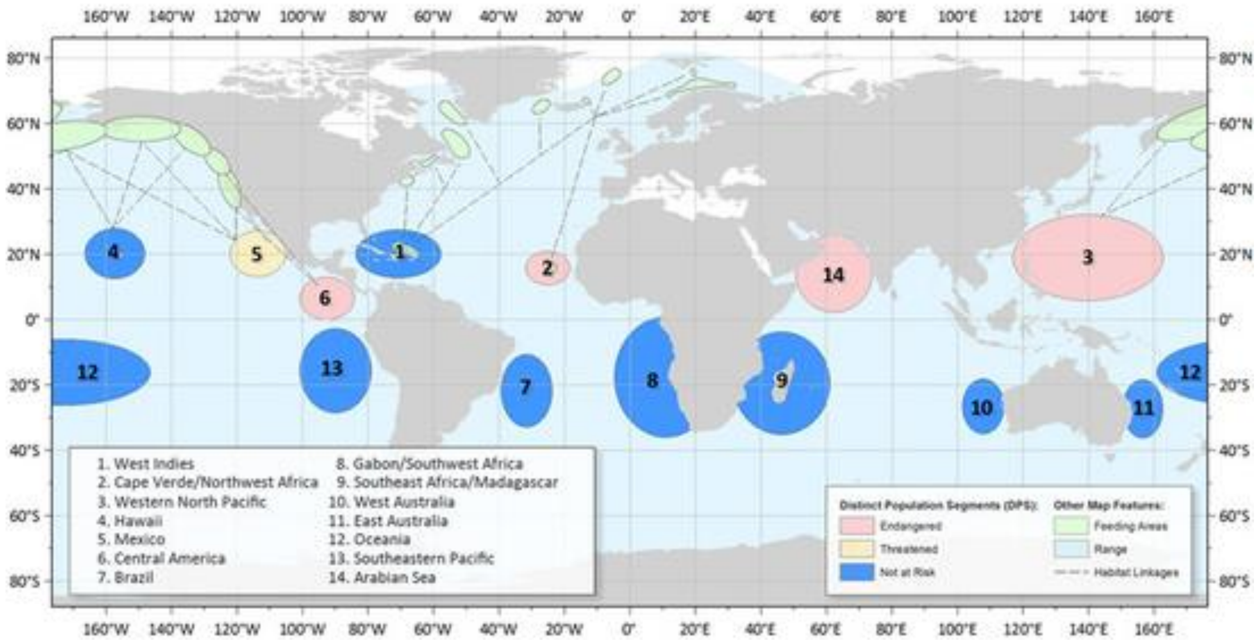
Fin whales are found in deep, offshore waters of all major oceans, primarily in temperate to polar latitudes (Davis et al. 2001). They are less common in the tropics. They occur year-round in a wide range of locations, but the density of individuals in any one area changes seasonally. Most migrate from the Arctic and Antarctic feeding areas in the summer to tropical breeding and calving areas in the winter. The location of winter breeding grounds is not known. Fin whales travel in the open seas, away from the coast, so they are difficult to track (NMFS 2015a).

Determination of Impacts: Based on the previous analysis, the Project *may affect, but is not likely to adversely affect* the fin whale in the marine and offshore environments.

7.2.4.6 Humpback Whale, *Megaptera novaeangliae*

Current Federal Status: Endangered, in 2 DPS (Central America and Western North Pacific)

Habitat and Range Requirements: Humpback whales' bodies are primarily black, but individuals have different amounts of white on their pectoral fins, their bellies, and the undersides of their flukes (tails). Many Southern Hemisphere humpback whales have extensive amounts of white on their flanks and bellies. Northern hemisphere humpback whales tend to have less white markings (Frankel et al. 1995; NMFS 2017b). While feeding and calving, humpbacks prefer shallow waters. During calving, humpbacks are usually found in the warmest waters available at that latitude (Frankel et al. 1995; NMFS 2017b). Calving grounds are commonly near offshore reef systems, islands, or continental shores. Humpback feeding grounds are in cold, productive coastal waters (Frankel et, al 1995; NMFS 2017b).



Source: NMFS 2017b

Figure 7-11: Map showing locations of the 14-distinct humpback whale population segments

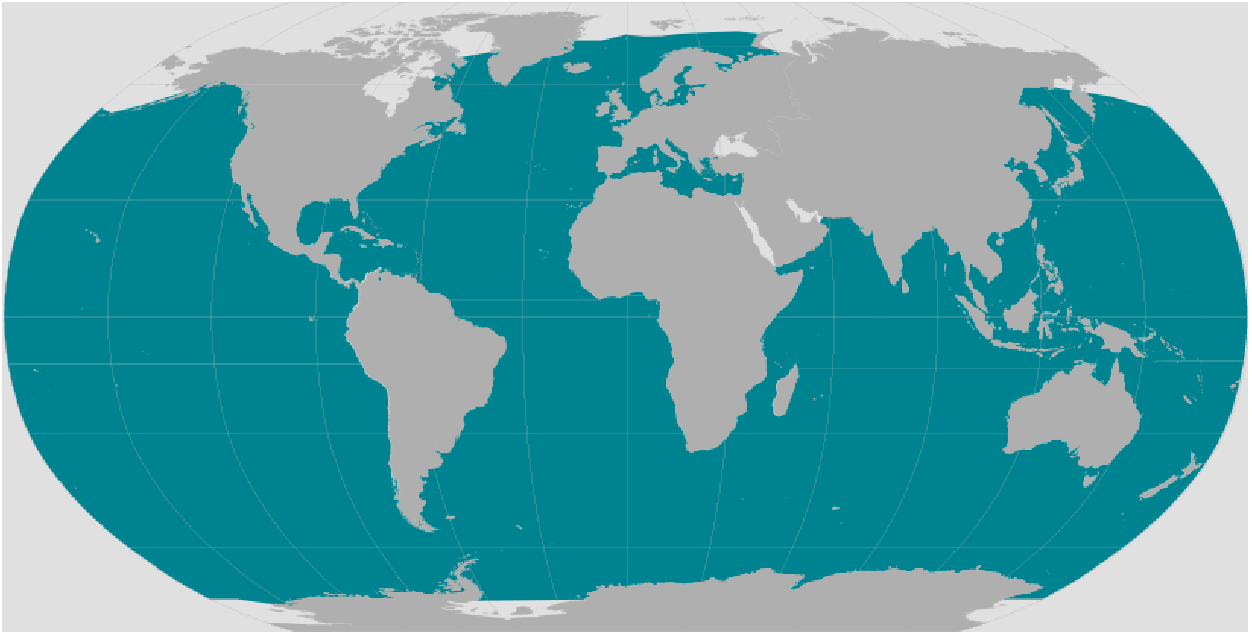
Humpback whales live in all major oceans from the equator to sub-polar latitudes. In the western North Atlantic Ocean, humpback whales feed during spring, summer, and fall over a range that encompasses the eastern coast of the U.S. (including the Gulf of Maine), the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland. In winter, whales from the Gulf of Maine mate and calve primarily in the West Indies. Not all whales migrate to the West Indies every winter, and significant numbers of animals are found in mid- and high-latitude regions at this time (NMFS 2017b).

Determination of Impacts: Due to the typical range and distribution of the humpback whale, an occurrence within the GOM, along the Texas coast would be an incredibly rare occurrence. The proposed Project has *no anticipated affects or impacts* to the humpback whale in the marine inshore and offshore environments.

7.2.4.7 Sperm Whale, *Physeter macrocephalus*

Current Federal Status: Endangered, throughout its range

Habitat and Range Requirements: Sperm whales are the largest of the toothed whales and have one of the widest global distributions of any marine mammal species. They are found in all deep oceans, from the equator to the edge of the pack ice in the Arctic and Antarctic (Jaquet and Gendron 2002; Mullin 2003; NMFS 2017c).



Source: NMFS 2017c

Figure 7-12: Current range of the Sperm whale

Sperm whales inhabit all the world's oceans. Their distribution is dependent on their food source and suitable conditions for breeding and varies with the sex and age composition of the group. Sperm whale migrations are not as predictable or well understood as migrations of most baleen whales. In some mid-latitudes, sperm whales seem to generally migrate north and south depending on the seasons, moving toward the poles in the summer. However, in tropical and temperate areas, there appears to be no obvious seasonal migration (Davis et al., 2001; Jaquet and Gendron, 2002). Sperm whales tend to inhabit areas with a water depth of 1,968 ft. (600 m) or more, and are uncommon in waters less than 984 ft. (300 m) deep. Female sperm whales are generally found in deep waters (at least 3,280 ft., or 1000 m) of low latitudes (less than 40 degrees (°), except in the North Pacific where they are found as high as 50°). These conditions generally correspond to sea surface temperatures > 15°C, and while female sperm whales are sometimes seen near oceanic islands, they are typically far from land (Davis et al., 2001; Jaquet and Gendron, 2002; NMFS2017c).

Determination of Impacts: Based on the habitat and range requirements typical to the sperm whale and the proposed Project only reaching depths to 93 ft. or 28 m within the intercontinental shelf, the Project has *no anticipated affects or impacts to* the sperm whale.

7.2.4.8 West Indian Manatee, Trichechus manatus

Current Federal Status: Threatened, throughout range

Habitat and Range Requirements: The West Indian manatee (*Trichechus manatus*) is a migratory marine mammal of Florida, the Greater Antilles, Central America, and South America (USFWS 2003b). Texas is the extreme western edge of this species' distribution (USFWS 2003b). Occurrences in Texas are occasional to rare and thus this species is unlikely to occur in the vicinity of the Project area (USFWS 2003b; Texas Marine Mammal Stranding Network 2016) (Figure 7-13). A recent sighting of this species occurred in 2014 within South Padre Island harbor (Garza 2014). Although the manatee is unlikely to occur in the vicinity of the Project area, the Project will still implement best management practices (BMPs) to ensure its activities adhere to federal laws. The manatee is protected under the MMPA, which prohibits the take of marine mammals in U.S. waters by U.S. citizens.

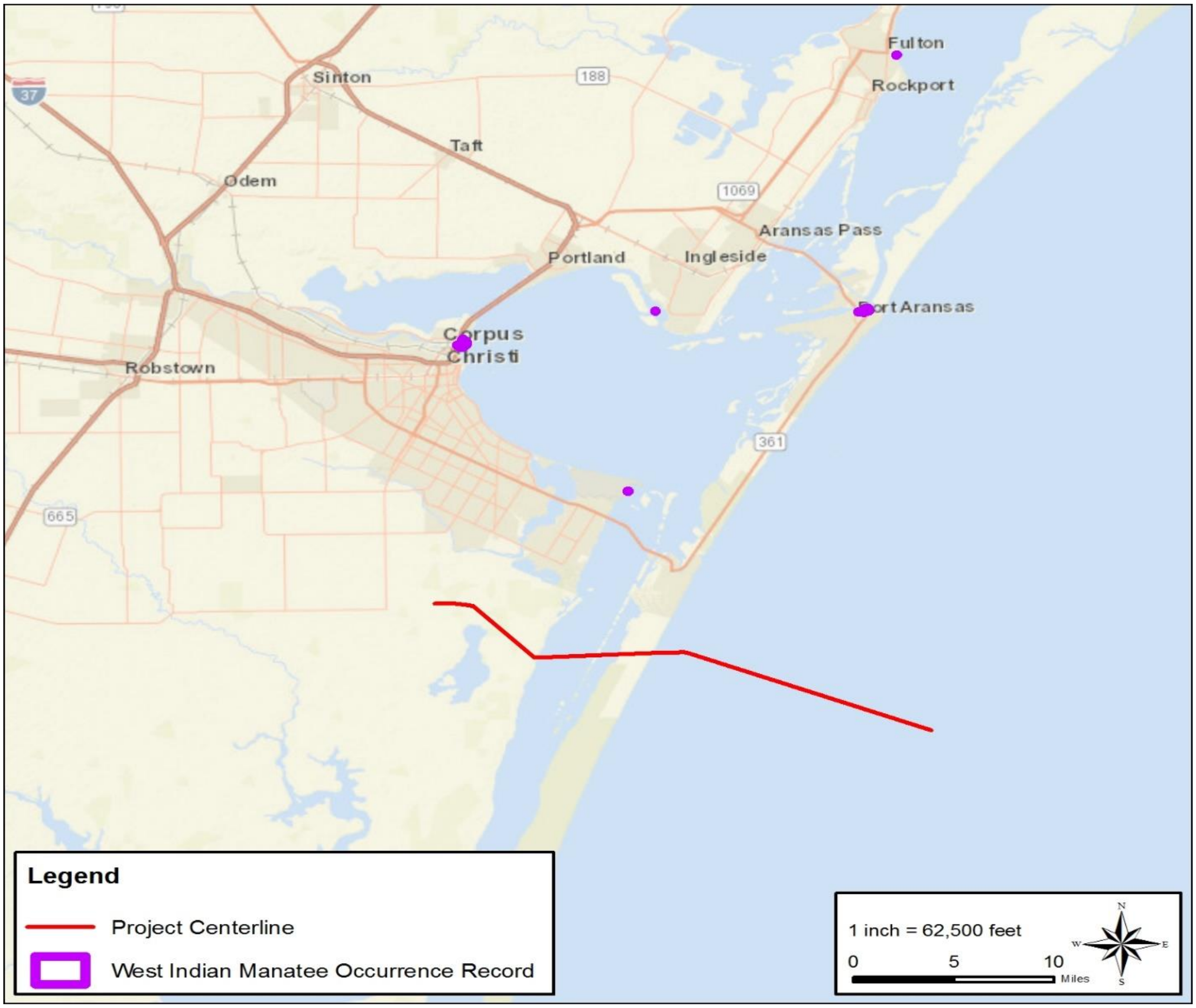


Figure 7-13: Map of West Indian Manatee Observations

Determination of Impact: Texas is the extreme western edge of this species' distribution, and thus it is unlikely that this species will occur in the Project area and be exposed to the Project's activities. Some temporary impacts to seagrass beds are anticipated due to temporary trenching activities proposed across Laguna Madre. The localized and temporary sediment plume associated with offshore construction activities will be comprised of sediments that will quickly return to the sea floor upon completion of construction activities and thus are not expected to affect foraging activities of the manatees. In the unlikely event that a manatee is present near the Project area, marine mammal monitors will be present during construction to identify the species should it appear during offshore construction activities, to ensure construction activities do not result in unanticipated take of this species. Based on the previous analysis, the Project *may affect, but is not likely to adversely affect* the manatee in the estuarine inshore and marine offshore environments.

7.2.4.9 Marine Mammals Not Listed Under the Endangered Species Act

Only two of the non-endangered mammal species are known to regularly inhabit the shallow shelf waters in the Project area: the bottlenose dolphin (*Tursiops truncatus*) and the Atlantic spotted dolphin (*Stenella frontalis*). A third species, the rough-toothed dolphin (*Steno bredanensis*) is most likely to be found in deeper waters, but has been identified in shelf waters near the Project. These three species are discussed further below. The remaining non-endangered marine mammal species that occur in the GOM are found in depths deeper than that of the Project and are considered unlikely to occur in the Project area.

Atlantic Spotted Dolphin

The Atlantic Spotted Dolphin (*Stenella frontalis*) is common in the northern GOM, where it is found in shallow continental shelf waters (32 ft. [10 m] deep) down to slope waters > 1,640 ft. (500 m) deep (Fulling *et al.* 2003). The species occurs in two forms that may be distinct sub-species; however, only the larger, heavily spotted form is known to occur in the GOM. Evidence has further supported predominantly independent populations within the GOM, one of which primarily occupies the shelf waters from the Texas/Mexico border to the Florida panhandle, and the other of which is concentrated over the western shelf of Florida (see Figure 7-14). The current population size is unknown, but abundance estimates from data through 2004 included 37,611 individuals in the northern GOM (Hayes et al. 2017a).

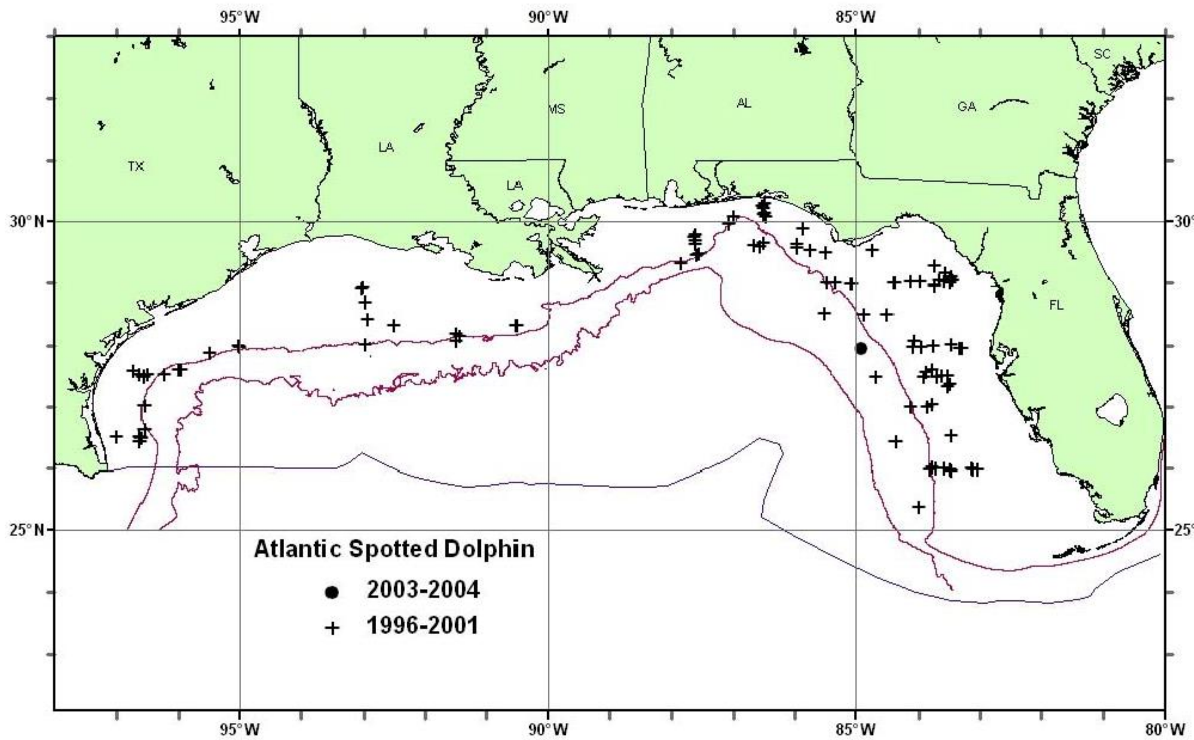


Figure 7-14: Distribution of Atlantic Spotted Dolphins Sighted During 1996-2004

Bottlenose Dolphin

The bottlenose dolphin (*Tursiops truncatus*) is commonly found in most tropical, temperate, and sometimes cooler waters across the world. Within the GOM, bottlenose dolphins are classified as one of 36 different stocks according to their habitat and general location. The various stocks occur in bays/estuaries, coastal areas, on the continental shelf, and in oceanic waters. The two stocks most likely to occur in the nearshore and offshore Project waters include the Western Coastal Stock and the Continental Shelf Stock. The two stocks most likely to occur in the inshore waters of the Project area include the Laguna Madre Estuary Stock and the Nueces Bay/Corpus Christi Bay Estuary Stock.

The Western Coastal Stock is defined as those dolphins that occur between the shore, barrier islands (in this case Padre Island), or outer bay boundaries, out to the 66-ft. (20-m) isobath from the Texas/Mexico border to the Mississippi River delta (see Figure 7-15). The Continental Shelf Stock includes those dolphins occurring between the 66-ft. (20-m) and 656-ft. (200-m) isobaths across the entire northern GOM (see Figure 7-16). The degree of overlap between the two stocks is unknown, but genetic studies have shown significant differences between them. The best population estimates for these two stocks are 20,161 animals (Western Coastal Stock) and 51,192 animals (Continental Shelf Stock). Neither stock is considered "strategic" under the MMPA, which indicates that human-caused mortality does not exceed the potential biological removal level (i.e., human-caused mortalities do not preclude a stock's ability to reach or maintain its optimum sustainable population. (Hayes et al. 2017a.)

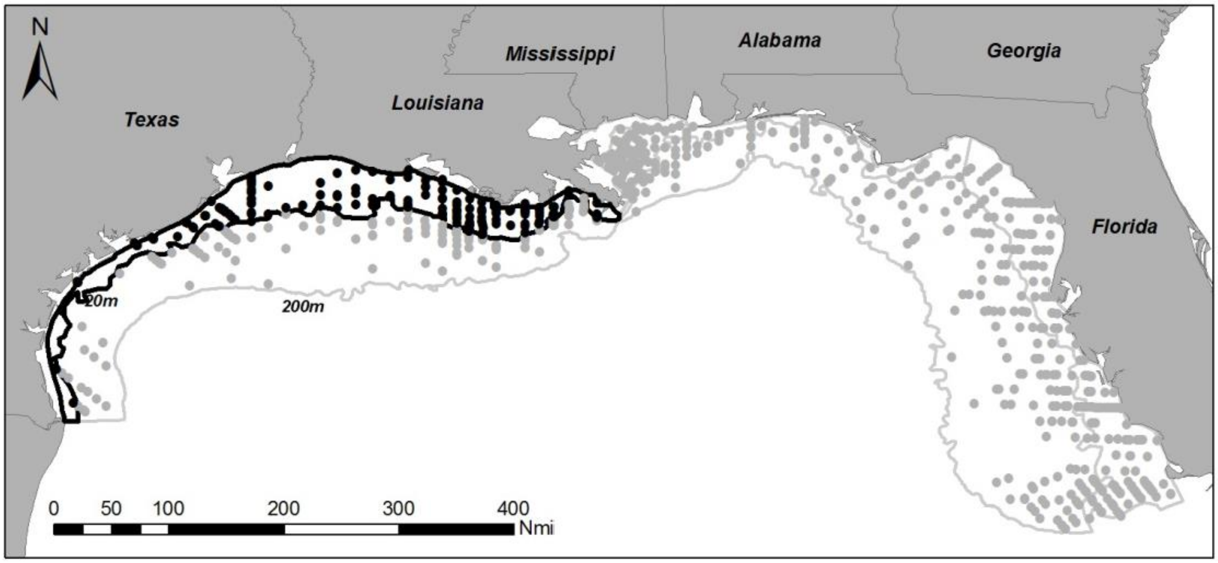


Figure 7-15: Distribution of the Western Coastal Stock of Bottlenose Dolphins 2011-2012

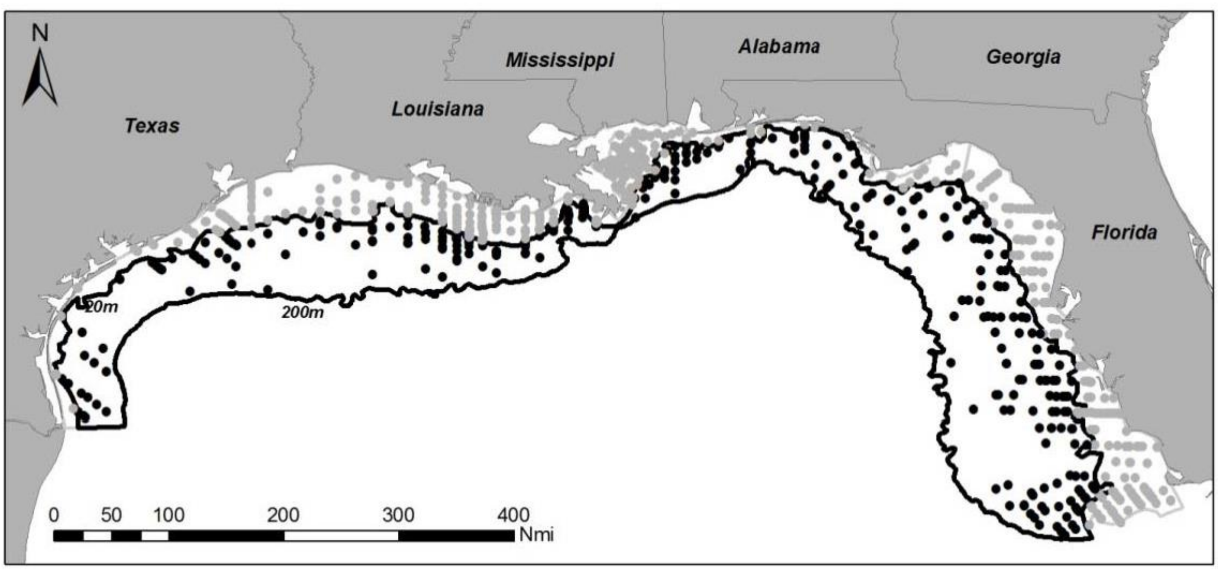


Figure 7-16: Distribution of the Continental Shelf Stock of Bottlenose Dolphins 2011-2012

In addition to nearshore and offshore stocks, bottlenose dolphins distributed throughout the bays, sounds, and estuaries of the GOM have been identified as 31 individual stocks. These inshore stocks are generally believed to have year-round residencies in their respective estuarine waters with limited or no interbreeding and intermixing between stocks. Resident animals are also believed to have limited movements through passes to the GOM. The best population estimates for these two stocks are 80 animals (Laguna Madre) and 58 animals (Nueces Bay/Corpus Christi Bay). NMFS considers each of the 31 inshore stocks to be strategic stocks based on their small/unknown populations, which indicates that a relatively few mortalities and serious injuries could exceed the potential biological removal level. (Hayes et al. 2017b)

Rough-toothed Dolphin

The rough-toothed dolphin (*Steno bredanensis*) is distributed throughout the world in tropical to warm temperate waters (West *et al.* 2011). In the GOM, this species occurs within oceanic, and to a lesser extent, continental shelf waters (Fulling *et al.* 2003; see Figure 7-17). Generally, the rough-toothed dolphin prefers northern GOM waters, with depths averaging 640 ft. (195 m). Its diet consists of fishes, squid, and octopuses that are found in deep waters that are within 328 ft. (100 m) of the ocean surface (Byrnes et al. 2017). Although this species may occur in shelf waters, its preferred depths make it unlikely to occur with any regularity in the immediate Project area (Byrnes et al. 2017).

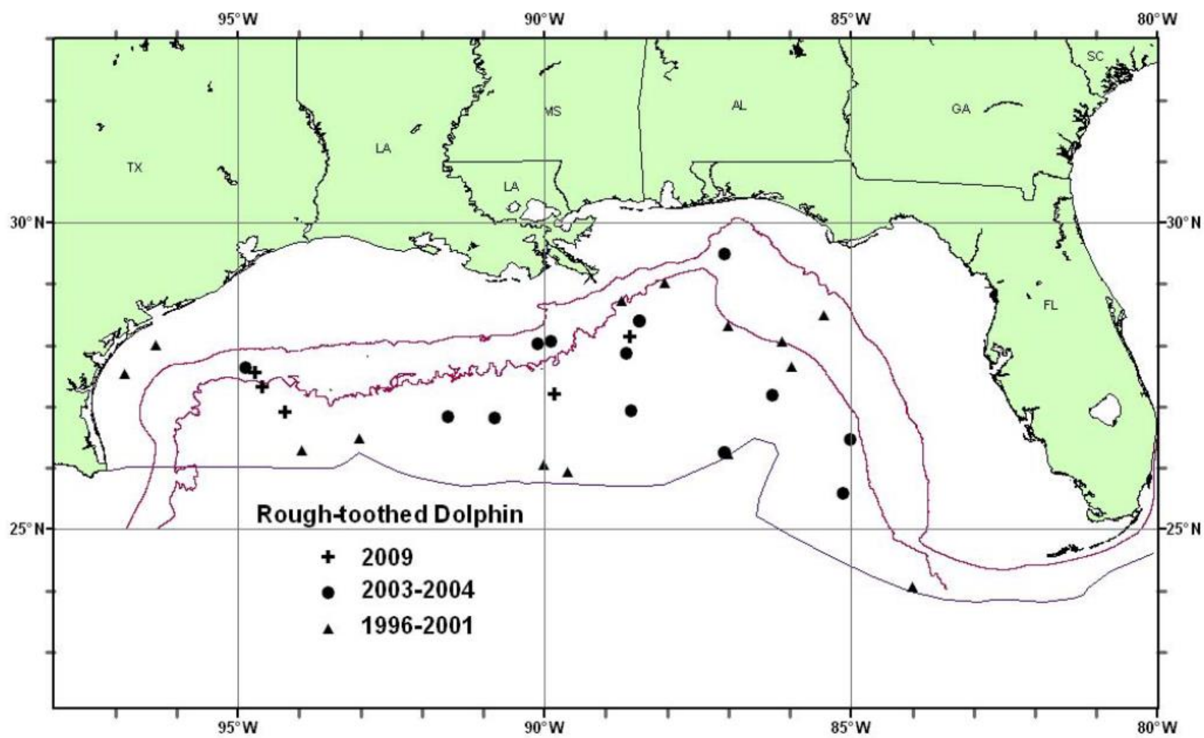


Figure 7-17: Distribution of the Rough-toothed Dolphins Between 1996 and 2009

7.2.4.10 Importance of Sound for Marine Mammals

Marine mammals are very sensitive to sounds in the ocean, both natural and human-made. Marine mammals produce and hear a broad range of sounds to navigate and communicate because the oceans are much more transparent to sound than to light (National Research Council [NRC] 2003). Each species has an auditory threshold dictating the frequencies that can be heard. Increases in background noise often interfere with, or "mask," noises that generally can be heard by an individual (Richardson et al. 1995). Masking occurs when both the signal and the masking noise have similar frequencies and overlap or occur very close together, decreasing the ability of an individual to hear other sounds (NRC 2003, NMFS 2003). Masking becomes a problem when it covers biologically significant sounds, such as the call of a calf or conspecific, or the sound of a predator or hazard (NMFS 2003).

When exposed to noise, marine mammals can experience a variety of behavioral and physical effects. Behavioral effects may include a change in dive duration and frequency, vocalizations, migration routes, and general movements. The duration and extent of the behavioral effects are influenced by the hearing sensitivity of the individual, as well as by its age, sex, current activity, past exposure to the noise, and the presence of dependent offspring. Behavioral effects of an individual are also influenced by the characteristics of the sound, such as the frequency and intensity, and the location and duration of the sound (NRC 2003).

Exposure to noise also can result in physical injury to marine mammals in the form of temporary and permanent threshold shifts (TTS and PTS), hemorrhage, and death (NMFS 2003). TTS occurs when an individual is exposed to a sound for a period, causing the hair cells within the ear to become fatigued and change shape. When that occurs, the individual temporarily loses hearing in that range for a certain period, depending on the duration and level of sound exposure (NRC 2003). Exposure that occurs above a certain sound level and duration may cause the hair cells to become permanently damaged, resulting in PTS, or a permanent loss of hearing over a certain frequency range (NRC 2003). As with general changes in behavior, the level and durations of sound exposure that cause TTS and PTS are species-specific.

As previously discussed, the MMPA prohibits the "take" of marine mammals, which is defined as the harassment, hunting, or capturing of marine mammals, or the attempt thereof. "Harassment" is defined as any act of pursuit, annoyance, or torment, and is further categorized as either Level A or Level B harassment. Level A harassment is defined as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is considered any act that has the potential to disturb a marine mammal or marine mammal stock in the wild by disrupting behavioral patterns, including migration, breathing, nursing, breeding, feeding, or sheltering. In 2016, NOAA Fisheries released its *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals* that specified the sound exposure levels (SEL) considered to result in Level A and Level B harassment. Table 7-7 summarizes the MMPA Level A and B harassment criteria for mid-frequency cetaceans (including dolphins) based on NOAA Fisheries' 2016 guidance.

Table 7-7: Acoustic Harassment Sound Levels for Mid-Frequency Marine Mammals

Marine Mammal Injury/Effect	Cumulative Sound Exposure Level (SEL_{cum}) (dB re 1 μPa^{2}s)[a]	Root Mean Square Sound Level (dB RMS) (dB re 1 μPA)[b]	Peak Sound Level (dB re 1 μPA)[c]
Temporary Threshold Shift for impulsive/non-impulsive noise[d,e]	170/178 [e]	--	224/ --
Permanent Threshold Shift for impulsive/non-impulsive noise[d,e]	185/198[e]		
Behavioral Effects for impulsive/non-impulsive noise	--	160/120	230/ --

[a] The cumulative sound exposure level is the energy accumulated over multiple strikes or continuous vibration over a period of time.
[b] The root mean square exposure level is the square root of the average squared pressures over the duration of a pulse and represents the effective pressure and intensity produced by a sound source.
[c] Peak sound pressure level is the largest absolute value of instantaneous sound pressure.
[d] Use of impact hammers is considered impulsive noise; use of vibratory hammers is considered non-impulsive noise.
[e] The injury threshold is the general level for temporary or permanent threshold shift onset for mid-frequency cetaceans (including dolphins) as identified by NOAA Fisheries (2016b); however, threshold shifts are influenced by the frequency of noise received and a cumulative sound exposure exceeding this level may not cause a threshold shift if outside the range of hearing.

Source: NMFS 2016.

7.2.5 Marine and Coastal Birds

More than 400 species of birds have been reported in the Northern GOM (BOEM 2011). Birds encountered in the location of the Project would primarily be migratory birds utilizing the GOM as a migratory corridor.

The majority of bird species found are known to reside primarily in interior or coastal beach and wetland habitats. Many of the species are known to occur along the coastline and nearshore waters at least part of the year. Some of the species are federally listed as either endangered or threatened and occur in the Project area at least part of the year. Table 7-7 provides a list of the bird species protected under the ESA which could occur in the coastal portions of the Project area and their protected status.

Table 7-8: ESA-Listed Bird Species Potentially Occurring within the Project Area.

Species	ESA Status
Least Tern (Sterna antillarum)	Endangered
Northern Aplomado Falcon (Falco femoralis septentrionalis)	Endangered
Piping Plover (Charadrius melodus)	Threatened
Red Knot (Calidris canutus rufa)	Threatened
Whooping Crane (Grus americana)	Endangered

7.2.5.1 Bald Eagle, *Haliaeetus leucocephalus*

Current Federal Status: Other

Habitat and Range Requirements: The bald eagle is a large, white-headed, and white-tailed raptor that was initially listed as endangered in 1967. Delisted in 2007, the bald eagle continues to have protection under the BGEPA (USFWS 2007b). Bald eagles are opportunistic predators that feed primarily on fish within large, perennial bodies of water. Nests are typically constructed in large, tall trees (i.e., 40 to120 ft. 12 to 37 m]) within 1 mi (0.7 km) of rivers, reservoirs, or open water (Campbell 2003). Nesting, in Texas, typically takes place from October through July with breeding pairs returning to the same nest annually (Campbell 2003). Wintering areas are typically associated with open water or waterfowl concentration areas. Bald eagles are typically found in the eastern half of Texas and isolated locations within the panhandle of the state (Campbell 2003).

Potential for Occurrence: This species is unlikely to occur in the Project area. The closest TXNDD occurrence records for bald eagle is more than 50 mi (80 km) northeast of the Project area (TXNDD 2018). No nests or individuals were observed within the Project area during the reconnaissance survey, but SWCA observed potential foraging habitat adjacent to the Project area. There is no suitable nesting habitat for the bald eagle in the terrestrial portion of the Project area.

Determination of Impact: The proposed Project may disturb potential bald eagle foraging habitat during construction activities; however, since no individuals, nests, or critical habitat were identified within the Project area, the Project is *not likely to cause a take* of bald eagles.

7.2.5.2 Rufa Red Knot, *Calidris canutus rufa*

Current Federal Status: Threatened

Habitat and Range Requirements: The rufa red knot is a medium to large sized shorebird with a weight of approximately 5 ounces, a body length of 9 to 10 inches, and a wingspan of 20 to 22 inches (USFWS 2013a). Adult individuals in breeding plumage have a cinnamon-colored face, chest, and underside with a mottled grayish with cinnamon edgings on wings and back. While in winter plumage, it has a gray head, chest, and upperparts with a white underpart (USFWS 2013a). Adults also have a relatively short, straight bill tapering towards the tip and short, thick, greenish legs. There is almost no sexual dimorphism between male and female except that while in breeding plumage, the female has light-colored feathers amongst the belly feathers and a less distinct eye line (USFWS 2013a). Juveniles of the species appear similar to the adult winter plumage but have gray back feathers outlined in white and black, which gives a scaly appearance (USFWS 2013a). The rufa red knot breeds in the tundra of the central Canadian arctic between May and mid-July, as well as winters along the U.S. coastline from North Carolina to Texas. Wintering habitat includes tidal flats, beaches, oyster reefs, and herbaceous wetlands where they feed primarily on small invertebrates, particularly clams (Newstead 2012; Newstead et al. 2013; USFWS 2011).

The red knot prefers the shoreline of coast and bays; it also utilizes mudflats during rare inland encounters. Primary prey items include coquina clam (*Donax* spp.) on beaches and dwarf surf clam (*Mulinia lateralis*) in bays (USFWS 2014b). Wintering range includes Aransas County, as well as areas further up and down the Texas coast. It winters close to the coast, inhabiting tidal flats and beaches, herbaceous wetlands, and tidal flats and shorelines (TXNDD 2018).

Long-term systematic population surveys are lacking for this species, but current estimates suggest Texas wintering populations may range between approximately 50 to 2,000 with numbers increasing from survey counts in the early 1990s to recent counts in 2012 (USFWS 2014b). The increase in numbers does not necessarily reflect in an increase in the population but may be due to an increase or variation in survey effort. Although rigorous population estimates are lacking preliminary trends indicate decline or low stabilized populations (USFWS 2014b).

The rufa red knot was listed as threatened on January 12, 2015 (79 Federal Register (FR) 73706). Primary threats to the species are habitat loss closely followed by a reduction of preferred prey items in nesting areas and along migration routes (USFWS 2014b).

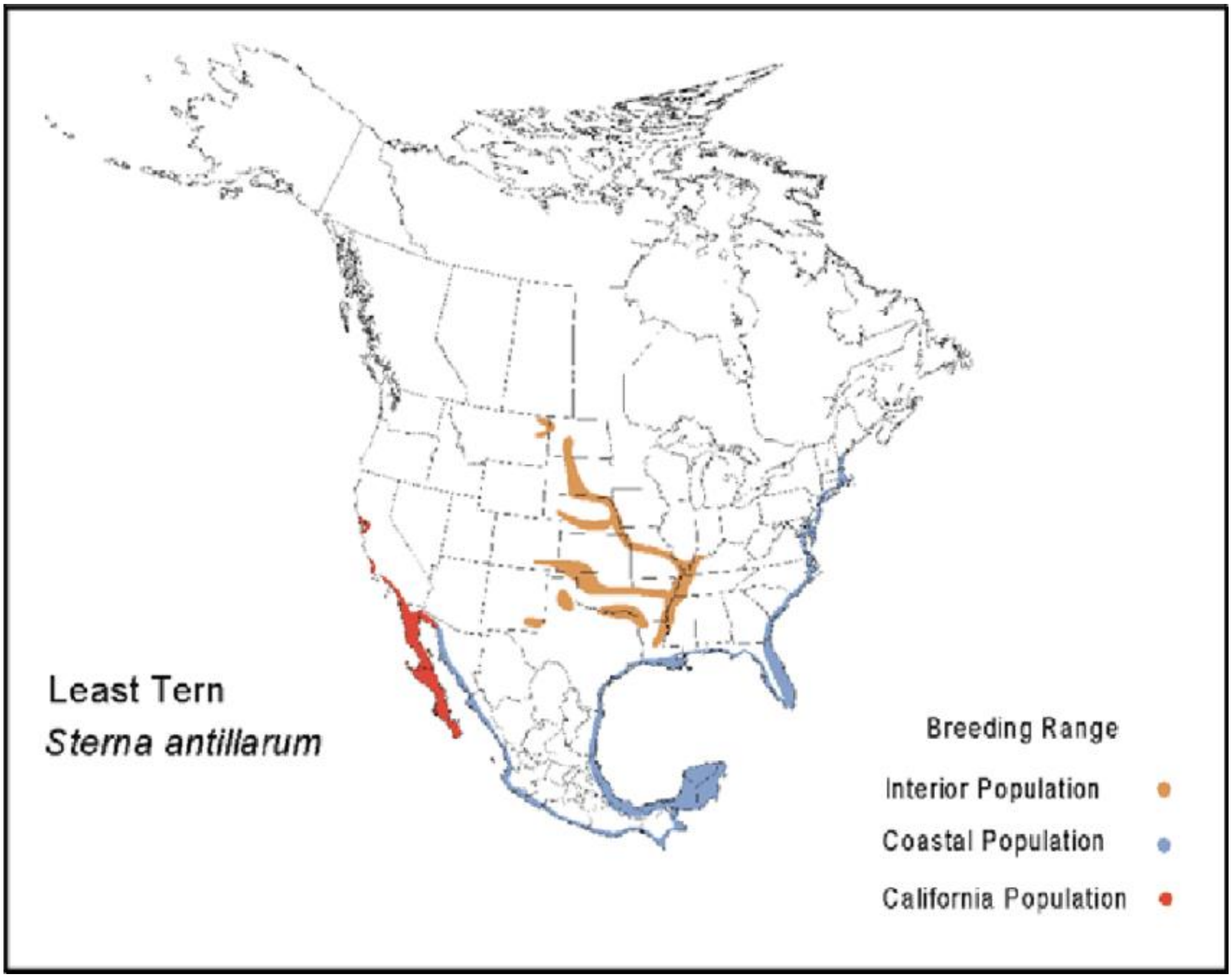
Determination of Impact: There are no known TXNDD occurrences for the vicinity of the Project area and no critical habitat has been designated for the rufa red knot (TXNDD 2018). A significant amount of effort was expended by avian biologists during the January – April 2018 species surveys to locate this species. No red knots were observed during the winter 2018 surveys. It is not known whether the red knot would utilize the Project area during winter and migration. Therefore, the Project *may affect, but is not likely to adversely affect* the red knot in the estuarine inshore and terrestrial environment. The Project would result in *no anticipated effects* to the species in the marine offshore environment.

7.2.5.3 Interior Least Tern, *Sterna antillarum athalassos*

Current Federal Status: Endangered

Habitat and Range Requirements: Least terns are the smallest member of the gull and tern family. They are approximately 9 inches in length, a weight of 1.5 ounces, and a wingspan of about 20 inches (TPWD 2018a). While in breeding plumage, adults have a black cap ending at a white forehead with short white eye stripes (TPWD 2018a). The bill is yellow with a black tip. The backs of individuals are light gray with a white underside and black on wing tips and edges (TPWD 2018a). Non-breeding plumage includes a black eye stripe extending to the back of a white-capped head and a black bill. Juveniles show brownish, U-shaped markings, have a dusky crown and dark carpal bars on the wing (TPWD 2018a).

Least terns arrive at breeding grounds along the coast in late April (TPWD 2018a). Sandy beaches and exposed sandbars are preferred for nesting, however a flat gravel surface such as that found on roofs are occasionally used as well. After breeding, birds return to their wintering grounds in Central America and northern South America (TPWD 2018a).



Source: Mitchell et al. 2000

Figure 7-18: Distribution Range of the Least Tern in North America and Mexico

The interior least tern was listed as endangered on May 28, 1985 (50 FR 21784 21792). Although widespread and common in some places, its favored nesting habitat is sought for human recreation, residential development, and alteration by water diversion.

Determination of Impact: There are no known TXNDD occurrences for the vicinity of the Project and no critical habitat has been designated for the least tern (TPWD 2018a). Additionally, as directed by the USFWS, this species only needs to be considered during wind related projects within its migratory route; therefore, there would be *no anticipated effects* to the species.

7.2.5.4 Piping Plover, *Charadrius melodus*

Current Federal Status: Threatened

Habitat and Range Requirements: The piping plover is a small, pale sand-colored shorebird with a weight of 1.5 to 2.5 ounces, a body length of 7 inches and a wingspan of 15 inches (Palmer 1967; Elliot-Smith and Haig 2004). Plumage differs in breeding and wintering seasons by the presence of a single black breast band, often incomplete, and a black bar across the forehead in the breeding season. The bill color may also turn from orange to black (TPWD 2018b). The piping plover is a migratory species with a breeding distribution within the Great Lakes region and Atlantic coast and along central North America from Alberta, Canada to Colorado and Oklahoma (USFWS 2012). The non-breeding or wintering distribution occurs mainly coastal from North Carolina to Florida and the Gulf Coast states including Texas (USFWS 2012).

The piping plover was listed as threatened in Texas wintering grounds on January 10, 1986 (USFWS 1985). The primary threats to the species occur in the breeding areas of this species where it is listed as federally endangered. Population declines were historically due to hunting and currently due to habitat alteration at nesting grounds, nest depredation, and nest disturbance on beach habitat (USFWS 2012). Secondary threats occur in wintering habitats where the species is no longer listed as endangered and instead listed as federally threatened. Wintering habitats on the Texas Gulf Coast are threatened by industrial activities, urban development, and maintenance activities for commercial waterways, with the potential for pollution from spills of petrochemicals or other hazardous materials also being a concern (Campbell 1995). Human activity on beaches can also disturb wintering piping plovers and degrade habitat conditions (Campbell 1995; USFWS 2003b). The Texas wintering population census indicates a fluctuating to increasing trend in populations from 1,904 plovers in 1991 to 2,145 plovers in 2011 (Haig et al. 2005; USFWS 2012). Fluctuations may be due to localized effects of weather conditions; changes in roosting, foraging, or nesting habitats; or variance in survey efforts among observers.

Piping plovers nest on wide, gravelly beaches with little vegetation in alkali lakes and wetlands, inland lakes, reservoirs, and major rivers in the northern Atlantic coast, Great Lakes region, and around waterbodies of the Great Plains and Canada (TPWD 2018b). Wintering habitat includes beaches, tidal sand flats, mud flats, algal mats, washover passes, and small dunes where they feed primarily on small invertebrates (Campbell 2003). The migration and wintering period may last as long as 10 months (mid-July through Mid-May) (USFWS 2012). Migration to breeding grounds may occur from mid-February through mid-May, with peak migrations in March (USFWS 2012). The piping plover exhibits intra-and inter-annual wintering site fidelity (Drake et al. 2001, Noel and Chandler 2008, Stucker et al. 2010) and the mean-average home-range size for piping plovers in southern Texas is 4.9 square mi (12.7 square km) with a core area of 1.1 square mi (2.8 square km). They may move 2 mi (3 km) between sites within a season (Drake et al. 2001). Piping plovers can also be seen foraging along sandy, wet areas along waterways and wetlands beaches. Wintering piping plovers forage on invertebrates located on top of the sand or just below the surface along wrack lines. Specific prey items may include polychaete marine worms, crustaceans, fly larvae, beetles, and bivalve mollusks (USFWS 2012).

Potential for Occurrence: Critical habitat for the wintering population of piping plovers was designated July 10, 2001 and divided into 137 units across 8 states (66 FR 36038) (USFWS 2001) (Figure 5). Critical habitat for the piping plover has been designated and revised based on current use and conditions of the habitat (USFWS 2012). With revisions of critical habitats in North Carolina (USFWS 2008a) and Texas (USFWS 2009a) there are now 141 designated units, totaling 256,513 ac (103,807 ha), still among 8 states; 18 of these units are located along the Texas coastline and comprise 139,029 ac (56,263 ha). Although these units are designated to protect essential life cycle needs of the species (i.e. primary constituent elements), these critical habitat units are protecting the wintering habitat of the species, which are not associated with the leading threats to the species. The proposed Project will cross two identified piping plover designated critical habitat designated units, referred to as TX-3D and TX-5, totaling 2,876 ac (1,164 ha); 36 ac (15 ha) (1.25 percent) occur within the survey area, excluding areas that will be avoided via HDD (USFWS 2001). According to the USFWS (2001), these units include wind tidal flats that are infrequently inundated by seasonal winds, and includes the tidal flats hydrologically connected to the Laguna Madre. Beaches within the TX-3D unit reach from the National Seashore to the Nueces / Kleberg County border. The southern and western boundaries follow the change in habitat from wind tidal flats, preferred by the piping plover, to upland areas where densely vegetated habitat, not used by the piping plover, begins and where the primary constituent elements no longer occur.

There are 36 TXNDD occurrence records documenting a wintering population of piping plover along the North PINS and the beaches of the Laguna Madre as shown on Figure 7-19. During wetland delineation and threatened and endangered species surveys piping plovers were observed on both the beach side and the Laguna Madre side of the Project area. These birds were observed within the tidal flats of the piping plover critical designated habitat unit TX-5, or the beach areas of the coastline, designated as TX-3D. These areas contained wide un-vegetated tidal flats, areas covered in algae, or sandy beaches.

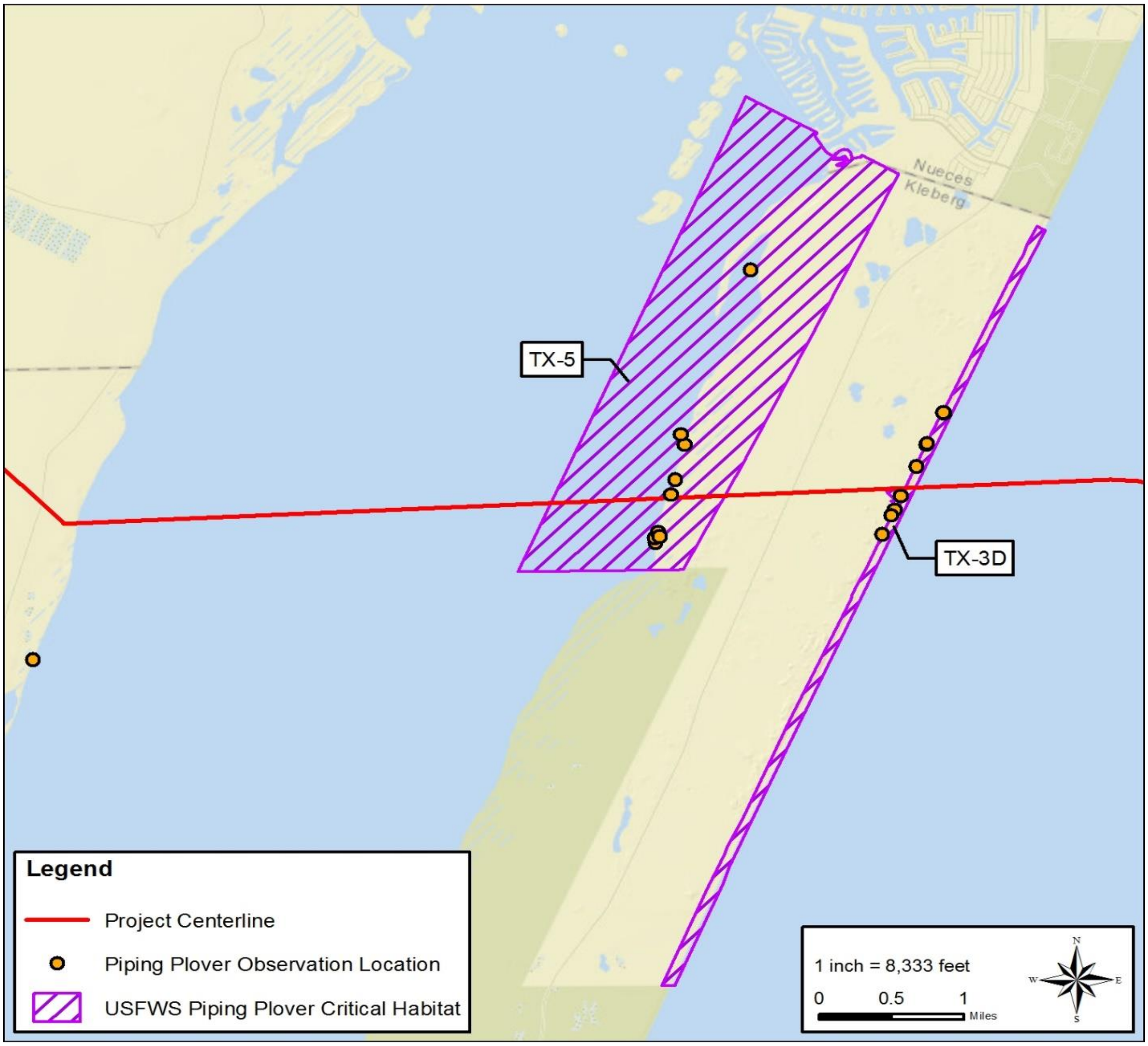


Figure 7-19: Piping Plover observation map

Presence/Absence Survey: A full survey was conducted at the proposed Project site during February, March and April of 2018. A comprehensive report on the findings is included in this volume as Appendix J. A total of five separate presence/absence surveys were conducted on and near the Project area. The initial site visit in January of 2018 is also be included with the survey findings. Locations of the surveys included three distinct areas: 1) Beach front on eastern side of North Padre Island, 2) Laguna Madre beachfront and tidal areas along the western side of North Padre Island, and 3) mainland beach surveys along the western edge of the Laguna Madre. The Padre Island beach and Eastern Laguna Madre surveys were conducted on foot while the mainland surveys along the western edge of the Laguna Madre were conducted from a boat. Surveys included the Project boundaries and nearby areas. Surveys began daily from 30 minutes after sunrise and concluded 30 minutes before sunset. Severe weather shortened survey duration on only one day of the 10-day survey period. During the survey activities, all avian species were recorded but only piping plover observations are reported here. Locations of each sighting were recorded with global positioning system devices and photos were taken when available. Any leg banding information was also recorded as well as behavioral data such as location duration, direction of flight, and any co-foraging species. A total of 102 piping plovers were observed in the Project area during the surveys, and the initial site visit in January 2018. The Laguna Madre side of North Padre Island had the most recorded observations.

Determination of Impact: SWCA documented the existence of this species in the Project area. Based on this information, the Project *may affect, but is not likely to adversely affect* the piping plover in the inshore terrestrial and estuarine environments. The Project would have *no anticipated effects* on the species in the marine offshore environment.

Table 7-9: Piping Plover Survey Results

Piping Plover Recorded Observations			
Date of Survey	**Beach**	**Laguna Madre**	**Boat/Onshore**
Initial site visit: Jan 18-19, 2018	2	1	n/a
First two weeks in Feb: Feb 12-13, 2018	0	60	n/a
Last two weeks in Feb: Feb 20-21, 2018	0	27	n/a
First two weeks in March: Mar 12-13, 2018	0	3	0
Last two weeks in March: Mar 19-20, 2018	0	2	0
First two weeks in April: April 3-4, 2018	6	0	1

7.2.5.5 Northern Aplomado Falcon, *Falco femoralis septentrionalis*

Current Federal Status: Endangered

Habitat and Range Requirements: Northern aplomado falcons are permanent residents in South Texas occurring in savannas, open woodlands, grassy plains, coastal prairies, and desert grasslands (USFWS 2007c; USFWS 2014a). In the Gulf Coast region of Texas and Mexico, the species occupies coastal prairie habitat, coastal savannahs, marshes, and tidal flats with few trees, mesquite, yucca and cactus, or other tall succulent shrubs (Figure 7-20).

In northern Mexico, southeastern Arizona, New Mexico, and west Texas, the species has a strong association with Chihuahuan desert grasslands with scattered tall yuccas (USFWS 2014a). In the southwestern U.S., the northern aplomado falcon uses old nests of ravens and other raptors. Nests can be found in Spanish dagger (*Yucca treculeana*), mesquite (*Prosopis* spp.), and manmade structures like power poles. Nests built in Spanish dagger are typically 6 to 10 ft. off the ground and average 1 to 3 ft. in diameter (USFWS 2007c; TPWD 2018c). Nesting/breeding activities occur between February 1st and August 31st; however, this species is territorial and pairs may stay near and defend their nest or nest site throughout the year (TPWD 2018c). Their diet consists primarily of birds, but also includes insects, small snakes, lizards, and rodents (Keddy-Hector 2000).

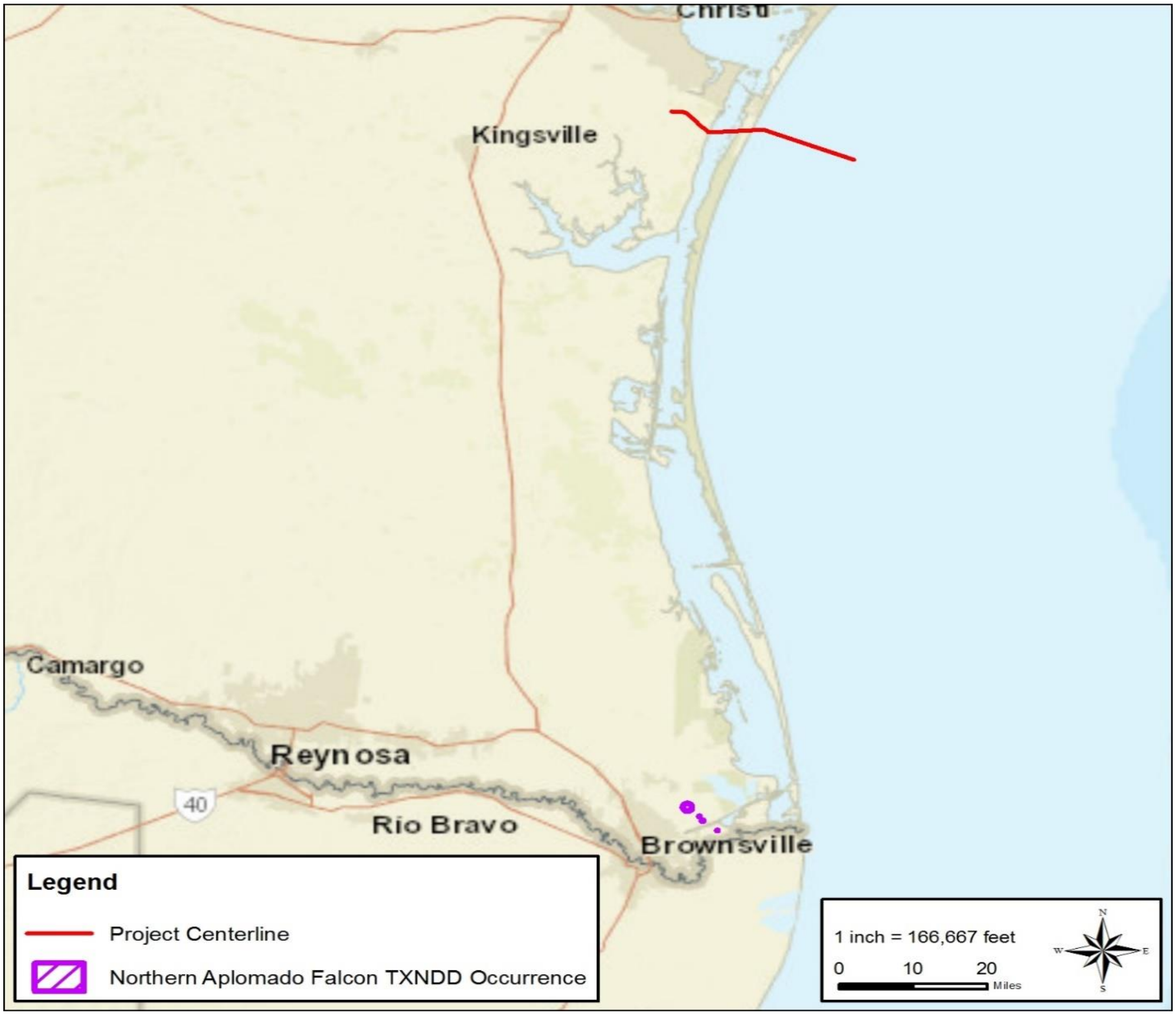


Figure 7-20: Northern Aplomado Falcon Observations

Determination of Impact: The habitat present within the Project area of North Padre Island does not meet the life history needs of this species. There are no Spanish dagger or mesquite, plants in which to build nests. With that said, Nueces County has installed a man-made structure near the Project on the bay side in effort to draw a breeding pair back to that portion of the North Padre Island. No nests of falcons were observed during surveys. Even with the current lack of habitat and the lack of observations of the species within the Project vicinity, the presence of hacking towers in the Project vicinity may attract this species to the Project. Based on the above analysis, the Project *may affect, but is not likely to adversely affect* the aplomado falcon in inshore and terrestrial environments and would have *no anticipated effects* in marine environments.

7.2.5.6 Whooping Crane, *Grus americana*

Current Federal Status: Endangered

Habitat and Range Requirements: Whooping cranes currently exist in the wild at 3 locations and in captivity at 12 sites (TPWD 2018d). The July 2010 total wild population was estimated at 383 (USFWS 2018c). There is only one self-sustaining wild population, the Aransas-Wood Buffalo National Park population, which nests in Wood Buffalo National Park (WBNP) and adjacent areas in Canada, and winters in coastal marshes in Texas (USFWS 2018c). The whooping crane nests within and directly adjacent to WBNP in the Northwest Territories and Alberta provinces of Canada, and winters mainly in and adjacent to Aransas National Wildlife Refuge (NWR) along the central Texas coast in Aransas, Calhoun, and Refugio Counties (Figure 7-21).

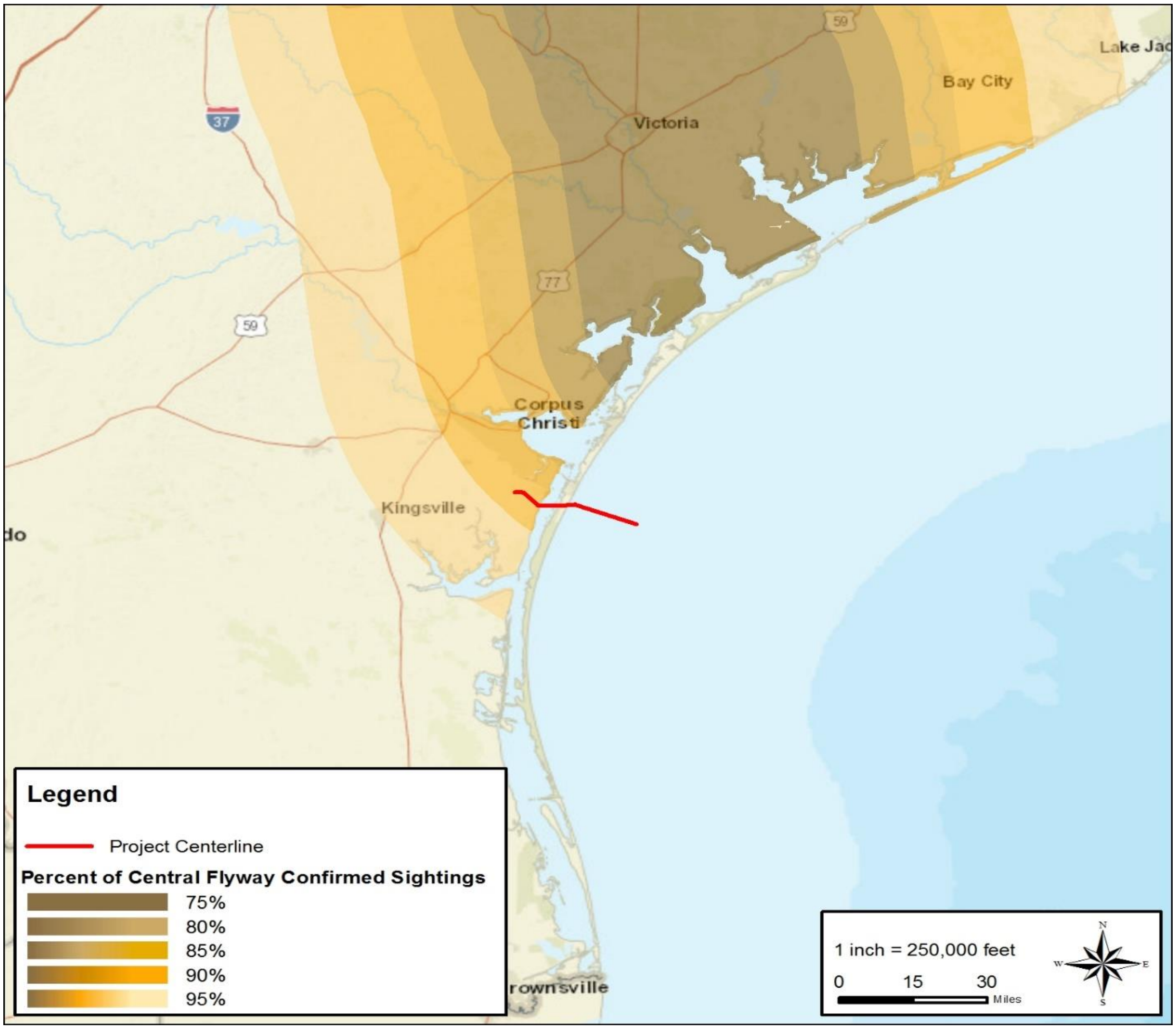


Figure 7-21: Whooping Crane Range within Texas Gulf Coast

The cranes migrate during spring and fall through an approximately 200-mile-wide corridor between Aransas NWR and WBNP (Gil-Weir et al. 2012). The migration corridor follows a straight line through the Great Plains, with the cranes traveling through Alberta, Saskatchewan, extreme eastern Montana, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas (Gil-Weir et al. 2012). Whooping cranes migrate primarily during daylight hours, relying heavily on tailwinds and thermal currents to aid their flight. They normally migrate at altitudes between 1,000 and 6,000 ft. (305 to 1,829 m) (Kuyt 1992) and typically fly from 200 to 400 mi (322 to 644 km) per day and land at night. Approximately 12 to 15 stopovers are made during migration (Kuyt 1992). The birds begin to arrive at their wintering grounds in mid-October, with most birds arriving from late October through mid-November. Spring migration generally begins in late March, with some birds remaining on the wintering grounds into early May (Figure 7-21).

Whooping cranes use a variety of habitats during migration, including croplands for feeding and wetlands for roosting (Howe 1989; Lingle et al. 1991). Austin and Richert (2001) report that migrant whooping cranes observed at feeding sites have primarily been recorded in upland cropfields, including row crops. Whooping cranes have also been observed feeding in palustrine wetlands, seasonally flooded habitats, permanent water, pastures, and meadows (Austin and Richert 2001). Austin and Richert (2001) report that migrant whooping cranes roost predominantly in palustrine or riverine wetland systems, with these types of wetlands accounting for 91.5 percent of roost sites recorded. Most palustrine roost sites were adjacent to cropland or grassland; less than 8 percent of palustrine roost sites were reported as occurring adjacent to woodland (Austin and Richert 2001). Studies cited by USFWS (2009b) suggest landscapes characterized as "wetland mosaics" provide the most suitable stopover habitat.

Determination of Impact: There are no known TXNDD occurrences for the vicinity of the proposed Project. The Project area does not occur within the nesting grounds (Northwest Territories and Alberta) or wintering grounds (Aransas, Calhoun, and Refugio Counties) used by the whooping cranes; however, the Project area in Kleberg County does occur within the whooping crane migratory corridor. The Project will be located within the whooping crane migratory corridor band that accounts for 10 percent of whooping crane sightings. The Project area includes 14 small palustrine emergent wetlands that more than likely lack the adequate invertebrate and floral forage to sustain whooping cranes. The majority of the wetlands present within the Project area are extremely vegetated and would not be preferred by the species. Based on this information, the Project *may affect, but is not likely to adversely affect* the whooping crane in inshore environments.

7.2.5.7 Migratory Birds Species of Conservation Concern

Table 7-10 contains a list of migratory birds and migratory birds of conservation concern (BCC) that may occur within the Project area. While this is not an exhaustive list of all the species that may occur, it is representative of the avian species that may occur within the Project area and may be affected by the proposed Project.

Table 7-10: Typical Migratory Bird Species Occurring Within the Project Area.

Species	Bird of Conservation Concern	Breeding Dates
American Oystercatcher (*Haematopus palliatus*)	Yes	April 15 to August 31
Black Skimmer (*Rynchops niger*)	Yes	May 20 to September 15
Brown Pelican (*Pelecanus occidentalis*)	No	January 15 to September 30
Clapper Rail (*Rallus crepitans*)	Yes	April 10 to October 31
Double-crested Cormorant (*Phalacrocorax auritus*)	No	April 20 to August 31
Gull-billed Tern (*Gelochelidon nilotica*)	Yes	May 1 to July 31
Herring Gull (*Larus argentatus*)	No	April 20 to August 31
King Rail (*Rallus elegans*)	Yes	May 1 to September 5
Reddish Egret (*Egretta rufescens*)	Yes	March 1 to September 15
Royal Tern (*Thalasseus maximus*)	No	April 15 to August 31
Seaside Sparrow (*Ammodramus maritimus*)	Yes	May 10 to August 20
Sooty Tern (*Onychoprion fuscatus*)	No	March 10 to July 31

American Oystercatcher, Haematopus palliates

Bird of Conservation Concern: The American oystercatcher is a BCC and is a large shorebird that is approximately 18.5 inches in length and a weight in the range of 14.1 to 24.7 ounces (TPWD 2018e). Adult individuals display a black head with a large red-orange bill and dark brown back. Underparts are white with stout, dull pink legs. While in flight, bold white stripes in wings and a white rump is visible. Juveniles appear similar in color and have a scaly pattern above, and a dark tipped bill (TPWD 2018e).

The American oystercatcher was listed as a species most in danger of extinction without any significant conservation plan on the 2014 State of the Birds Watch List; as well as a species of special concern by the National Audubon Society. Oystercatchers are shy birds that are sensitive to human disturbance and to loss, degradation, or development of their beach habitat. Additionally, they are vulnerable to attack by gulls so they do not nest alongside gulls, thus further limiting nesting habitat available to them.

Habitat and Range Requirements: American oystercatchers are year-long residents to the Texas Gulf coast (TPWD 2018e). During the breeding season, they can be found in coastal habitats including sand or shell beaches, dunes, saltmarsh, marsh islands, mudflats, and dredge spoil islands (NatureServe 2016a). Over winter, they can be found on the mud flats where they feed almost exclusively on shellfish and other marine invertebrates. Nesting sites are on the ground, on marsh islands or among dunes well above any high tide mark (NatureServe 2016a). Nests are shallow scrapes in sand, about 8 inches across and 2.5 inches deep, and sometimes lined with pebbles or shells. A clutch usually contains three eggs that are sub-elliptical to oval in shape and yellowish with stone, grayish, or buff tinted blotches. Incubation lasts 24 to 27 days (NatureServe 2016a). The young are attended to by both parents and remain at the nest for 1 to 2 days.

Determination of Impact: Although no American oystercatchers were observed upon initial surveys, the Project will fall within the natural range of the species (TXNDD 2018). The Project *may affect, but is unlikely to adversely affect* American oystercatcher populations in Texas.

Black Skimmer, Rynchops niger

Bird of Conservation Concern: The black skimmer is a BCC and is a medium-sized to large water bird measuring approximately 18 inches in length, 7.5 to 15.8 ounces in weight, and a wingspan of 44 inches. Individuals of this species have a long red and black bill; it is the only species in America where the lower mandible is longer than the upper. Adults have a black back and cap, white undersides, and distinctive short red legs. Wings are long and pointed. Juveniles appear similar to adults; however, they are a mottled dingy brown above as opposed to black.

Black skimmer is not a federally-listed species; however, it is protected under the MBTA of 1918. The North American Breeding Bird Survey estimates that populations significantly declined between 1966 and 2015. The main threat to the species includes development or other loss of their beach-nesting habitat. In addition to habitat loss, skimmer nests also face destruction due to predator presence (i.e. canids) along the beach.

Habitat and Range Requirements: Black skimmers can be found on sandy beaches, gravel or shell bars with sparse vegetation, or mats of debris in saltmarshes (NatureServe 2016b). They prefer habitat near coastal waters protected from open surf, such as lagoons, estuaries, inlets, and sheltered bays (NatureServe 2016b). Much of this species' original beach habitat has been developed as housing and attractions for beachgoers; and, particularly in the southeastern U.S., artificial islands made from dredge spoils are an important nesting habitat for this species. Black skimmers nest on the ground in a loose colony. Nests are excavated by both male and female birds and are bare, shallow, unlined scrapes that are 4 to 5 inches in diameter and 1 to 2 inches deep. A clutch contains 2 to 5 sub-elliptical to oval shaped eggs that are colored white to creamy-white and boldly and irregularly blotched with colors of black, blackish-olive, and shades of pale gray (NatureServe 2016b). Incubation lasts 21 to 25 days. The young are tended to by both parents, and do not fledge until 23 to 26 days (NatureServe 2016b).

Determination of Impact: Although no black skimmers were observed upon initial surveys, the Project will be within the natural range of the species. The Project *may affect, but is unlikely to adversely affect* black skimmer populations in Texas.

Brown Pelican, Pelecanus occidentalis

Bird of Conservation Concern: Although this species is not a BCC, it is protected under the MBTA of 1918. Brown pelicans are very large, stocky seabirds. Adults have a total length of approximately 48 inches, a weight of 70.5 to 176.4 ounces, and a wingspan of 84 inches (TPWD 2018f). Non-breeding adults of the species have white heads and necks, often washed with yellow, a grayish brown body, and a blackish belly. While in breeding plumage, the hindneck is dark chestnut in color and there is a yellow patch at the base of the neck (TPWD 2018f). Gular pouch is grayish but may occasionally be red. Juveniles are grayish brown above and whitish on the underparts.

The brown pelican warrants special attention for potential susceptibilities in inshore and offshore areas from certain types of development or activities. Brown pelicans nearly disappeared from North America between the late 1950s and early 1970s due to pesticides like DDT contaminating the food chain (TPWD 2018f). After the ban of DDT in 1972 pelican numbers, as well as numbers of various other bird species, were able to rise (TPWD 2018f). As a result, the species was fully de-listed in 2009. Since then, their populations continue their overall increase, though pelicans still face human-cause threats. Since they breed, roost, and forage near shipping channels, they are highly susceptible to oil spills. Additionally, disturbances from human activity in their coastal nesting habitats can cause problems, as panicked adults often abandon or accidentally destroy nests.

Habitat and Range Requirements: Brown pelicans are year-round residents of the Texas Gulf coast (TPWD 2018f). They are found in salt bays, beaches, and ocean habitats, mostly over shallow waters along immediate coast. Brown pelicans usually breed on small coastal islands (TPWD 2018). Nests are made on the ground, but may occasionally be built in bushes or low trees (i.e. mangroves). Nests range from 18 to 24 inches in diameter and 4 to 5 inches in height; the structure of which can be as simple as a scrape in the ground rimmed with soil and other debris or as elaborate as a platform of sticks woven into branches and heaped with sticks, reeds, straw, and grass (TPWD 2018f). A clutch usually contains three long sub-elliptical eggs that are dull white in coloration. Eggs are laid at intervals of 2 or more days and incubation can last 28 to 30 days. The young are attended to by both parents and are fully fledged at 9 weeks (TPWD 2018f).

Determination of Impact: Brown pelican was observed on initial site surveys. The Project may affect, *but is unlikely to adversely affect* brown pelican populations in Texas.

Clapper Rail, Rallus crepitans

Bird of Conservation Concern: The clapper rail is a BCC. Clapper rails are medium-sized, chicken-like marsh birds that measure approximately 14.5 inches in length and a weight of 9.2 to 14.1 ounces. They have a compact body, short tail, strong legs, a long slightly down-curved bill and rounded wings (NatureServe 2016c). They are generally gray or reddish in color with dull stripes on flanks. Plumage can be variable, but individuals will always have grayish edges on brown-centered back and scapular feathers with olive wing coverts (NatureServe 2016c). Juveniles appear similar to adults.

Clapper rails are abundant but secretive, so it is hard to have an accurate estimate on their actual numbers. They are threatened by habitat development and degradation, and high tides associated with storms (NatureServe 2016c). Sand deposition from storms may destroy marsh grasses, and this can affect clapper rail populations. Land development that alters vegetation, water levels, or salinity can cause local population declines. Additionally, toxic materials settle in coastal wetlands, and can compromise clapper rail populations (clapper rails have served as indicator species for estuary health). They are listed as game birds, however, it is unclear whether hunting pressure causes declines in populations.

Habitat and Range Requirements: Along the Gulf coast, clapper rails are strictly found in salt marshes (NatureServe 2016c). Nests are built on the ground, hidden in growing or dead herbage, or under a small bush and have the appearance of a bulky cup made of grasses and plant stems. May have living plants pulled over it to provide a canopy. Nests are 7 to 10 inches in diameter and 1 to 1.5 inches deep. A clutch contains 8 to 11 sub-elliptical eggs that can be very pale buff, pinkish-buff, or creamy-white and are sparsely blotched with dark reddish-brown (NatureServe 2016c). Incubation lasts 20 to 24 days. Young are tended to by both parents and leave the nest soon after hatching.

Determination of Impact: Although no clapper rails were observed upon initial surveys, the Project will be within the natural range of the species. Due to the scope of the Project, the Project may affect, but is *unlikely to adversely affect* clapper rail populations in Texas.

Double-crested cormorant, Phalacrocorax auritus

Bird of Conservation Concern: Although this species is not a BCC, it is protected under the MBTA. Double-crested cormorants are large waterbirds with a length ranging from 27.6 to 35.4 inches, weight of 42.3 to 88.2 ounces, and a wingspan of about 52 inches (NatureServe 2016d). They have small heads on long, kinked necks. The bills are strongly hooked and are about the length of the head. Breeding adults have tufts on either side of the head starting from behind the eye and are either white or black depending on locale (NatureServe 2016d). Juveniles are brown above and pale below centering on the upper breast area.

Habitat and Range Requirements: Double-crested cormorants are usually found along coasts, bays, lakes, and rivers; however, they are very adaptable and may be found in almost any aquatic habitat from large reservoirs to mangrove swamps to small inland ponds (NatureServe 2016d). Breeding is usually done in colonies and sites are usually on larger bodies of water on small islands, isolated rocks or trees standing in water. Nests are built with twigs, plant debris, and various rubbish. The outside diameter is approximately 24 inches and has a depth of 4 to 6 inches (NatureServe 2016d). A clutch usually contains 3 to 4 long sub-elliptical eggs that are pale blue in color. Incubation lasts 25 to 29 days. The young are tended to by both parents and are fully fledged at 5 to 6 weeks from hatching. Double-crested cormorant populations have rebounded from persecution and pesticides over the years and are now widespread and abundant.

Determination of Impact: Double-crested cormorants were observed during initial site surveys. The Project may affect, but is *unlikely to adversely affect* double-crested cormorant populations in Texas.

Gull-billed Tern, Gelochelidon nilotica

Bird of Conservation Concern: Gull-billed terns, which are a BCC, are medium sized terns measuring approximately 14 inches in length, 5.3 to 7.2 ounces in weight, and has a wingspan of 34 inches (NatureServe 2016e). Breeding adults are white below, pale gray above, with a black crown and nape, stout black bill, and black legs and ft. Birds in winter plumage are white below, pale gray above, and mostly white on the head apart from some streaking (NatureServe 2016e). Juveniles resemble wintering adults.

Populations of gull-billed tern appear erratic, with fluctuations in numbers across its range (NatureServe 2016e). This species is threatened by the deterioration and loss of habitat through wetland drainage, agricultural intensification, pesticide pollution, fluctuating water levels, beach erosion, and the development of foraging sites. Additionally, it suffers from reduced reproductive successes as a result of human disturbances at breeding colonies.

Habitat and Range Requirements: Gull-billed terns are found in salt marshes, fields, and coastal bays restricted to the seacoast (NatureServe 2016e). Breeding happens on sandy beaches of coasts and offshore islands, and occurs in colonies. Nests resemble a shallow hollow in soft sand or soil, and is usually lined with grasses, seaweed, or nearby vegetation. The outside diameter of the nest is approximately 18 inches wide. A clutch is made of three sub-elliptical, very pale cream-colored eggs marked with small blotches of dark brown (NatureServe 2016e). Incubation lasts 22 to 23 days. The young are tended by both adults and are fully fledged at 5 weeks.

Determination of Impact: Although no gull-billed terns were observed during initial surveys, the Project will be within the natural range of the species. Due to the scope of the Project the Project may affect, but is *unlikely to adversely affect* gull-billed tern populations in Texas.

Herring Gull, Larus argentatus
Bird of Conservation Concern: Although this species is not a BCC, it is protected under the MBTA. Herring gulls are large gulls with lengths ranging from 22 to 26 inches, a weight of 28 to 44 ounces, and a wingspan of 58 inches (NatureServe 2016e). Adults have light gray backs, black wingtips, and white heads and underparts. Winter plumage includes dusky streaks marking their heads. Juveniles are mottled brown, while second year birds are brown but show gray on the back. Third year birds have grayer on the back and more white on the head and underparts (NatureServe 2016e). Legs are a dull pink in color.

Populations of the herring gull took a plunge in the late 19th century due to over hunting for eggs and feathers. Since then, numbers have surged, and breeding ranges have expanded due to in part conservation efforts. More recently, however, overfishing has made smaller fish species used as prey by herring gulls to become less numerous. Additionally, oil pollution, pesticide contamination, and deliberate control measures continue to threaten some herring gull populations.

Habitat and Range Requirements: Herring gulls can be found in a wide variety of habitat, typically associated with water, such as ocean coasts, bays, beaches, lakes, piers, farmlands, and dumps (NatureServe 2016). The species forages at sea, on beaches, mudflats, plowed fields, marshes, or where human activity provides food. Herring gulls breed in sand dunes, among rocks and grass, and edges of islands. The nest is usually just a large accumulation of grass, seaweed, and other plant material. Nest diameter can measure 12 to 24 inches and have a depth of 3 inches. A clutch consists of 2 to 3 sub-elliptical eggs. The eggs are variable in color, but usually light olive, buffish, or greenish and are blotched with black, blackish-brown, or dark olive. Incubation lasts 25 to 33 days. The young are tended by both parents and are fledged at 6 to 7 weeks.

Determination of Impact: Herring gulls were observed during initial site surveys. The Project *may affect, but is not likely to adversely affect* herring gull populations in Texas.

King Rail, Rallus elegans
Bird of Conservation Concern: The king rail is a BCC. The king rail is a medium-sized, chicken-like marsh bird that can range from 15 to 19 inches in length, 11 to 13 ounces in weight, and has a wingspan of 19.5 inches (NatureServe 2016g). Adults have short tails and compact bodies on strong legs and a long, slightly down-curved bill. A rusty red colors the chest, neck, and back, while the flanks are patterned with strongly aligned black and white bars. The head is slate with brown or grayish cheeks and buff eyebrows. Juveniles appear similar to adults, but markings are indistinct and with variable amounts of black on the sides.

King rail numbers have declined by 91 percent from 1966 to 2014; however, numbers are thought to now be stable at lowered populations. Population declines are related to the loss of wetlands across North America as well as pesticide runoff into wetlands (NatureServe 2016g).

Habitat and Range Requirements: The king rail uses a variety of habitats with shallow fresh or brackish water and dense cover including marshes, rice fields, swamps, and sometimes salt marshes during winter. Breeding primarily occurs in large freshwater marshes with rank vegetation (NatureServe 2016g). Nests are made on the ground in a grass tussock or waterside vegetation or raised on plants growing in shallow water. Nests have different appearances depending on whether they are found on dry sites or wet sites. On dry sites, nests are cups of grasses with growing vegetation pulled over to form a canopy. On wet sites, stems of plants are bent down to form a base where a cup several inches thick is built up from plant material. Nests are generally 8 to 9 inches across and 1 to 4 inches thick. A clutch usually consists of 8 to 11 sub-elliptical creamy white eggs with sparse dark reddish-brown blotches. Incubation lasts 21 to 24 days. The young are tended by both adults and leave the nest soon after hatching and first flight about 63 days after hatching.

Determination of Impact: Although no king rail were observed during initial surveys, the Project will be within the natural range of the species. The Project may affect, but is *unlikely to adversely affect* king rail populations in Texas.

Reddish Egret, Egretta rufescens

Bird of Conservation Concern: The reddish egret is a large member of the family Ardeidae, with a length of 30 inches and a wingspan of 46 inches (Dunn and Alderfer 2011). There are dark and white plumage types associated with this species. The white variation has all white plumage with a dark bill and cobalt blue legs. The dark plumage variant of the reddish egret differs from the white in that the head and neck area is a rusty brown, and the body is a reddish grey. The white phase only appears in 20 percent of the total U.S. population and was previously thought to be a different species (TPWD 2018g).

Habitat and Range Requirements: The reddish egret inhabits coastal tidal flats, salt marshes, shores, and lagoons, where it utilizes the calm shallow waters, protected bays, and estuaries to forage for fish, frogs and crustaceans (TPWD 2018g). Breeding takes in place during the spring months in Texas, but they have been known to also breed during the winter months in Florida (TPWD 2018g). Nest are built by both sexes on the ground in Texas, but nests are built among the mangroves in Florida. Clutch size ranges from 3 to 4 eggs, with both sexes participating during incubation (TPWD 2018g).

Determination of Impact: Although no reddish egrets were observed during initial surveys, the Project will be within the natural range of the species. The Project may affect, but is *unlikely to adversely affect* reddish egret populations in Texas.

Royal Tern, Thalasseus maximus

Bird of Conservation Concern: The royal tern is a BCC. The royal tern is a large member of the tern family, Laridae, only second in size to the elegant tern. This tern species averages 20 inches in length, with a wingspan between 39 and 53 inches, and weighing between 11.3 and 17.6 ounces (NatureServe 2016h). It is distinguishable from other tern species by its large size. It is however similar in plumage to other tern species in that it is covered in mostly white plumage. During breeding season they briefly obtain a black cap on their heads. During the non-breeding season, this cap only has minor black streaks (NatureServe 2016h). The back and upper wings are a very pale grey. The bill is characterized as the shape and color of a carrot which differentiates it from young elegant terns. The tail is much more deeply forked from that of the Caspian tern.

Habitat and Range Requirements: Royal terns will begin breeding at the age of 4 and typically nest in large colonies (NatureServe 2016h). Breeding behavior involves males presenting food to females. If receptive, both birds will begin to build a nest in a shallow depression categorized by sandy soils (NatureServe 2016h). On average only one egg will be produced as a result of breeding. The incubation period of eggs can be anywhere from 28 to 35 days, with both sexes sharing incubation duty. Within North America, breeding commences in April for Texas, and in May from Florida to Maryland (NatureServe 2016h).

Determination of Impact: Royal tern were seen during initial surveys. The Project *may affect, but is not likely to adversely affect* royal tern populations in Texas.

Seaside Sparrow, Ammodramus martimus

Bird of Conservation Concern: The seaside sparrow is a BCC. Seaside sparrows are small non-descript members of the family Passerellidae about 6 inches in length (Dunn and Alderfer 2011). Adults have brownish, chestnut colored upperparts with grey on the crown and nape, and a grayish buff colored breast. They have a dark face with greyish blue cheeks, a white throat, and a short, pointed tail. The main defining characteristic is a small yellow supraloral patch (NatureServe 2016i). While these colors are most common, there are 9 subspecies that can be variable in color depending on locality.

Habitat and Range Requirements: The seaside sparrow requires salt marshes and can be seen residing in the tidal marshes along the coast where there is dense cordgrass and Salicornia growth above the tide (NatureServe 2016i). They frequent open habitat and edge habitat for foraging invertebrates and seeds. According to the Audubon Society, no other songbird among North American passerines is so closely tied to salt marshes as the Seaside Sparrow. Breeding takes place in the salt marshes of the Atlantic and Gulf coast from New Hampshire to South Texas where males will follow females during courtship. Nests are built only by the female and are typically a few inches above the tide. Clutch size averages from 3 to 4 but can be up to 5 and is incubated by the female only (NatureServe 2016i).

Determination of Impact: Although no seaside sparrows were observed during initial surveys, the Project will be within the natural range of the species. The Project may affect, but is *unlikely to adversely affect* reddish egret populations in Texas.

Sooty Tern, Onychonprian fuscatus

Bird of Conservation Concern: The sooty tern is a BCC. The sooty tern, a large member of the family Laridae, is considered a pelagic seabird, known for its ability to sleep while flying. They average 16 inches in length and have a wingspan of 32 inches (Dunn and Alderfer, 2011). The wings and tail are extremely long making it successful as an oceanic bird. The upper parts of its body are dark grey, while its underside is white. Both the bill and the legs of the Sooty Tern are black in color. Juveniles are a brownish grey on all part of the body with the exception of the undertail coverts and pale underwings. They can possibly be confused with bridled terns, but sooty terns lack the white collar seen in bridled terns (NatureServe 2016j)

Habitat and Range Requirements: Different from other tern species, rather than inhabiting marshes and shores, the sooty tern chooses to spend much of its time at sea. Sooty terns do not begin mating until they are 6 years of age (NatureServe 2016j). They begin arriving at Dry Tortugas of the coast of Florida two months prior to laying the first egg, with rituals involving circling, calling, high flight with gliding decent, and strutting and bowing once on the ground (NatureServe 2016j) Nests are on the ground, usually in the open, but sometimes under shrubs, and are built by both sexes. The clutch size typically consists of only one egg. Both male and females take part in the incubation process which takes 30 days (NatureServe 2016j).

Determination of Impact: Although no sooty terns were observed during initial surveys, the Project will be within the natural range of the species. The Project may affect, but is *unlikely to adversely affect* sooty tern populations in Texas.

7.2.5.8 Marine Birds

The Texas coast has a variety of marine or pelagic birds that utilize the GOM or use the area as a migratory corridor. Seabirds are generally defined as species that spend extended periods away from land and obtain all or most of their food from the sea while flying, swimming, or diving. Within the northern GOM, there are three taxonomic orders of seabirds and migratory birds (BOEM 2011):

- *Procellariiformes* (albatrosses, fulmars, petrels, shearwaters, and storm petrels);
- *Pelicaniformes* (pelicans, tropicbirds, boobies and gannets, cormorants, and frigatebirds); and
- *Charadriiformes* (phalaropes, gulls, jaegars, terns, noddies, and skimmers).

The proposed Project would cause no affect or impact to these orders of birds, as most of these birds would avoid construction areas as they should occur offshore.

7.2.6 Benthic Community

The benthic community generally consists of two groups: infauna (animals that live in the substrate) and epifauna (animals that live on or are attached to the substrate). The distributions of these animals are typically influenced by sediment composition or grain size but also by temperature, salinity, and distance from shore (Mineral Management Service [MMS] 2002). Illumination, food availability, currents, tides, and wave shock also play a role in the distribution of benthic fauna. Benthic organisms are valuable indicators of water/sediment pollution and construction-related perturbations. They also transfer large amounts of food energy to the higher trophic levels. These relatively immotile infauna can provide evidence of habitat changes related to construction operations through changes in their presence and abundance.

Benthic surveys for SAV and oysters were performed within the Laguna Madre from March 21 to March 23, 2018, and April 10-12, 2018. The survey identified six habitat types within the Project area, including 691 ac of SAV (502 ac of continuous SAV and 189 ac of patchy SAV), 268 ac of unconsolidated bottom – sand, 30.72 ac of special aquatic site – mudflat or land. Two individual black mangroves associated with a spoil island east of the GIWW were also found. No oysters were identified within the survey area. The Benthic Survey Report is included in this volume as Appendix E.

7.2.6.1 Inshore

As previously discussed, estuaries are highly productive aquatic environments that sustain important shellfish and finfish species; the benthic community helps to support the high biomass within the estuaries by its place in the estuarine food web; high benthic production greatly enhances an estuary's ability to serve as a nursey ground for juvenile nekton. Based on studies conducted in 1979, the greatest infaunal abundance in the upper Laguna Madre (and each of the studied Texas estuaries) was observed in winter and in early spring. The most varied and abundant infauna included polychaetes and mollusks. Laguna Madre differ from the brackish-water organism-dominated assemblages found in less saline estuaries. The dominant polychaetes included *Mediomastus californiensis* and *Streblospio benedicti*; dwarf surf clam (*Mulinia lateralis*) and *Anomalocardia cuneimeris* were the dominant mollusks. Epifauna identified in the upper Laguna Madre included brown and white shrimp, blue crab (*Callinectes sapidus*), lesser blue crab (*Callinectes similis*), mud crab (*Neopanope texana*), and grass shrimp (*Palaemonetes* spp.). The studies indicate that the abundance of benthic fauna within the Texas coast estuaries increases as you move from the more freshwater to the more saline estuaries. (Armstrong 1987)

Oyster reefs are absent throughout most of the Laguna Madre and reappear near Port Isabel and in South Bay and no oyster reefs were identified during the March 2018 surveys in Laguna Madre. NOAA's GOM Data Atlas does identify oyster reefs on the bay side of Padre Island between the Project and Corpus Christi Bay (see Figure 5-3 in Section 5: Inshore and Offshore Aquatic Environment); however, the closest reef area is about 3.5 mi (5.6 km) from the landfall location of the Inshore Pipelines. A full technical benthic resources survey report regarding SAV has been completed and can be referenced in Appendix E.

7.2.6.2 Offshore

Infaunal communities on the continental shelf are generally dominated by polychaete worms (bristleworms), followed by crustaceans and mollusks. Epifaunal communities include crustaceans, echinoderms, mollusks, hydroids, sponges, and soft and hard corals. Shrimp and demersal fish are also closely associated with benthic communities (MMS 2002). Species diversity varies significantly between habitat types. Species and individual abundances are generally higher in medium sand substrates in water less than 197 ft. (60 m) and lower in finer sediments and deeper water. Species diversity is highest in habitats with medium to coarse sands and lower in habitats with finer sands that are in water depths over 197 ft. (60 m) (MMS 2000).

The major benthic habitat of the northern GOM consists of a soft muddy bottom. On the Texas-Louisiana continental shelf, densities of benthic organisms are greatest nearshore and decrease with distance offshore and water depth (Phillips and James 1988). This trend in densities may relate to the gradient in sediment size described above. Nematodes, harpacticoid copepods, and kinorhynchs are the predominant taxa that dominate the smaller benthic fauna (meiofauna) in the GOM (Phillips and James 1988; Rowe 2017).

Macrobenthic species include polychaetes, crustaceans, and mollusks. Average densities of microbenthic fauna on the south Texas continental shelf decline with depth and range from about 2,900 individuals per square meter in nearshore areas to 390 individuals per square meter on the outer shelf (Phillips and James 1988). Polychaetes dominate, followed by amphipod crustaceans and bivalve mollusks (Rowe 2017).

Megabenthic fauna (those organisms > 1 centimeter (cm) in size) includes squids, penaeid shrimp, large crabs, stomatopods, and demersal fishes. Maximum densities of demersal fish on the Texas shelf occur between depths of 239 and 269 ft. (73 and 82 m) (Phillip and James 1988). Many megabenthic species are mobile, and life stages can vary with the seasons. For example, brown and white shrimp spawn offshore and migrate to estuarine habitat as postlarvae (GMFMC 2004).

7.2.7 Plankton

As previously noted, the phytoplankton community consists of plankton and zooplankton, each of which are discussed below. Ichthyoplankton (fish eggs and larvae) are a specific subset of the zooplankton.

7.2.7.1 Phytoplankton

Phytoplankton are microscopic plants that photosynthesize and are a keystone for the marine food chain. They are generally found drifting within surface waters across the world and are impacted by a variety of physical and biological factors including, but not limited to, prevailing ocean currents, mixing, nutrient loading, and temperature. Phytoplankton have a major impact on the near-surface nutrient concentrations within the photic zone, being largely responsible for the primary production in the ocean (Qian et al. 2003). Alterations in the phytoplankton community composition can therefore lead to negative ecological impacts on entire ecosystems. Harmful algal blooms, areas of hypoxia, eutrophication, and decreases in nutrient availability are all consequences of changes in phytoplankton communities (Hallegraeff 2010)). It is generally assumed that all the phytoplankton is consumed by the zooplankton, except for brief periods during major plankton blooms (GMFMC 2004).

Shelf phytoplankton and zooplankton (See Section 5.2.2) are more abundant, productive, and seasonally variable than the deep Gulf plankton. This is due primarily changes in salinity, increases in available nutrients, vertical mixing, and zooplankton predation on the continental shelf (MMS 2002). Light and nutrients (particularly nitrogen) are the two primary factors controlling phytoplankton production on the continental shelf (MMS 2007). In GOM-wide studies of cholorphyll-a, which is an indicator of primary productivity, 13 regions were identified as having a distinct pattern of chlorophyll-a when compared to other areas over a period of 11 years (1997 to 2008). The inner shelf waters of the Texas coast (the area of the proposed Project) showed a peak in chlorophyll-a in between December and April; the outer shelf reached its maximum concentrations in December and January (Salmeron et al. 2011).

7.2.7.2 Zooplankton

Similar to phytoplankton, zooplankton are vital to the food web, linking primary production to higher tropic levels and clearing detrital organic matter out of surface layers and channeling it to deepwater biota through excretion and exoskeleton molting (Byrnes et al. 2017). Most zooplankton undergo diurnal vertical migrations, swimming up to surface waters (less than 164 ft. [50 m]) at night and descending to deeper depths during the day (generally to depths of 328 ft. [100 m] or shallower) (Byrnes et al. 2017).

Zooplankton densities are highest in nearshore habitat and decrease with distance offshore (Flint and Rabalais 1980). The abundance of zooplankton offshore is likely limited by the availability of phytoplankton (the primary food supply), while nearshore, where plankton are more abundant, zooplankton may be limited by predation (Flint and Rabalais 1980). In the GOM on the Texas-Louisiana shelf, zooplankton densities range from about 166 to 1.5 million individuals per m^3 (Phillips and James 1988). On the continental shelf, in addition to phytoplankton, suspended organic detritus particles transported by rivers or re-suspended from benthic sediments supplements the food supply. Water circulation patterns and breeding seasons also may play a significant role in determining seasonal zooplankton distribution (Phillips and James 1988).

Zooplankton on the south Texas continental shelf were quantified as part of the South Texas OCS study in between 1975 and 1977 (Flint and Rabalais 1980). The zooplankton of the Texas-Louisiana shelf is very diverse, including many species of protozoans, heteropods, pteropods and copepods, as well as larval forms of a variety of animals. The majority of holoplanktonic organisms (species that spend their entire lives in the water column) are copepods, which constitute between 39 and 72 percent of zooplankton abundance on the south Texas shelf near the Project (Flint and Rabalais 1980, Phillips and James 1988). Along the south Texas shelf, zooplankton abundance was found to vary greatly among nearshore and offshore stations. For the survey transects nearest to the Project area, Flint and Rabalais documented an average of 3,764 individuals per m^3 at nearshore stations and 957 individuals per m^3 at offshore stations (1980; Phillips and James 1988). In offshore waters zooplankton abundance peaked in the winter and were lowest in the spring and fall (Flint and Rabalais 1980, Phillips and James 1988).

7.2.7.3 Ichthyoplankton

The larval planktonic stage of many fish species is referred to as ichthyoplankton. Ditty et al. (1988) summarized information from over 80 studies on ichthyoplankton in the northern GOM and reported 200 fish species from 61 families. The larval stage can range in duration from 10 to 100 days. Year-class strength in adult populations of fish and invertebrates largely depends on variability in survival and transport of pelagic larvae. The distribution of fish larvae depends on spawning behavior of adults, hydrographic structure and transport at a variety of scales, duration of the pelagic period, behavior of larvae, and larval mortality and growth (BOEM 2012).

For most of the year in the north-central GOM, densities of ichthyoplankton are highest at the surface and decrease with depth (Shaw et al. 2002); however, larvae may migrate vertically within the water column (Muhling et al. 2013). Water temperature has a major influence on the structure of larval fish assemblages (MMS 2002). Larval densities typically are lowest during winter, increase during the spring, peak during the summer, and decline during the fall. Table 7-11 presents the seasonality and peak seasonal occurrence of larval fishes in the northern GOM. Most larvae are expected to be present in the Project area from spring through early fall. In addition to the seasonal variations, many ichthyoplankton taxa are collected within specific depth ranges (see Table 7-12). Those species occurring in depths shallower than 164 ft. (50 m) are most likely to occur in the vicinity of the Project.

Table 7-11: Seasonality and Peak Seasonal Occurrence of Larval Fishes (<10 mm standard length) in the Northern GOM

Family (common name)	Taxa (common name)	Scientific Name	Months of Occurrence[a]											
			J	F	M	A	M	J	J	A	S	O	N	D
Herring and Menhaden[a]	Gulf menhaden	*Brevoortia patronus*	*	*	X	X					X	X	X	*
	Round herring	*Etrumeus teres*	*	*	*	X	X	X					X	X
	Scaled sardine[b]	*Harengula jaguana*			X	X	*	*	*	*	X	X	X	
	Atlantic thread herring[b]	*Opisthonema oglinum*			X	X	*	*	*	*	X	X	X	
Anchovy[a]	Striped	*Anchoa hepsetus*	X	X	*	*	*	*	*	*	*	X	X	X
	Bay	*Anchoa mitchilli*	X	X	*	*	*	*	*	*	*	X	X	X
	Longnose	*Anchoa nasuta*	X	X	*	*	*	*	*	*	*	X	X	X
Sea Bass and Grouper	Sand perch	*Diplectrum formosum*	X	X	X	X	*	*	*	*	X	X	X	X
	Pygmy sea bass	*Serraniculus pumilio*					X	*	*	*	*	X	X	
Large-tooth flounders	Dusky flounder[b]	*Syacium papillosum*					X	*	*	*	*	X	X	
Left-eye flounders[b]	NA	*Bothus* spp.[b]	X			X	X	X	X	X	X	X	X	X

Family (common name)	**Taxa (common name)**	**Scientific Name**	**Months of Occurrence[a]**											
			J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Tonguefish	NA	*Symphurus* spp.[b]	X	X	X	X	X	X	X	X	X	X	X	X
Cusk eels[b]	NA	*Ophidion* spp.	X	X	X	X	X				X	X	X	X
Wormfishes	NA	*Microdesmus* spp.			X	X	X	X	X	X	X	X	X	X
Jacks, scads, pompanos, and relatives	Blue runner	*Caranx crysos*			X	X	X	*	*	*	X	X	X	
	Atlantic bumper[b]	*Chloroscombrus chrysurus*				X	X	*	*	*	*	X		
	Round scad	*Decapterus punctatus*			X	*	*	*	*	*	*	X	X	
	Rough scad	*Trachurus lathami*	*	*	X	X	X						X	X
	Dolphin	*Coryphaena hippurus*					X	X	X	X	X	X	X	
Snapper	Red	*Lutjanus campechanus*				X	X	*	*	*	X	X	X	
	Gray	*Lutjanus griseus*				X	X	*	*	*	X	X	X	
	Lane	*Lutjanus synagris*				X	X	*	*	*	X	X	X	
Majorras, Porgies	Pigfish	*Orthopristis chrysoptera*	X	X	*	X	X							
	Sheepshead	*Archosargus probatocephalus*	X	*	*	*	X							
	Pinfish	*Lagodon rhomboides*	*	*	X	X						X	X	*
Drums, Croakers, Seatrout[b]	Sand seatrout[b]	*Cynoscion arenarius*		X	*	*	X	X	*	*	X	X		
	Spotted seatrout[b]	*Cynoscion nebulosus*		X	X	*	*	*	*	*	X	X		
	Silver seatrout[b]	*Cynoscion nothus*					X	X	X	X	*	*	X	
	Spot	*Leiostomus xanthurus*	*	X	X	X						X	X	*
	NA	*Menticirrhus* spp.[b]		X	X	X	X	X	X	X	X	X	X	X
	Atlantic croaker	*Micropogonias undulatus*	*	X	X	X					X	*	*	*
	Red drum[b]	*Sciaenops ocellata*								X	*	*	X	
Spadefish	Atlantic spadefish	*Chaetodipterus faber*				X	X	*	*	*				
Mackerels, Tunas, Wahoo	Bullet mackerel	*Auxis rochei*	X	X	X	X	*	*	*	*	*	X	X	
	Little tunny	*Euthynnus alletteratus*				X	*	*	*	*	*	X	X	
	Skipjack tuna	*Euthynnus pelamis*				X	X	X	X	X	X	X		
	King mackerel	*Scomberomorus cavalla*					X	X	X	*	*	X	X	
	Spanish mackerel	*Scomberomorus maculatus*				X	X	X	X	*	*	X		
	Bluefin tuna	*Thunnus thynnus*				X	X	X						
Butterfish	Gulf butterfish	*Peprilus burti*	*	*	*	X	X	X	X	X	X	X	*	*

Source: Ditty et al. 1988.

[a] X = Seasonality; * = Peak Seasonal Occurrence.

[b] These taxa were identified as one of the 20 most prevalent taxa at the offshore location of the proposed Project (see Table 7-13). Seasonal distribution was not available for each identified taxon.

Table 7-12: Primary Depth Distribution of Larval Fishes (<10 mm standard length) in the Northern GOM[a]

Common Name	Scientific Name	Depth				
		<25 m	<50 m	<100 m	50–200 m	>150 m
Sheepshead	*Archosargus probatocephalus*[b]	x				
Atlantic spadefish	*Chaetodipterus faber*	x				
Atlantic bumper[c]	*Chloroscombrus chrysurus*	x				
Sand seatrout[c]	*Cynoscion arenarius*	x				
Spotted seatrout	*C. nebulosus*[b]	x				
Pigfish	*Orthopristis chrysoptera*	x				
Atlantic harvestfish	*Peprilus paru*	x				
Black drum	*Pogonias cromis*[b]	x				
Anchovies	*Anchoa* spp.		x			
Gulf menhaden	*Brevoortia patronus*[b]		x			
Gulf black sea bass	*Centropristis striata*		x			
Sand perch	*Diplectrum formosum*		x			
Scaled sardine[c]	*Harengula jaguana*		x			
Pinfish	*Lagodon rhomboides*[b]		x			
Spot	*Leiostomus xanthurus*[b]		x			
Atlantic croaker	*Micropogonias undulatus*[b]		x			
Atlantic thread herring[c]	*Opisthonema oglinum*		x			
Spanish sardine	*Sardinella aurita*		x			
Spanish mackerel	*Scomberomorus maculatus*		x			
Pygmy sea bass	*Serraniculus pumilio*		x			
Round scad	*Decapterus punctatus*			x		
Gulf butterfish	*Peprilus burti*			x		
Frigate/bullet mackerel	*Auxis* sp.				x	
Blue runner	*Caranx crysos*				x	
Round herring	*Etrumeus teres*				x	
Bonito	*Euthynnus alletteratus*				x	
Red barbier	*Hemanthias vivanus*				x	
Red snapper	*Lutjanus campechanus*				x	
King mackerel	*Scomberomorus cavalla*				x	
Rough scad	*Trachurus lathami*				x	
Skipjack tuna	*Euthynnus pelamis*					x
Sailfishes	*Istiophorus* spp.					x
Swordfish	*Xiphias gladius*					x

a Depths are those reported at which more than 75 percent of larvae were collected.
b Estuarine-dependent larvae.
c These taxa were identified as one of the 20 most prevalent taxa at the offshore location of the proposed Project (see Table 7-13). Depth distribution was not available for each identified taxon.
Source: Ditty et al. 1986

Plankton surveys have been conducted in the GOM as part of the Southeast Area Monitoring and Assessment Program (SEAMAP) since 1982. Plankton are collected using both a neuston net and a bongo net. The neuston net has a 3.3- x 6.6-ft. (1- x 2-m) mouth opening and a mesh size of 0.04 inch (0.950 millimeter [mm]). This net is fished at a depth of 1.6 ft. (0.5 m) along the surface of the water. The bongo net has a 23.6-inch (60-cm) mouth opening and carries 0.01-inch (0.33-mm) mesh netting. The bongo net is fitted with a flowmeter that allows the volume of water filtered during the tow to be measured. This net is fished from approximately 3.28 to 16.4 ft. (1 to 5 m) off the bottom to the water's surface and yields a sample from the water column that is integrated over depth.

Ichthyoplankton abundance for the Project area was determined using data provided by NMFS from the summer/fall plankton collections. Data were available along the Texas Coast from 1986 to 2014 (GSMFC 2018). SEAMAP Station B235 is in close proximity to the location of the proposed Project and is the only station with a 30- by 30-nautical mile (56- by 56-km) block centered on the Project; therefore, Station B235 was the only station assessed to determine local ichthyoplankton abundance (see Figure 7-22). The station was sampled once per year in August or September, with the exception of two years in which the station was sampled twice (2002 and 2007). Based on the bongo net data from the 26 samples taken over 24 years, the average observed abundance of eggs is 14,746 per million gallons (range 167 to 43,969) and the average abundance of larvae is 22,289 per million gallons (range 1,004 to 84,821). Within these samples, a total of 92 taxa of fish, as well as a category for unidentified fish, were collected; 20 taxa made up over 92 percent of the collection (see Table 7-13); eggs are not identified to taxa. As noted in Table 7-11, species abundance varies throughout the year and the prevalence and diversity of species would likely change depending on the seasons; however, as peak occurrence for most species is in the summer/fall months, the overall abundance of ichthyoplankton would likely decrease in cooler months.

Table 7-13: Dominant SEAMAP Taxa Occurring in the Project Area

Common Name	Taxa Level and Taxa	Samples of Occurrence (No.)	Average No. of Larvae at Station B235 per Million Gallons
Anchovies and sardines	Family: Engraulidae	23	8,582
Gobies	Family: Gobiidae	23	2,681
Herrings and anchovies	Order: Clupeiformes	13	1,840
Atlantic bumper	Species: *Chloroscombrus chrysurus*	21	1,275
Atlantic thread herring	Species: *Opisthonema oglinum*	15	890
Dusky flounder	Species: *Syacium papillosum*	8	783
Herrings, shads, sardines, and menhadens	Family: Clupeidae	2	720
Tonguefish	Genus: *Symphurus*	19	482
Sand seatrout	Species: *Cynoscion arenarius*	11	412
Cusk eels	Family: Ophiidae	21	367
NA	NA: Unidentified fish	15	358
Largetooth flounders	Genus: *Syacium*	8	335
King croakers	Genus: *Menticirrhus*	20	323
Wormfishes	Family: Microdesmidae	17	262
Red drum	Species: *Sciaenops ocellatus*	11	238
Left-eye flounders	Family: Bothidae	10	215
Silver seatrout	Species: *Cynoscion nothus*	11	209
Seatrouts and weakfishes	Genus: *Cynoscion*	8	198
Scaled sardine	Species: *Harengula jaguana*	12	189
Drums and croakers	Family: Sciaenidae	8	153
	Total	**26**	**22,289**

Source: GSMFC 2018

[a] SEAMAP data identifies each species to the lowest practicable taxa, therefore, a specific species may be included in multiple taxonomic groupings. For example, the sand seatrout (*Cynoscion arenarius*) is a member of the genus *Cynoscion*; therefore, some portion of the 198 larvae per million gallons attributed to the genus *Cynoscion* may be sand seatrout that were not identified to a species level.

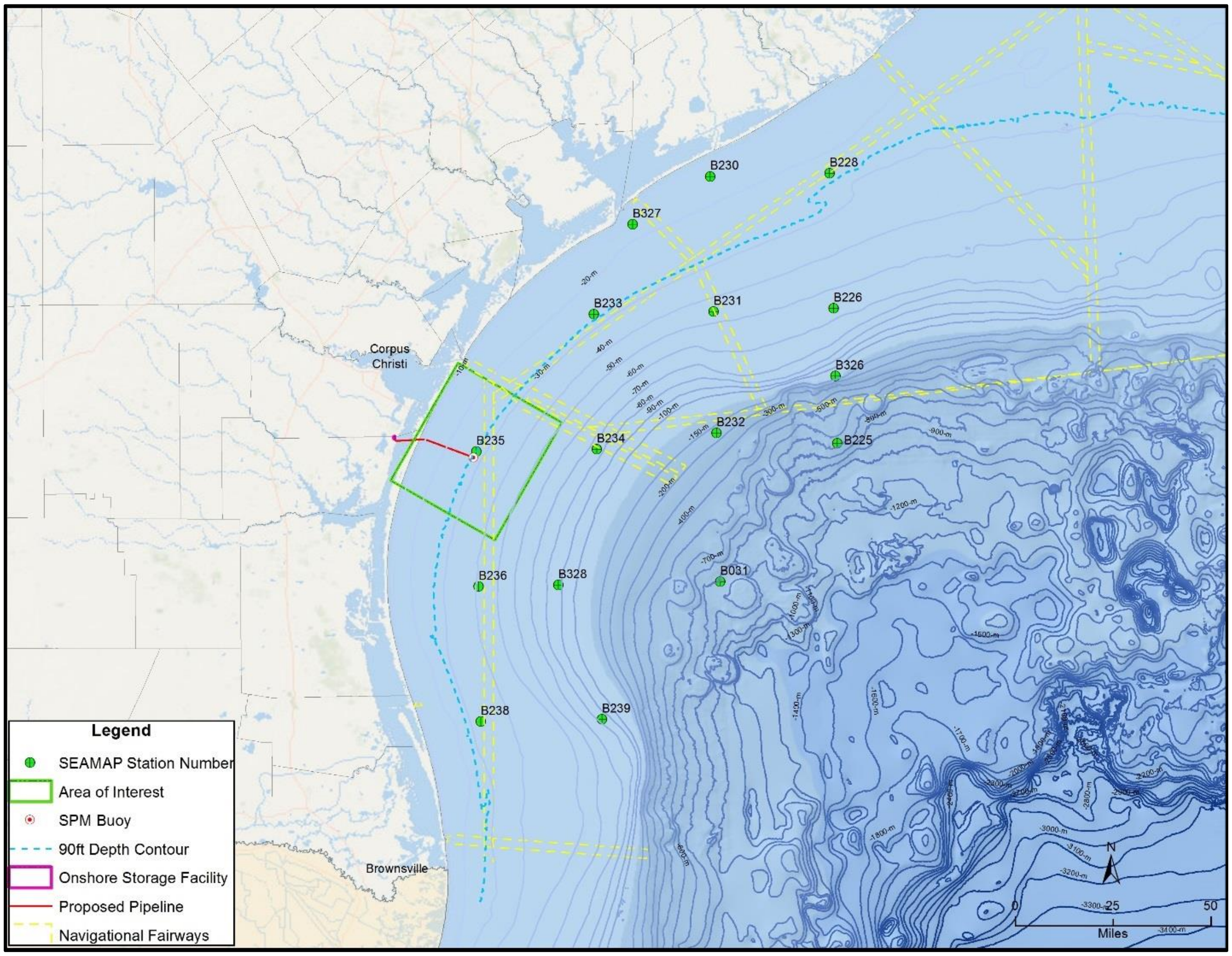


Figure 7-22: Location of SEAMAP Samples in the Vicinity of the Project Location

7.2.8 Other Terrestrial Species

7.2.8.1 Federally Listed Mammals

The terrestrial portions of the Project area would be inhabited by a wide variety of mammal species. Animals observed during site surveys included white-tailed deer, raccoon, bobcat, javelina, feral hog and coyote. There are three mammals that are listed on the ESA, as shown in Table 7-14, and explained in the following sections.

Table 7-14: ESA-Listed Mammal Species Occurring Within the Project Area.

Common Name	Scientific Name	Status
Gulf Coast Jaguarundi	(*Herpailurus yagouaroundi cacomitli*)	Endangered
Ocelot	(*Leopardus pardalis*)	Endangered
West Indian Manatee	(*Trichechus manatus*)	Threatened

Ocelot, Leopardus paradalis
Current Federal Status: Endangered

Habitat and Range Requirements: The ocelot is a medium-sized, mostly nocturnal species, listed as endangered in 1982 because of extensive habitat destruction and past predator-control operations in Texas. The species historically ranged throughout south Texas, Mexico, Central America, and South America (Tewes and Schmidly 1987, USFWS 2010, Navarro-Lopez et al. 1993). With the conversion of brush habitat in southernmost Texas and past predator-control operations, known populations are currently restricted to two disparate aggregations in Willacy and Cameron Counties with population sizes of less than 50 individuals (Campbell 2003, Janečka et al. 2011) (Figure 7-22). One aggregation is in Cameron County and is contained in and around the Laguna Atascosa NWR. The other is a smaller group of ocelots present in northern Willacy County on the privately owned Yturria Ranch (Navarro-Lopez 1983, USFWS 2010a). Both aggregations occur over 50 mi (80 km) south of the proposed Project (Figure 7-22).

Ocelots prefer habitat which consists of dense Tamaulipan thornscrub and woodland habitats with > 75 percent canopy cover, and dense ground cover interspersed with some alkali sacaton grasses, and canopy height > 6 ft. (10 m) (Tewes and Everett 1986, Simpson 2010). They may also prefer palustrine scrub-shrub or densely vegetated riparian corridors. Greater plant species richness and greater plant densities were positively correlated with the ocelot's habitat preferences (Simpson 2010).

Determination of Impact: The Project area does not contain suitable habitat for the species. In addition, the two known populations are well over 50 mi (80 km) away from the Project. Consequently, there are *no anticipated effects* of the Project's activities and environmental consequences on the ocelot.

Gulf Coast Jaguraundi, Herpailurus yagouaroundi cacomitli
Current Federal Status: Endangered

Habitat and Range Requirements: The Gulf Coast jaguarundi is a small, secretive cat listed as endangered in 1976 (41 FR 24062–24067). Within the U.S., jaguarundis historically occurred primarily in dense thorny scrublands in Cameron, Hidalgo, Willacy, and Starr Counties, Texas (USFWS 2013) (Figure 7-22). Because of its secretive nature, its status and distribution within its historic northern range limits in the Lower Rio Grande Valley of southern Texas are poorly known. Approximately 95 percent of lands that formerly contained brushy habitat in southernmost Texas have been converted to agriculture. This loss of habitat poses the greatest threat to existence of the jaguarundi in Texas (Campbell 2003) (Figure 7-22).

The nearest currently known population of Gulf Coast jaguarundis lies approximately 150 mi (241 km) away in Tamaulipas, Mexico (USFWS 2013). Few occurrences have been documented in Texas, with only three sightings of this species since 1993 (SpaceX Biological and Conference Opinion [SpaceX] 2013).

Determination of Impact: The Project area is dominated by estuarine intertidal emergent vegetation communities, as the Project route will cross through coastal marsh and barrier islands. These areas possess salt-tolerant species and aquatic invertebrate fauna, but otherwise do not provide habitat for the prey species targeted by the jaguarundi. Consequently, there are *no anticipated effects* of the Project's activities and environmental consequences on the jaguarundi.

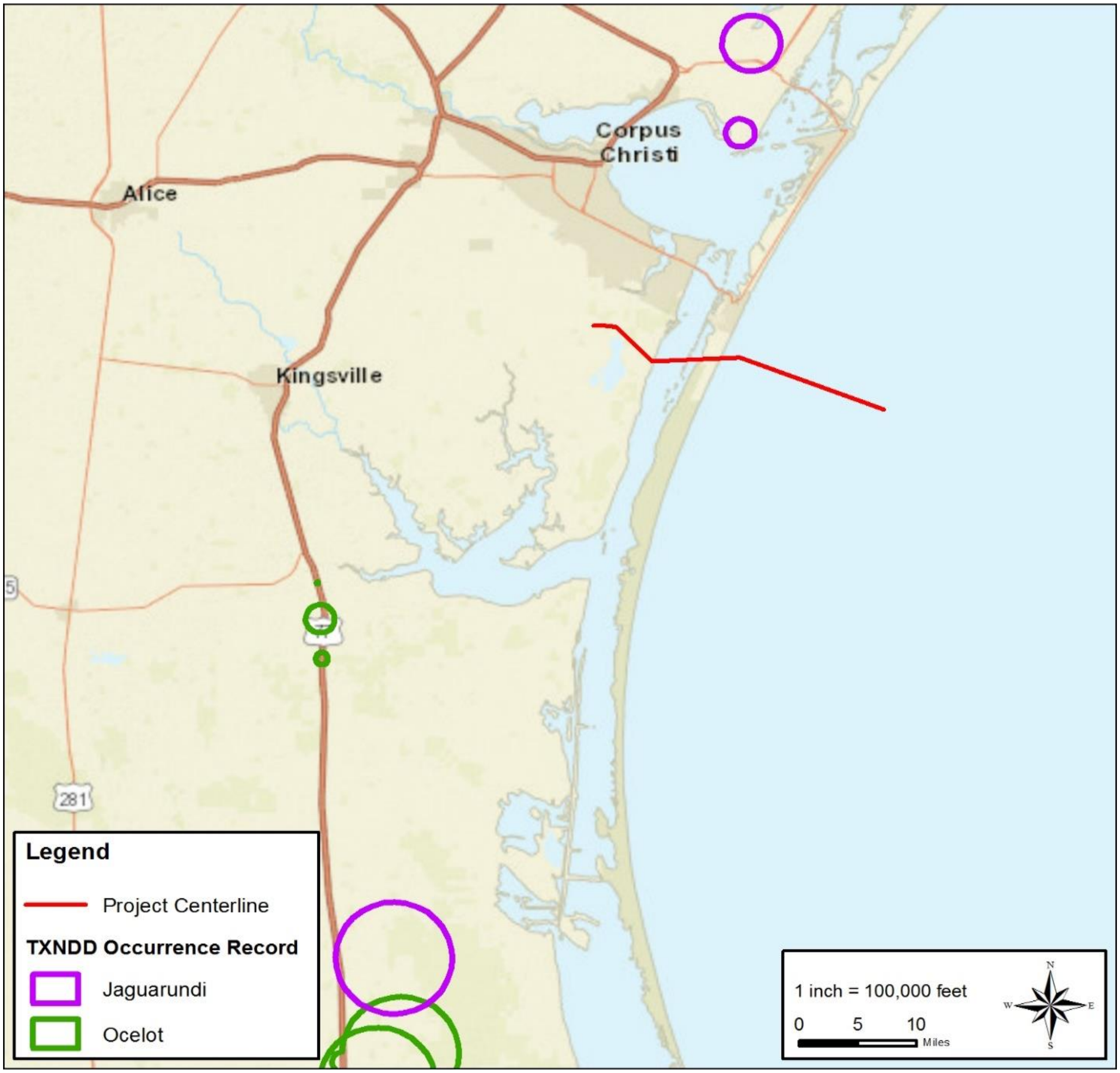


Figure 7-23: TPWD Occurrence map for Jaguarundi and Ocelot

7.2.8.1 Federally Listed Plants

There are three federal listed plant species listed for Kleberg and Nueces County, Texas, as shown in Table 7-15 and discussed in the following sections.

Table 7-15: ESA-Listed Plant Species Occurring Within the Project Area.

Common Name	Scientific Name	Status
Black Lace Cactus	*Echinocereus reichenbachii var. albertii*	Endangered
Slender Rush Pea	*Hoffmannseggie tenella*	Endangered
South Texas Ambrosia	*Ambrosia cheiranthifolia*	Endangered

Black Lace Cactus, Echinocereus reichenbachii var. albertii
Current Federal Status: Endangered

Habitat and Range Requirements: Black lace cactus is usually solitary stemmed, sometimes 5 to 12, cylindroid 7.5 to 15 cm long, 2.5 to 5 cm diameter, having 12 to 18 ribs. The black lace cactus was listed in 1979 as endangered. Historical range included counties in South Texas including the Project area. No critical habitat has been designated. The black lace cactus has three known populations located on private lands in Refugio, Jim Wells, and Kleberg Counties (USFWS 2009c) (Figure 7-24). It is not known to occur within the Project area.

Determination of Impact: The Project should have *no anticipated effects* on the black lace cactus due to lack of preferred habitat on North Padre Island.

Slender Rush Pea, Hoffmannseggie tenella
Current Federal Status: Endangered

Habitat and Range Requirements: Slender rush-pea is an herbaceous perennial plant identified by a long slender taproot, spreading stems and alternate bi-pinnately compound leaves. There are five small yellow-pink to reddish orange petals per flower, which bloom in the spring a summer.

Slender Rush Pea has been federally listed as Endangered since 1985. Its historical range included South Texas including the Project location in Kleberg County (Figure 7-24). No critical habitat has been designated. Currently there are eight known extant population sites in Texas, none of which are located on Padre Island or within the Project area (USFWS 2008b).

Determination of Impact: The Project may disturb potential slender rush-pea habitat during construction activities; however, since no individuals or critical habitat were identified within the proposed Project area, the Project should have *no anticipated effects* on the slender rush-pea due to lack of potential habitat on North Padre Island.

South Texas Ambrosia, Ambrosia cheiranthifolia
Current Federal Status: Endangered

Habitat and Range Requirements: South Texas Ambrosia is an herbaceous, rhizomatous perennial that stands erect to approximately 10 cm to 60 cm. Leaves are opposite below, alternate above, sessile, oblanceolate to oblong-lanceolate. Flowers are dioecious and raceme-like with yellowing florets (USFWS 2010b). The species has been listed as endangered since 1994. No critical habitat has been designated.

According to the USFWS, there are seven extant or presumed extant population of South Texas Ambrosia in north-central Kleberg County and central Nueces County (Figure 7-24). The species is not known to occur on Padre Island; therefore, it is not known to occur within the Project area (USFWS 2010b).

Determination of Impact: The Project should have *no anticipated effects* on the South Texas ambrosia due to lack of preferred habitat on North Padre Island.

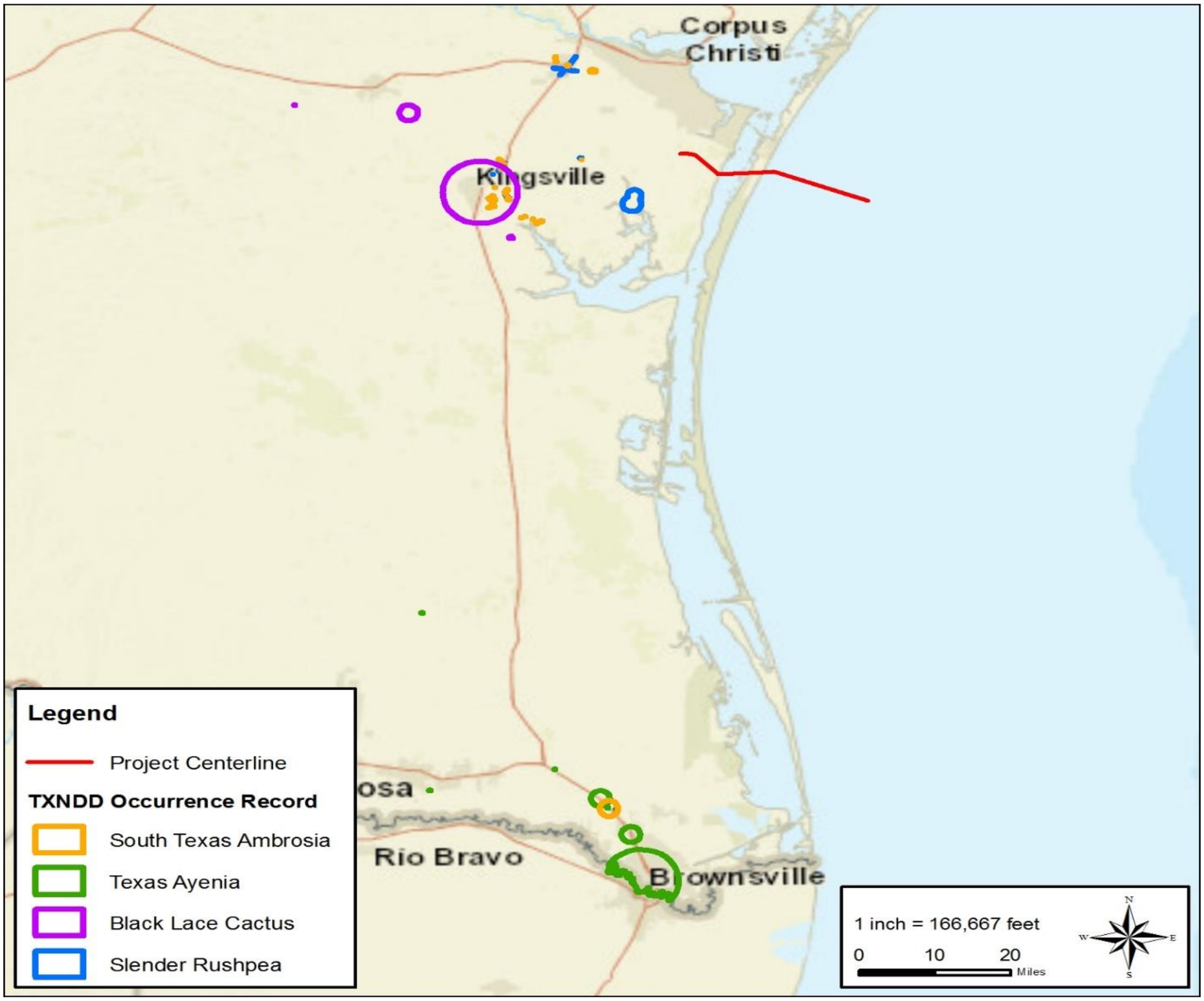


Figure 7-24: TPWD Occurrence Map for Rare Flowering Plants

7.2.9 Invasive Species

7.2.9.1 Onshore

Feral Hogs, Sus scrofa

One of the most widely distributed invasive species on the planet, with domestic, wild, and hybrid variations found on all continents except Antarctica, *Sus scrofa* is responsible for 1.5 billion dollars of crop damage in the U.S. alone (Garza et al. 2017). In addition to their destructive habits, they are thought to be of extreme veterinary significance as a source of pathogens to other livestock as well as a threat to public health (Jay-Russell et al. 2014).

Feral hogs generally reach heights of about 36 inches at the shoulders and can weigh between 100 to 400 lbs., however they can be larger in rare cases where they are not far removed from a state of domestication. They can vary wildly in coat pattern and color with mixtures of solid black, red, brown, or white and patterns such as spots, mottling, belting, or grizzled. A defining characteristic of wild hogs are the protruding anterior incisors known as elodont on the upper and lower mandibles (Steenkamp 2003). These tusks are in a continuous state of growth and can be very large, contributing to the desire as a trophy for hunters. The upper tusks act as a natural whetstone for the lower tusks. The opening and closing of the mandibles lead to the sharpening of these tusks, which are used against rival conspecifics, prey, and predators. In addition to defensive uses, the tusks are also used for marking trees and as levers for lifting stones and other heavy objects to locate food items (Briedermann 1990).

Wild hogs are considered some of the most widely distributed animals in the world, naturally spanning from Western Europe to Southeast Asia. Invasive hogs or feral hogs have been introduced to North America, South America, Australia, and New Zealand (Massei et al. 1992). Thought to have been introduced by the Spanish into the U.S. as a source of food around the 16th century, the wild boar, originated in Europe and Asia. In Texas, they were first introduced by LaSalle in the year 1665 (Tolleson et al. 1995), but in the early 1800's free ranging domestic pigs introduced by Texas colonists are theorized to be the origin of the feral hog in Texas (Taylor and Hellgren 1997). Due to prolific breeding, the feral hog has spread quickly throughout much of the lower half of the country and has an estimated population of over 5 million individuals. Feral hogs have colonized currently 40 states. States that are being heavily impacted by feral hogs include Georgia, South Carolina, Florida, Alabama, Mississippi, Louisiana, Arkansas, Texas, Oklahoma, and California. Recent years show that feral hogs are spreading north along the East and West coast of the country. In Texas, the areas with the densest populations are East, South and Central Texas. Until recently, the counties in the Northwest portion of the state had been spared from impact; however, populations are beginning to expand to these areas (Tolleson et al. 1995). In Texas alone, it is estimated that there are more than 2 million individuals (Franckowiak and Poche, 2017).

Relatives of pigs, javelina, or collared peccary, are members of the family Tayssuidae, which are pig-like animals in the order Artiodactyl that are restricted to the Western hemisphere (Dutra et al. 2016). Javelina resemble wild hogs in many ways and can be seen in the same habitat as feral hogs. Javelina are native to the U.S. and Texas. They are often seen traveling in bands of up to 45 individuals in areas of thick brush, prickly pear, and scrub oak most associated with South Texas, Trans Pecos, and the Edwards Plateau (Schmidly 2004). Feral hogs are much larger and lack the coarse collar around the neck that is associated with collared peccary. Wild hogs weigh between 100 and 400 lbs., whereas javelina are much more modest and compact, and are limited to between 30 and 55 lbs. (Schmidly 2004). About half of the diet of javelina are made up of members of the genus *Opuntia*, known as prickly pear, which also provides a large portion of the water requirements of peccary in the area (Hanselka and Pashal 1991). Feral hog can be seen also foraging on prickly pear in the same manner as javelina (Mapston 2010).

Feral hogs are habitat generalist that outcompete our native species for food. They flourish in dense vegetated bottomland areas near water sources such as creeks, ponds, tanks, and drainages. Hogs also tend to spend more time in agricultural areas during the night and crepuscular periods than during daylight hours (Franckowiak and Poche 2017). They have also shown to be successful in drought prone environments. During the warm months of the year, they can often be found wallowing in areas with mud and shallow water. The home range is typically under 5,000 ac (2,023 ha), however, large boars can have a much larger range.

7.2.9.2 Terrestrial Plants

Texas Department of Agriculture (TDA) and U.S. Department of Agriculture (USDA) both maintain lists of invasive plants occurring in Texas and potentially in the Project area while TPWD maintains a list of Prohibited Species. Some plant species occur on both lists while others do not. The Noxious and Invasive Plants named by the TDA are found in the Texas Administrative Code (**Tex. Admin.Code § 19.300**). The current lists have 26 species as "Noxious" and 4 listed as "Invasive." The USDA utilizes the National Invasive Species Information Center to maintain list of invasive plant species. There are currently 51 species of terrestrial plants on the list and 16 aquatic species. In an effort to narrow the list and determine which, if any, of the known invasive species have the potential to occur in the Project site, lists were compared to Texas Invasives' regional lists (Exotic and Invasive Species 2018a). Two regional lists were selected: Gulf Coast Prairies and Marshes and South Texas Plains. Each of the two regions have 12 species listed as particularly worrisome to their specific regions. Furthermore, maps of known and confirmed observations of each potential species were compared to Project area.

The list is a sampling and included species that are listed by both Federal and State agencies as noxious plants. Most of the listed species below have known documentation in Kleberg and neighboring Nueces County while others have documented sightings as close as the PINS. Freshwater invasive plants have also been included due to their potential for occurrence in the identified fresh water body on Padre Island within the proposed Project boundaries.

Chinese Tallowtree, Triadica Sebifera

A deciduous tree up to 60 ft. (18 m) tall but normally 30 ft. (9.1) native to China and Japan and now found throughout the Southeast including Texas. Usually found along stream banks, riverbanks and wet areas. The Chinese tallow thrives in freshwater and saline soils. They are flood tolerant, shade tolerant and allelopathic (Plants of Texas Rangeland 2018a). Chinese tallow out performs native species creating monospecific forests and thereby altering light availability for other species. Fallen tallow trees can contain toxins that create unfavorable conditions for native plant species (Jubinsky, 1995). Tallow trees are easily spread from seed dispersal by birds and water. There is a documented observation on the nearby PINS and several known sites inland on the Nueces/Kleberg county line. The Chinese tallow tree is currently listed a Noxious Weed by the TDA.

Giant Reed, Arundo donax

A tall perennial grass that can reach almost 20 ft. (6 m) in height. Rootstocks form compact masses from which tough, fibrous roots emerge that penetrate deeply into the soil. Giant reeds choke riversides and stream channels, crowds out native plants and can create a dangerous fire potential (AquaPlant 2018). It tolerates a wide variety of conditions including high salinity and can flourish in many soils types. Giant reed is currently listed as a Noxious Weed by the TDA.

Salt Cedar, Tamarix ramosissima

A native of Europe and Asia, saltcedar was introduced in the U.S. as an ornamental. It can tolerate extreme salinity. The saltcedar is a deciduous shrubs or small trees typically growing 10 to 30 ft. (3 to 9 m) tall and forming dense thickets growing in moist soils (Plants of Texas Rangelands 2018). The species spreads by adventitious roots or submerged stems and sexually. Each flower can produce thousands of small tufted seeds that aid in wind dispersal. Seeds can also be dispersed by water. Salt cedars are fire-resistant and have long tap roots that allow them to intercept deep water tables and outcompete native plant species (Plants of Texas Rangelands 2018b). Salt cedar is listed as a Noxious Weed by the TDA.

Guineagrass, Urochloa maxima

A tufted perennial grass with a short creeping rhizome and left blades tapering to a fine point. Guineagrass forms dense stands in open pastures and disturbed areas and is drought resistant. It can build a dangerous mass of plant material and cause fires to burn fiercer (Exotic and Invasive Species 2018b). As it survives fires through rapidly spreading underground rhizomes, it can quickly dominate after a fire (Plants of Texas Rangelands 2018b).

Brazilian Peppertree, Schinus terebinthifolius

A native of South America and introduced as an ornamental, Brazilian peppertree can reach heights of 30 to 40 ft. (9 to 12 m). This broadleaf evergreen small tree or shrub from well-laden intertwining dropping branches and foliage and is an active pioneer species. The species readily invades disturbed areas such as fallow fields, ditches, drained wetlands and roadsides (Gioeli and Langeland 19970). Peppertrees can from dense thickets shading out native grasses and shrubs. Seeds can be distributed by both birds and mammals. Its importation, sale and distribution is now prohibited. The species is a TPWD Prohibited Exotic Species and TDA Noxious Weed ().

Japanese honeysuckle, Lonicera japonica

A semi evergreen to evergreen woody vine often climbing high and trailing up to 80 ft. (24 m). It branches often and can cover forest canopies or under canopies. Introduced as a traditional ornamental, it was valued for erosion control and some wildlife forage (Langeland et al. 2008)USDA 2018). The plant grows and spreads by both vegetative means and by seeds. Dense infestations out compete native flora and persist through all kinds of sites through large woody rootstocks (Langeland et al. 2008).

Popinac, Leucaena leucocephala

Also known as lead tree, popinac is a shrub or small tree and is fast growing often reaching 25 to 50 ft. (8 to 15 m) in 20 to 40 years. Leaves are bipinnately compound and up to 10 inches long and have 11 to 17 pairs of leaflets. The species can form thick monospecific thickets and is difficult to eradicate once established. It favors alkaline and limestone soils and grows best in wet conditions. The species is a prolific seed producer and readily grows from seeds dispersed from rodents and birds (Exotic and Invasive Species 2018c).

Buffelgrass, Pennisetum ciliare

A perennial bunchgrass that forms thick mats and dense, usually stoloniferous root systems. Leaf blades are bluish-green in color and 3 to 30 cm long with soft hairs on the upper surface. Buffelgrass grows densely and crowds out native plants. Its dense roots prohibit seed germination of native plants. A native of Africa, Europe and Asia, it favors alkaline soils and does best in pockets of high nutrients and moisture (Exotic and Invasive Species 2018d).

Chinaberry, Tree Melia azedarach

A native of Asia and introduced as an ornamental, chinaberry is a deciduous tree up to 50 ft. (15 m) tall and having dark green lacy leaves and yielding yellow berries. This species outcompetes native species due to its high resistance to insects and pathogens. Its leaf litter alters pH creating poor conditions for some native plants and their seed germination. Chinaberry reproduces by both root sprouts and by seed dispersal – usually by birds. It is listed a Noxious Weed by TDA (Plants of Texas Rangelands 2018c,).

7.2.9.3 Inshore

Giant Salvinia, Salvinia molesta

Giant salvinia is a rootless aquatic fern that forms dense mats and floats on the water surface. Dense mats of salvinia shade out native aquatic species and reduce dissolved oxygen levels in the water. Agricultural water use is impacted due to obstruction of intake pipes. Recreational fishing and boating is hindered by the dense mats. Salvinia may reproduce by spores as other ferns do but generally reproduce by budding or broken stems. The plant spreads quickly and can double every 2 weeks. Giant salvinia thrives in slightly acidic fresh high nutrient warm slow-moving water. It has a low tolerance to salinity. Giant salvinia is listed as a Noxious Weed by both USDA and TDA. It is also a TPWD Prohibited Exotic Species (Exotic and Invasive Species 2018e).

Common water hyacinth, Eichhornia crassipes

A freshwater perennial herb found floating on the surface due to enlarged bulb-like petioles. Roots only extend into the soils when flowering. Hyacinth reproduces primarily through fragmentation and offshoots of branching stems. It alters native vegetation by limiting light penetrations and dissolved oxygen levels. Hyacinth also impedes boat traffic and obstructs water intake structures. This species is listed as TPWD Prohibited Exotic Species and a TDA Noxious Weed (Exotic and Invasive Species 2018f).

Water lettuce, Pistia stratiotes

Water lettuce strongly resembles a floating open head of lettuce with light green thick leaves. It can be found singly or in thick mats. Infestations can alter water ecosystems by blocking light penetration, reducing oxygen levels and restricting water flows. It can also aid in increased siltation and reduce spawning habitat for certain fishes. Water lettuce invades freshwater ponds. It is listed as a TDA Noxious Weed and Prohibited Exotic Species by TPWD (Exotic and Invasive Species 2018g).

Hydrilla, Hydrilla verticillata

A submersed freshwater perennial herb, Hydrilla can be rooted to the bottom in depths of 20 ft. (6 m) or more. It can be found in lakes, ponds, rivers and even roadside ditches. The species spread easily by fragmented stems and budding from left axils and is a very fast grower often filling the entire water column.

It is listed as Noxious Weed by both the USDA and TDA as well being listed a Prohibited Exotic Species by TPWD (Exotic and Invasive Species 2018h).

7.2.9.4 Offshore

Non-native fish, shellfish, and aquatic plants pose a threat to native species as they compete with existing species for available ecosystem resources. Generally, these species lack regional or natural enemies which would maintain normal population dynamics. Therefore, invasive species are able to easily multiply and overtake the environment. There are several known invasive species in the vicinity of the Project (TPWD 2018a).

One known marine invasive species within the GOM includes the brown mussel (*Perna perna*), which is believed to have entered the GOM and Texas waters via ballast water and/or within the hulls of marine vessels from other areas of the world. This species has spread from the coastline to platforms as far as 16 mi off of Port Aransas, and into the Lower Laguna Madre. The Australian spotted jellyfish (*Phyllorhiza punctata*) was believed to have arrived in the GOM by way of the Panama Canal during ship crossings and is a mass-producing species that eats algae, plankton, fish eggs, and small fish species. In some areas between Mobile Bay and the Mississippi River, they have been known to eat all existing zooplankton in the water column. Although not in the vicinity of the Project, the Asian green mussel (*Perna viridis*) and lionfish (*Pterois volitans*) have currently spread through Florida in the GOM. Lionfish are known competitors with snapper and grouper species and outcompete with these species for food sources (TPWD 2018b).

VLCCs may use ballast pumps to maintain appropriate draft levels and improve navigation; during loading at the SPM buoy system, ballast water would be discharged as the vessels are loaded with oil. If invasive species were transported in the ballast tanks, they could be introduced into the GOM. As required by Coast Guard Regulations under 33 Code of Federal Regulations (CFR) 151.2026, vessels equipped with ballast tanks must implement one of five options to control nonindigenous species in WOTUS. Examples of these strategies include retaining ballast water on board, minimizing discharge or uptake at certain times and locations, and exchanging ballast water with mid-ocean seawater. Ships that have operated outside of the U.S. Exclusive Economic Zone must either retain their ballast water on board or undergo a mid-ocean (> 200 nm [230 mi or 370 km] from shore/water depth > 6,561 ft. [2,000 m]) ballast water exchange in accordance with applicable regulations. The International Maritime Organization has adopted this regulation and requires each vessel to install and operate a ballast water management system. Other applicable laws, programs, and regulations require ships to limit the concentration of living organisms in ballast water; wash anchors and anchor chains to remove organisms at their point of origin; remove fouling organisms; and clean ballast tanks regularly. Because VLCCs would be subject to U.S. regulations to prevent the introduction of invasive species, impacts would be negligible.

7.3 Environmental Consequences

Construction, operation, and decommissioning of the proposed Project could result in impacts on the biological, chemical, or physical properties of the environment (seagrasses, water column, soft-bottom habitats, and *Sargassum*) that support the fish and wildlife species described above (Section 5: Inshore and Offshore Aquatic Environment). As proposed, the Project would include installation of approximately 26.8 mi (43.1 km) of dual, 30-inch-diameter pipeline and an offshore SPM buoy system located in 93 ft. (28 m) of water. Impacts on wildlife or protected species could occur due to components of the Project that are located onshore, inshore (Laguna Madre or North Padre Island), or offshore (seaward of North Padre Island) locations; those impacts are discussed below. Refer to Appendix A: Construction, Operation and Decommissioning Procedures, for a detailed description of techniques, procedures, and phases of the Project that were used to evaluated environmental consequences in the following sections.

The following sections address the potential impacts on taxa that could occur as a result of the Project. Impacts on EFH are specifically discussed in Appendix G.

Table 7-16: Impacts on Aquatic Habitats

Consequence-Producing Factors on Habitats	Habitats			
	Seagrasses	**Soft-bottom Habitat**	**Water Column**	***Sargassum***
Inshore Pipeline Installation	Temporary impacts from increased turbidity and sedimentation; Short-term disturbance/scouring, with removal of seagrasses at discrete locations	Temporary impacts from increased turbidity and sedimentation	Temporary impacts from increased turbidity	No expected impact
Offshore Pipeline Installation	No impact	No expected impact	Temporary impacts from increased turbidity and sedimentation;	No expected impact
Hydrostatic Testing of Pipelines	No expected impact	No expected impact	Temporary, negligible intake and discharge	No expected impact
DWP Pile-driving and Installation	No impact	Temporary impacts from increased turbidity and sedimentation; Permanent removal of 130 sq. ft.	Temporary impacts from increased turbidity and sedimentation;	No expected impact
Construction Vessel Operations	No expected impact	No expected impact	Negligible introduction of debris; minor impacts from regular discharges and inadvertent spills	Intermittent disturbance; possible but unlikely destruction
DWP Presence	No impact	Ongoing, localized, negligible scouring	Ongoing, localized, negligible turbidity	No expected impact
VLCC Water Use	No impact	No expected impact	Ongoing, negligible intake and heated discharge	Intermittent disturbance; possible but unlikely destruction
Support Vessel Mooring and Ancillary Operations	No expected impact	No expected impact	Ongoing, negligible intake and heated discharge	Intermittent disturbance; possible but unlikely destruction
Restricted Operations Zone	No impact	No expected impact	No expected impact	No expected impact
Inadvertent Product Release	No expected impact; release not anticipated	No expected impact; release not anticipated	No expected impact; release not anticipated	No expected impact; release not anticipated
Decommissioning	Temporary impacts from increased turbidity and sedimentation; Short-term disturbance/scouring, with removal of seagrasses at discrete locations	Temporary impacts from increased turbidity and sedimentation	Temporary impacts from increased turbidity and sedimentation	

7.3.1 Construction

Construction of the proposed Project has the potential to adversely impact terrestrial species through:

- Loss of wildlife habitat, and displacement of species, during construction and placement of the onshore facilities;
- Noise- and light-related effects resulting from construction activities;
- Increase in turbidity within waters adjacent to onshore construction;

- Alteration of surface contours; and
- Toxic effects from inadvertent spills from construction equipment at the site;

Construction of the proposed Project has the potential to adversely impact marine species through:

- Suspension of sediments during trenching, jetting, and anchor dragging, and other substrate-disturbing activities, resulting in increased turbidities and subsequent sedimentation;
- Smothering, crushing, and/or depauperation of localized benthic communities from construction activities and support vessel anchor placement;
- Entrainment and impingement of eggs/larvae and juvenile fishes, respectively, during pipeline hydrostatic testing and water intakes from VLCCs;
- Negative effects from inadvertent spills from construction and support vessels at the site;
- Noise-related effects resulting from construction equipment and vessels; and
- Increased vessel traffic, potentially resulting in vessel strikes of marine mammals.

7.3.1.1 Onshore Storage Terminal Facility and Pipeline Construction/Installation

Temporary onshore impacts would include loss of herbaceous wildlife habitat, including wetlands, native upland, dunes, and coastal vegetation communities during construction of the onshore storage facility as the vegetation is removed and converted to industrial use. Some permanent loss of PEM (herbaceous) wetlands and upland vegetation communities are also possible dependent on permanent structure locations including any permanently maintained rights-of-way (ROW). Impacted wildlife communities would include those that use upland areas, coastal dune areas, and the identified wetland areas onshore and across Padre Island.

Depending on construction methods and locations, these impacts could be either temporary or long-term. Usage of HDD techniques will completely bypass some areas and thereby omit any impacts. Development of the construction ROW, access roads, temporary workspaces (TWS) and equipment staging areas are short term until construction is complete. Following construction these areas will be allowed to revegetate following restoration measures. Activities associated with construction could also impact local water turbidity and sedimentation. With removal of vegetation, topsoil and alteration of surface contours, some local and short-term effects to the wildlife habitat are expected. Minimization of these effects with usage of silt fencing, mats, hay bales and an approved Storm Water Prevention Program (SWPP) can be achieved.

While unlikely, fuel spills would also be possible during the construction. Onshore and across Padre Island these impacts are minimized with the use of a Spill Prevention, Control, and Countermeasure (SPCC) Plan. Additional impacts during construction are also noise and light emissions from equipment and activities. Noise emissions from construction, drilling, and vehicular traffic and equipment operations can possibly impact some species of fauna. Similarly, light emissions from night construction activities can possibly affect fauna, especially avian species.

In the event of an inadvertent return during HDD activities, the Project's will employ the Inadvertent Returns Contingency Plan, which will be approved prior to initiating HDD installation. The objective of this plan is to minimize the impact of a potential inadvertent return of drilling muds during HDD operations by planning, early detection, and adequate containment of the HDD mud. Construction of the proposed Project could result in both temporary and permanent impacts to onshore communities.

7.3.1.2 Inshore Pipeline Installation

The Inshore Pipelines will be constructed across the Laguna Madre using a combination of the HDD method and jetting where trenching is needed. HDD construction methods result in impacts at the entry and exit points of the drill, but typically avoid impacts between the two points, whereas trenching results in an open ditch along the seafloor where the pipelines would be placed. The Project would entail crossing both the mainland shoreline (by the onshore storage facility) and the landward shoreline of Padre Island, as well as a series of small islands/dredge placement areas adjacent to the Gulf Intracoastal Waterway (GIWW) via

HDD, thereby avoiding impacts on the shorelines and islands (see Appendix A). As the floor of the Laguna Madre is generally covered in seagrass, seagrasses would be temporarily impacted within the footprint of the workspaces (See Appendix F for the Submerged Aquatic Vegetation Impact Analysis). No areas of hard bottom (i.e., oyster reefs or serpulid reefs) have been identified within 3.5 mi (5.6 km) from the landfall location of the Inshore Pipelines.

Although HDD construction generally minimizes impacts on sensitive resources, there is the potential for an inadvertent return of drilling fluids, during which HDD drilling mud forces through fractures in the overlying material and discharges to the surface. As the drilling fluid would follow the path of least resistance, fluids may come to the surface over the offshore pipelines, or in a nearby area. Although an inadvertent return is possible, HDD drilling mud is a benign, non-toxic substance composed primarily of bentonite clay. The substance is denser than seawater and would settle on the seafloor after discharge, resulting in the smothering of benthic organisms that are within the affected area. In the case of any inadvertent return, Texas Gulf Terminals would implement its Project-specific HDD Inadvertent Returns Contingency Plan, which includes measures to prevent, detect, and mitigate for inadvertent releases of drilling fluid.

Potential impacts on wildlife and protected resources resulting from trenching include direct take and habitat modification as well as indirect impacts via temporary increases in noise, turbidity, and suspended solid levels. Noise associated with construction is discussed in Section 7.3.1.3. Most fish species, as well as the bottlenose dolphins that occur in the Laguna Madre, are highly mobile and would likely leave the area during trenching activities. However, as the benthic community is generally less motile, it will likely be reduced in species richness, species abundance, and biomass through direct mortality. This would reduce the amount of prey available for fish species in the Project area; however, polychaetes and other similar species would quickly recolonize disturbed areas following construction. Through natural processes and rapid population growth, these species take advantage of unoccupied space in newly exposed sediments (MMS 2004). Therefore, direct impacts of trenching on the benthic community will be negligible and short-term. The return of epibenthic organisms that live on seagrass would be delayed as the seagrass would need to re-establish prior to return of the epifauna that use it as habitat.

Indirect impacts would result from temporary increases in turbidity and suspended solid levels within the water column. Turbidity refers to the insoluble, suspended particulates that impede the passage of light through water by scattering and absorbing light energy, and as such, can reduce light penetration and the corresponding primary production of seagrasses, algae, and phytoplankton. Increased turbidity and suspended solid levels could also adversely affect fish eggs and juvenile fish survival, benthic community diversity and health, foraging success, and suitability of spawning habitat. Sediments in the water column could be deposited on nearby substrates, burying benthic invertebrates. Suspended sediments resettle following disturbance; coarser sediments generally fall out and resettle quickly, while finer sediments generally remain suspended for longer periods of time, and thus may travel farther from the Project workspaces. Because of the fine- grained characteristics of the substrate within the Laguna Madre, it is expected that suspended sediment may be in the water column for hours to days, at a maximum.

Impacts due to increased turbidity and suspended solid levels would vary by species and life stage. For example, planktonic life stages (eggs and larvae) of macrofauna are most likely to be directly affected by a temporary increase in turbidity and potential decrease in dissolved oxygen concentrations. They are less mobile and are therefore more susceptible to decreased habitat quality than more mobile juveniles and adults, which can move to more favorable areas. Increased turbidities during trenching and jetting would temporarily cause a reduction in predation efficiency for local fish. Effects of extended elevated turbidities have been shown to reduce feeding rates by 20 percent and to reduce the efficiency of fish foraging (Gardner 1981). If fish are required to forage for longer amounts of time to compensate for increased turbidity, they increase the probability of encountering predators (Gerritsen and Strickler 1977). It is expected that mobile nekton species will be displaced temporarily from the construction area but will return to the area almost immediately following construction. As previously discussed, the only marine mammal expected to occur in the vicinity of the Inshore Pipelines are specific estuarine stocks of bottlenose dolphins. Dolphins are highly mobile and are unlikely to be adversely affected by localized increases in turbidity and sedimentation. Section 3, “Water Quality,” discusses turbidity impacts as a result of construction activities.

Increased turbidity and sedimentation could also result in the resuspension of contaminated materials. Toxic substances and pesticides are discharged into GOM estuaries from industrial and municipal discharges, urban and agricultural runoff, accidental spills, and atmospheric deposition. These activities can often have adverse effects on estuarine and near coastal habitats. Chemicals that enter estuaries are often bound to suspended particulate matter that eventually deposit on the sediment surface (U.S. Environmental Protection Agency [USEPA] 1999). Construction activities, such as trenching could result in resuspension of these sediments in the water column, which could result in exposure of the local flora and fauna to harmful substances. In some waterbodies, disturbance of sediments may cause a temporary increase in contaminants including metals, pesticides, polycyclic aromatic hydrocarbons, and polychlorinated biphenyls (USGS 1999). Toxic chemicals, such as heavy metals, can affect both ecological and human receptors because they may become biomagnified as they are stored in animal tissue and transferred through the food chain (USEPA 1999). Although sediments in the Project area may contain various organic or inorganic compounds, the predicted short-term exposure would not result in negative effects to biological receptors. Negative biological effects to biota from exposure of entrained contaminated sediments would only be important if exposure, and thus bio-uptake, is of a chronic or long-term nature. The potential for direct and indirect adverse impacts on marine taxa within the Project area would likely differ from species to species, depending on life history, habitat use (demersal vs. pelagic), distribution, and abundance. However, it is anticipated that impacts on aquatic resources within Laguna Madre would be limited to temporary displacement during installation of the pipelines.

7.3.1.3 Offshore Pipeline Installation

The most sensitive portion of the offshore pipeline route is near shore, where it passes through shallow water and makes landfall on Padre Island. To avoid impacts on the coast of the barrier island, which includes wetlands and sensitive coastal dune habitat, the Offshore Pipelines will be installed by HDD at this location.

The Offshore Pipelines will cross soft-bottom habitats beginning at the seaward boundary of PINS (about 0.7 mi [1.1 km] from shore at the terminus of HDDs 4A and 4B) to their interconnection with the SPM buoy system about 14.7 mi (23.5 km) offshore. Offshore pipeline installation will be completed using a submersible pipeline jetting sled operated from an anchored pipe-laying barge and will occur over a 3.5-month period. The pipelines will be buried a minimum of 5 ft. (2 m) below the sediment surface. Operation of the sled will redeposit some material over the pipeline, but full backfilling will occur naturally. Similar to the inshore pipelines, installation of the proposed offshore pipelines in soft-bottom habitat will produce a turbidity plume within the immediate vicinity of construction. The resultant suspended sediments have the potential to affect benthic infaunal or epifaunal organisms (including deposit or filter feeders) in its path. Because the marine soft-bottom habitat is highly variable and experiences frequent natural disturbances, any disturbance to the seafloor environment will have an initial impact, but the affected habitat should recover rapidly (generally less than 1 year, although possibly up to 3 years) by recruitment from the surrounding community (Brooks et al. 2004). Therefore, impacts are anticipated to be minimal and short-term. As noted above, nekton and marine mammals are highly mobile and can avoid areas of increased turbidity; therefore, turbidity impacts are not anticipated for mobile nekton species (including most fish) and dolphins.

Sediments along the continental shelf of the GOM generally consist of riverine sediments of the Mississippi River Delta as well as terrigenous muds and sand. Sediments are an important component of the offshore environment; however, the presence of elevated concentrations of contaminants within these sediments can significantly impact organisms and offshore ecosystems (Byrnes et al. 2017). Contaminant bioavailability is dependent on sediment characteristics, including concentrations of total organic carbon and acid-volatile sulfide (USEPA 1999). Chemicals commonly found in the northern GOM that may have negative biological impacts include heavy metals such as lead, mercury, arsenic, cadmium, silver, nickel, tin, chromium, zinc, and copper. Other known compounds which may impact the offshore environment include polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and pesticides. Some chemicals are acutely toxic, resulting in death of the animal; others may have chronic toxicity effects, affecting growth or reproduction. As described above, toxic chemicals can affect both ecological and human receptors as they bioaccumulate and are transferred through food chains (USEPA 1999). Construction activities such as jetting and anchoring would result in the re-suspension of sediments in the water column for a period of time. Disturbance of these sediments could result in temporary exposure of marine species to concentrations of harmful chemicals such as those listed above, which could accumulate in ichthyoplankton and other marine species. Known sediment contamination does not occur in the Project area. However, as described above, increased turbidity would be short-term and negligible; the limited exposure is not anticipated to result in a significant impact on most species.

7.3.1.4 Deepwater Port Pile-driving and Installation

The seafloor in the offshore Project area is a soft bottom environment, comprised of sand in areas closer to shore and under-consolidated mud in areas further offshore. As previously discussed, no hard bottom habitat is present within the Project area. To minimize impacts associated with offshore construction, the SPM buoy system and associated components will be fabricated onshore and delivered to the site by barge. Similarly, six anchor piles will be prefabricated on land prior to installation by industry acceptable practices at the offshore location. Once installed, the anchor chains will be attached to the piles, and subsequently to the SPM buoy. In addition, four PLEM foundation piles will be prefabricated on land and installed offshore to anchor the PLEM to the seafloor. These construction activities will be of limited duration and are not anticipated to cause long-term adverse effects to the biological community.

Approximately 130 sq. ft. of soft-bottom habitat will be permanently removed within the footprint of the SPM buoy system components. Any non-motile fauna in the footprint of the SPM buoy system will be lost during installation. Mobile organisms that are displaced during construction are expected to quickly return following construction. With the exception of the benthic community underlying the SPM buoy system's footprint, the benthos is expected to rapidly recover following construction (Brooks et al. 2004). Impacts beyond the permanent footprint of the Project are anticipated to be short-term. One potential benefit associated with installation of the SPM buoy system is its potential to function as artificial hard-bottom, providing a surface area for epifaunal colonization. As previously discussed, artificial reefs and 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.

Construction and installation of the SPM buoy system components will result in an increase in turbidity in the water column within and adjacent to the Project footprint; however, this effect is expected to be localized and limited to the time of facility placement. Deposition of suspended sediments in soft bottom habitats is expected to occur over a short distance from active construction and cover a small area relative to the total habitat available. Overall, the increased turbidity and sedimentation is considered a short-term and negligible impact given the extent of locally available soft-bottom and water column habitat.

Some installation activities will continue 24 hours a day and require continuous lighting. Lights in the form of navigational beacons will also be required. Although lighting may attract fishes, and their predators, to the construction area, resulting impacts are expected to be short-term and negligible.

Noise Effects

Temporary underwater noise during construction will result from installation of the pipelines (including vessel activity and trenching to bury the offshore pipelines after they are laid on the seafloor) and construction of the SPM buoy system (including vessel activity and pile-driving). Underwater noise may be generated by continuous sources, such as vessels in transit, and short, intense (impulse) sources, such as pile-driving. In addition, airborne noise generated by the Project could impact terrestrial wildlife and marine and coastal birds in the Project area; a detailed description of the airborne noise sources associated with construction of the Project is included in Section 12.

Fundamentals of Underwater Sound

As described in Section 12.2.3, sound is a physical disturbance in a medium, such as air or water, which can be detected by a human or animal ear. Sound pressure levels (intensity) are measured in units of decibels (dB) with respect to a reference pressure value on a logarithmic scale; the reference pressure in water is 1 micro Pascal (µPa) at 1 m.

Sound travels much faster through water than through air (about 1,500 meters per second [m/s] in water and about 330 m/s in air) (OSPAR Commission 2009). As sound spreads away from the source, the acoustic intensity is reduced. The difference between the measured sound pressure level at the source and at a receiver some distance away is known as transmission loss (OSPAR Commission 2009). The way that sound travels away from a source may be affected by water depth, bathymetry, salinity, and temperature (OSPAR Commission 2009).

The RMS sound pressure is the standard measurement used for continuous underwater sound (Hildebrand 2009). The RMS exposure level represents the effective pressure and intensity produced by a sound source; it is the square root of the average squared pressures over the duration of a pulse. Impulsive sounds, such as pile-driving, may be presented as the peak sound pressure level (the largest absolute value of instantaneous sound pressure). To measure exposure to a sound over time, cumulative SEL incorporate both the sound level and duration. The cumulative SEL measures the sound energy accumulated over a period of time.

Ambient Underwater Sound

Ambient underwater sound sources in the GOM (and Laguna Madre) include natural sources (such as wind-driven waves, fish, tidal currents, and marine mammals) and anthropogenic (man-made) sources. Anthropogenic underwater noise in the GOM originates from a variety of activities including shipping traffic, seismic surveys, explosions (such as from platform removal), and oil and gas production and development (BOEM 2012). Similarly, in the Laguna Madre, anthropogenic noise is generated by shipping traffic in the GIWW, as well as commercial and recreational fishing and boating activity. As with airborne noise, ambient underwater noise varies over time due to changes in the intensity and abundance of noise sources. In addition, noise generated from each of these sources may be transient, or may occur over an extended time.

Vessel traffic generates low-frequency sounds that can travel considerable distances; ambient underwater sound in the 10 to 500 Hz range is mostly due to vessel traffic (Tyack 2008, Hildebrand 2009). Ambient sound in the mid-frequency range of 500 to 25,000 Hz is primarily due to sound from breaking waves, bubble formation and collapse, and spray; the intensity of sound in this frequency range increases with wind speed (Tyack 2008, Hildebrand 2009). Higher frequency sounds attenuate quickly and are primarily generated by thermal sound, which is the sound of the random movement of water molecules (Hildebrand 2009). Biological sounds associated with a host of mammals, fishes, and invertebrates can generate noise in a broad frequency range, from 1 to > 100,000 Hz (Simmonds *et al.* 2004). For example, echolocation clicks of the bottlenose dolphin are in the high frequency range (110,000 to 130,000 Hz), while blue whales emit low frequency calls (10 to 15 Hz; Simmonds *et al.* 2004).

Noise produced by ships is the dominant source of anthropogenic sound in the sea (Tyack 2008). Vessel sound is primarily generated by propeller cavitation (the formation of air bubbles, followed by their collapse), propulsion machinery (engine noise), the flow of water over the hull, and flexing of the hull (Marine Mammal Commission 2007). Vessel traffic is concentrated along major commercial shipping lanes and near major ports, and sound generated by vessel traffic is transient at any given location. However, low-frequency sounds, such as those generated by large ships, can propagate great distances with little attenuation (Marine Mammal Commission 2007, Hildebrand 2009). Therefore, shipping sound contributes to ambient noise across ocean basins (Hildebrand 2009). Shipping lanes in the vicinity of the proposed Project are depicted in Figure 7-25; the nearest to the offshore facilities is about 2.9 mi (4.7 km) away from the SPM buoy system. Vessels in the Project area may include commercial vessels in the GOM travelling along shipping fairways or calling at the nearby Port of Corpus Christi (PoCC), commercial vessels travelling in the GIWW across the Laguna Madre, and smaller, recreational boats in both the Laguna Madre and the GOM. Vessel traffic is discussed in detail in Section 13: Navigation and Navigation Safety.

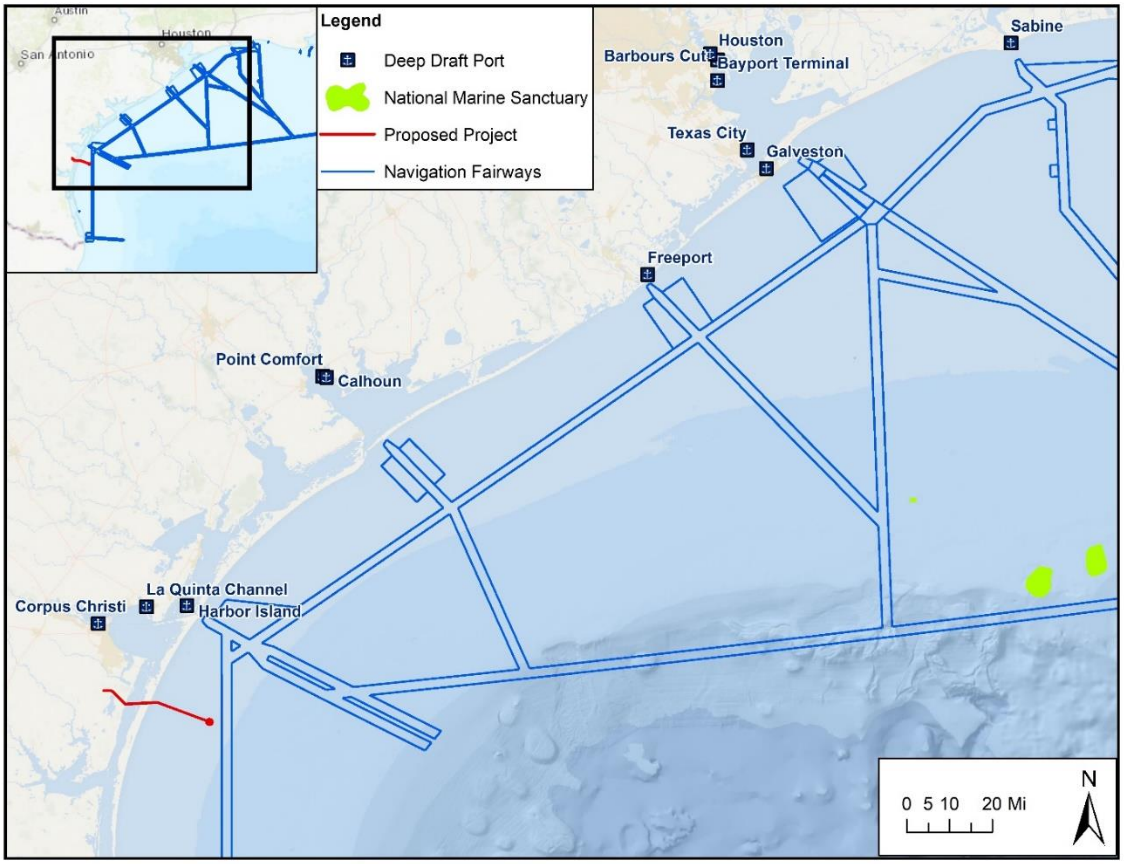


Figure 7-25: Navigation Fairways and Ports

The intensity of sound produced by vessels is generally greater for larger ships, and as vessel speed and load size increases. In addition, larger vessels produce sound in a lower frequency range than small boats. Typical sound levels range from 150 dB re: 1 µPa for tugboats to between 185 and 190 dB re: 1 µPa for a supertanker (Jasny 2005). The contribution of shipping to ambient noise in the ocean has increased by between 10 and 12 dB over the past few decades (McDonald *et al*. 2006, Andrew *et al*. 2002). While these data were not collected in the GOM, similar ambient noise increases have likely occurred due to global increases in commercial shipping (BOEM 2012).

While shipping is the predominant source of anthropogenic underwater sound, other sources may include marine seismic surveys, explosions, and oil and gas development (such as the operation of platforms). Marine seismic surveys use an air-gun or air-gun array to generate an energy wave that, when directed at the ocean floor, creates a pattern of reflected waves that map layers below the ocean surface. Sound generated by seismic surveys are in a range of 215 to 255 dB re: 1 µPa, with the majority of sound generated in the low frequency range, as summarized by Simmonds *et al.* (2004). The removal of offshore structures using explosions generates sudden, impulsive sound; peak broadband sound levels measured for underwater explosions are near 280 dB re: 1 µPa (Simmonds *et al.* 2004). While blasting is not planned for decommissioning of the proposed Project (see Section 8.4.3), the practice is used for other ongoing projects in the GOM.

Underwater sounds generated from the operation of fixed structures, such as oil and gas platforms common in the GOM, are estimated to range between about 20 and 40 dB above background levels within the low (30-300 Hz) frequency range at a distance of about 100 ft. (31 m) from the structure (Gales 1982). Since equipment is placed on above-water decks and the surface area of the platform in contact with the water is limited, underwater sound from platforms on metal legs is expected to be relatively low (BOEM 2012). Helicopters used to transport supplies and workers to offshore oil and gas facilities also generate underwater sound; however, most sound is reflected by the surface of the ocean and noise from helicopters is transient (Richardson *et al.* 1995). Underwater sound levels range from 101 to 109 dB re: 1 µPa, and helicopter sound has been documented to be detectible for less than 1 minute under water (Richardson *et al.* 1995).

NMFS recognizes the sound level for "effective quiet" or the safe exposure level at which risks for impacts on marine organisms are low (NMFS 2016). While defining the sound level of effective quiet for all species groups is not possible due to a lack of available data, we have assumed a conservative level of 150 dB re 1µPa SEL (NMFS 2017, NMFS 2016). While measurements of background sound levels are not available in the Project area, we assume that sound from construction of the Project below the 150 dB level of effective quiet would not harass marine organisms.

Continuous Noise

Installation of the pipelines in the GOM and Laguna Madre will be conducted by jetting or trenching, respectively, using a pipe laying barge and support vessels. Underwater pipeline installation will progress along the route such that construction at any one location is of short duration, and pipe laying may occur up to 24 hours per day. Underwater sound levels from pipe laying have been measured to be a mean of 130.5 dB re: 1 µPa at a distance of 0.9 mile (1.5 km); that measurement includes a pipe laying fleet of nine vessels and is similar to the sound levels generated by other commercial vessels (Johansson and Andersson 2012). Installation of the pipelines will require a pipe laying barge and 2 to 3 support vessels (including small water craft suitable for a beach landing and a material transport barge) and is therefore expected to produce a lower sound level. Underwater HDD activity and trenching the pipelines may cause transient underwater noise in the immediate vicinity of the pipelines; however, underwater noise will be limited to periods of active HDD installation or trenching. Sound levels associated with vessels used for underwater trenching have been shown to be similar to sound generated by other commercial vessels (Johansson and Andersson 2012). As described in Section 7.3.1.3, the Project is in an area subject to noise impacts by commercial vessels operating in the Intracoastal Waterway and shipping fairways in the GOM. Because the underwater sound levels associated with installation of the pipelines will be temporary, limited to the period of active construction, and consistent with similar activity in the Project vicinity, underwater noise impacts will be minor.

The most prevalent sources of continuous underwater sound associated with installation of the SPM buoy system will be the vessels used for construction, during construction activity and transit. Construction vessels will be in the 164 - 328 (50 – 100 m) size class, and sound levels for each vessel will likely range between 160 and 180 dB re: 1 µPa (Richardson et al. 1995, OSPAR Commission 2009).

Vessel traffic will temporarily increase during construction of the SPM buoy system for the transportation of supplies and construction crews over the 5-week-long construction period for the SPM buoy system and components. Given the amount of vessel traffic in the GOM, the noise associated with construction and supply vessels transiting to the offshore facilities will have a negligible contribution to total ambient underwater sound levels. Similarly, nearshore vessel activity will be generally concentrated in established shipping channels and near industrial port areas, and will be consistent with the existing noise environment in those areas. Therefore, impacts from and underwater sound due to Project construction, including vessel activity, will be negligible and are unlikely to affect biological resources in the Project area.

Impulsive Sounds

Pile-driving will be used for installation of six anchor piles for the SPM buoy system and four PLEM foundation piles, and will occur in depths of approximately 93 ft. (28 m). The intensity of sound produced during pile-driving is dependent on the material and size of the pile, depth of water, and method of pile-driving. A total of four 24-inch (0.6-meter)-diameter piles will be installed using an impact hydraulic hammer for the PLEM foundation; in addition, six 60-inch (1.5-meter)-diameter piles will be installed using an impact hydraulic hammer for the anchor piles. Pile-driving will occur over the 5-week installation timeframe for the SPM buoy system, and only one pile will be driven at a time. A detailed description of pile-driving and installation required for the Project is included in Section 1. While source levels were not available for 24- and 60-inch (0.6- and 1.5-m) -diameter concrete piles at water depths of 93 ft. (28 m) using impact pile-drivers, the most applicable source levels available are for 24-inch (0.6-m) -diameter steel pipes in water depths of about 49 ft. (15 m) and 60-inch (1.5 m) -diameter concrete cast in steel shell (CISS) pipes in water depths of about 16 ft. (5 m) (NMFS 2017).

Estimated underwater sound levels associated with pile-driving for the Project are presented in Table 7-10. These sound levels are less intense than the sound levels generated by air guns during seismic surveys, which range from 215 to 255 dB (see Section 7.3.1.3, Simmonds *et al.* 2004).

NMFS has established thresholds for physical and behavioral effects of underwater noise due to sound generated from pile-driving activity on fish, sea turtles, and marine mammals (NMFS 2017, NMFS 2016). Effects levels for marine mammals are based on hearing groups, which have different generalized hearing frequency ranges; low-frequency (baleen whales) and mid-frequency (dolphins, toothed whales, beaked whales, bottlenose whales) cetaceans could occur in the vicinity of pile-driving (NMFS 2016). Table 7-17 summarizes the Project-related pile-driving sound level impacts and these behavioral effects levels.

Table 7-17: Estimated Sound Levels from Underwater Pile-Driving and Effects Levels for Marine Species

Pile-driving Activity or Effect Level	Cumulative Sound Exposure Level (SEL) (dB re 1 μPa^{2}s)	Root Mean Square Sound Level (dB RMS) (dB re 1 μPA)	Peak Sound Level (dB re 1 μPA)
24-inch-diameter steel piles at 33 ft. (10 m) away	178	194	207
60-inch-diameter CISS piles at 33 ft. (10 m) away	185	195	210
Sea Turtles			
Sea Turtle Injury	--	180	--
Sea Turtle Behavioral Effects	--	166	--
Marine Mammals			
Low-frequency cetaceans (baleen whales)			
Injury (Temporary Threshold Shift for impulsive/non-impulsive noise)[a,b]	168/179	--	213/ --
Injury (Permanent Threshold Shift for impulsive/non-impulsive noise) [a,b]	183/199	--	219/ --
Mid-frequency cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)			
Injury (Temporary Threshold Shift for impulsive/non-impulsive noise)[a,b]	170/178	--	224/ --
Injury (Permanent Threshold Shift for impulsive/non-impulsive noise) [a,b]	185/198	--	230/ --
All species			

Pile-driving Activity or Effect Level	Cumulative Sound Exposure Level (SEL) (dB re 1 μPa²s)	Root Mean Square Sound Level (dB RMS) (dB re 1 μPA)	Peak Sound Level (dB re 1 μPA)
Marine Mammal Behavioral Effects (impulsive/non-impulsive noise)[a]	--	160/120	--
Fish			
Injury Onset (all sizes)	--	--	206
Injury Onset (>2 grams)	187	--	--
Injury Onset (<2 grams)	183	--	--

[a] Use of impact hammers is considered impulsive noise; other continuous sound is considered non-impulsive noise.

[b] The injury threshold is the general level for temporary or permanent threshold shift onset for cetaceans by hearing frequency group as identified by NOAA Fisheries (2016); however, threshold shifts are influenced by the frequency of noise received and a cumulative sound exposure exceeding this level may not cause a threshold shift if outside the range of hearing.

Source: NMFS 2017, NMFS 2016

By using a standard transmission loss constant to account for attenuation over distance, as defined by NMFS, a zone of influence (ZOI), the area in which pile-driving sound exceeds the thresholds, was identified for pile-driving related impacts on each species group (2017). The ZOIs were calculated using the estimated sound levels for 60-inch (1.5 m) -diameter piles, which will have a greater sound level impact than the smaller 24-inch (0.6-m) -diameter piles, and are therefore a conservative estimate of Project impacts. Table 7-18 identifies the distance at which sound levels from pile-driving would attenuate to the effects levels described in Table 7-17. Impacts by species are included below. Figures 7-26 and 7-27 depict the estimated ZOIs for injury and behavioral effects on sea turtles and marine mammals, respectively; Figure 7-28 depicts the estimated ZOIs for fish injury (based on approximate pile locations).

Table 7-18: Estimated Zone of Influence for Sound Levels from Underwater Pile-Driving for Marine Species

Pile-driving Activity or Effect Level	Zone of Influence for Impulsive Sounds (ft. [m])[a]		
	Cumulative Sound Exposure Level (SEL) (dB re 1 μPa²s)	Root Mean Square Sound Level (dB RMS) (dB re 1 μPA)	Peak Sound Level (dB re 1 μPA)
Sea Turtles			
Sea Turtle Injury	--	328 (100)	--
Sea Turtle Behavioral Effects	--	2,813 (858)	--
Marine Mammals			
Low-frequency cetaceans (baleen whales)			
Injury (Temporary Threshold Shift for impulsive noise)[b]	446 (136)	--	21 (6)
Injury (Permanent Threshold Shift for impulsive noise)[b]	46 (14)	--	8 (3)
Mid-frequency cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)			
Injury (Temporary Threshold Shift for impulsive noise)[b]	328 (100)	--	4 (1)
Injury (Permanent Threshold Shift for impulsive noise)[b]	33 (10)	--	2 (<1)
All species			
Marine Mammal Behavioral Effects (impulsive noise)	--	7,066 (2,154)	--
Fish			
Injury Onset (all sizes)	--	--	61 (19)

Pile-driving Activity or Effect Level	**Zone of Influence for Impulsive Sounds (ft. [m])[a]**		
	Cumulative Sound Exposure Level (SEL) (dB re 1 μPa^{2}s)	**Root Mean Square Sound Level (dB RMS) (dB re 1 μPA)**	**Peak Sound Level (dB re 1 μPA)**
Injury Onset (>2 grams)	24 (7)	--	--
Injury Onset (<2 grams)	45 (14)	--	--

[a] The ZOIs were calculated using the estimated sound levels for 60-inch (1.5 meter)-diameter piles.

[b] The injury threshold is the general level for temporary or permanent threshold shift onset for cetaceans by hearing frequency group as identified by NMFS (2016); however, threshold shifts are influenced by the frequency of noise received and a cumulative sound exposure exceeding this level may not cause a threshold shift if outside the range of hearing.

Source: NMFS 2017, NMFS 2016

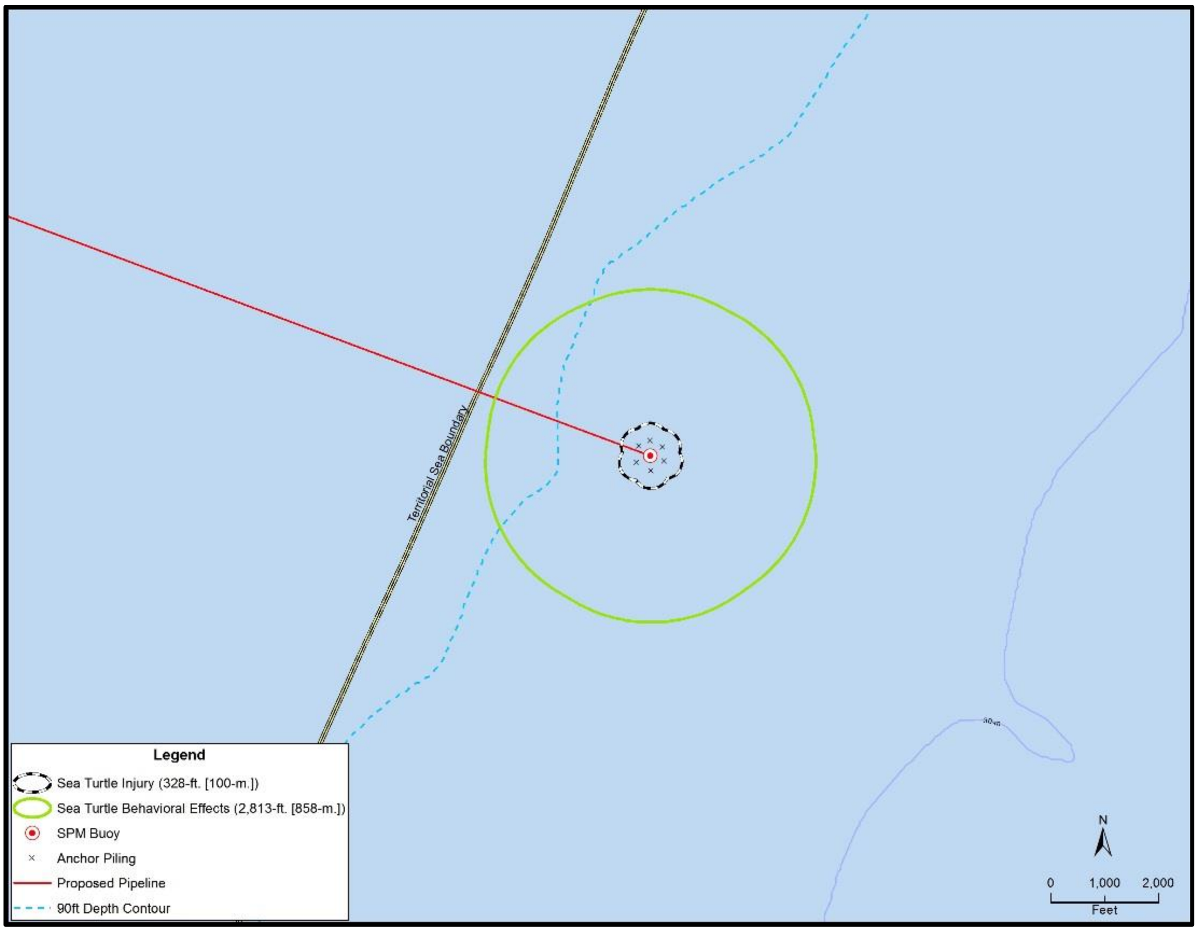


Figure 7-26: Zones of Influence for Effects on Sea Turtles due to Pile-Driving

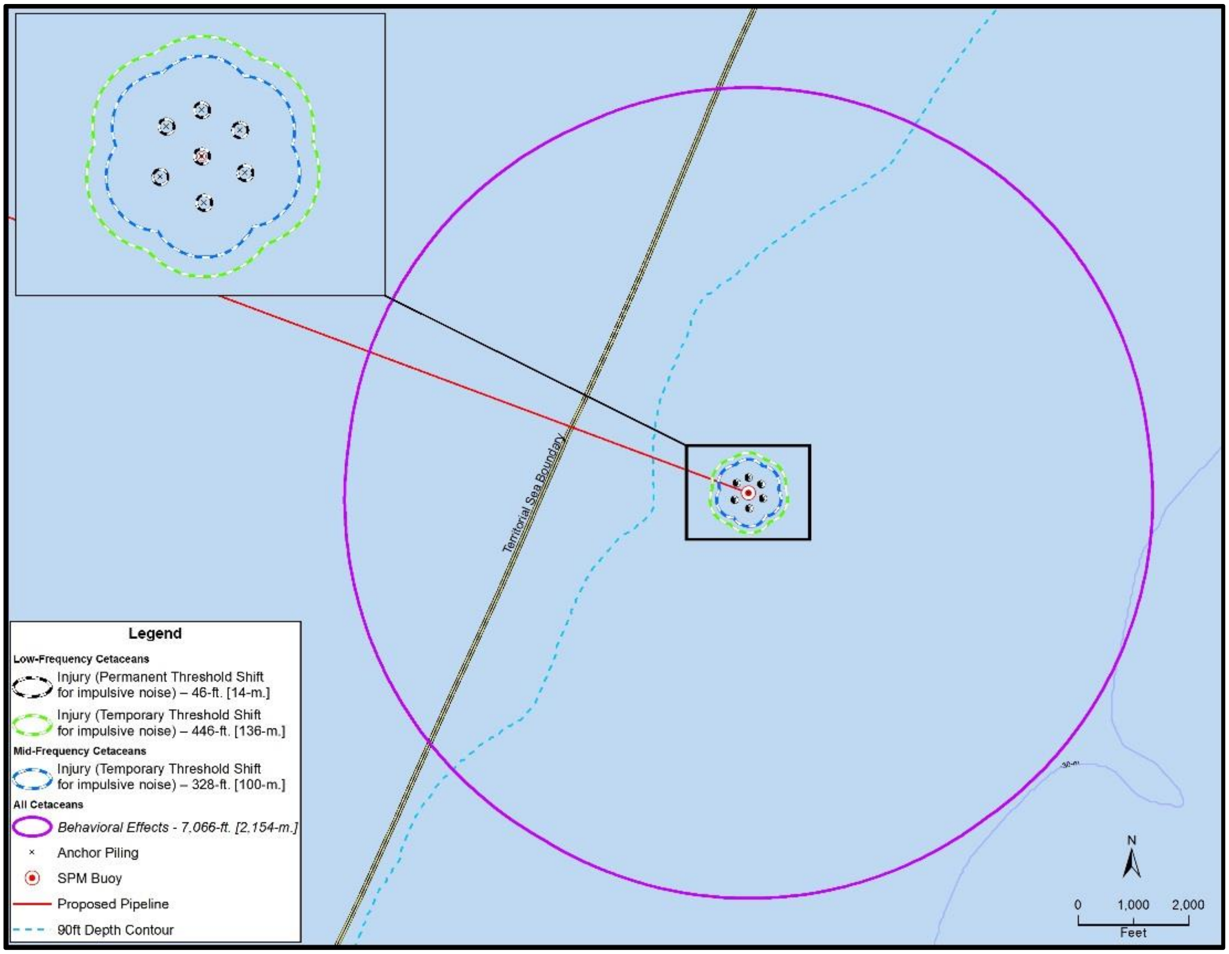


Figure 7-27: Zones of Influence for Effects on Marine Mammals due to Pile-Driving

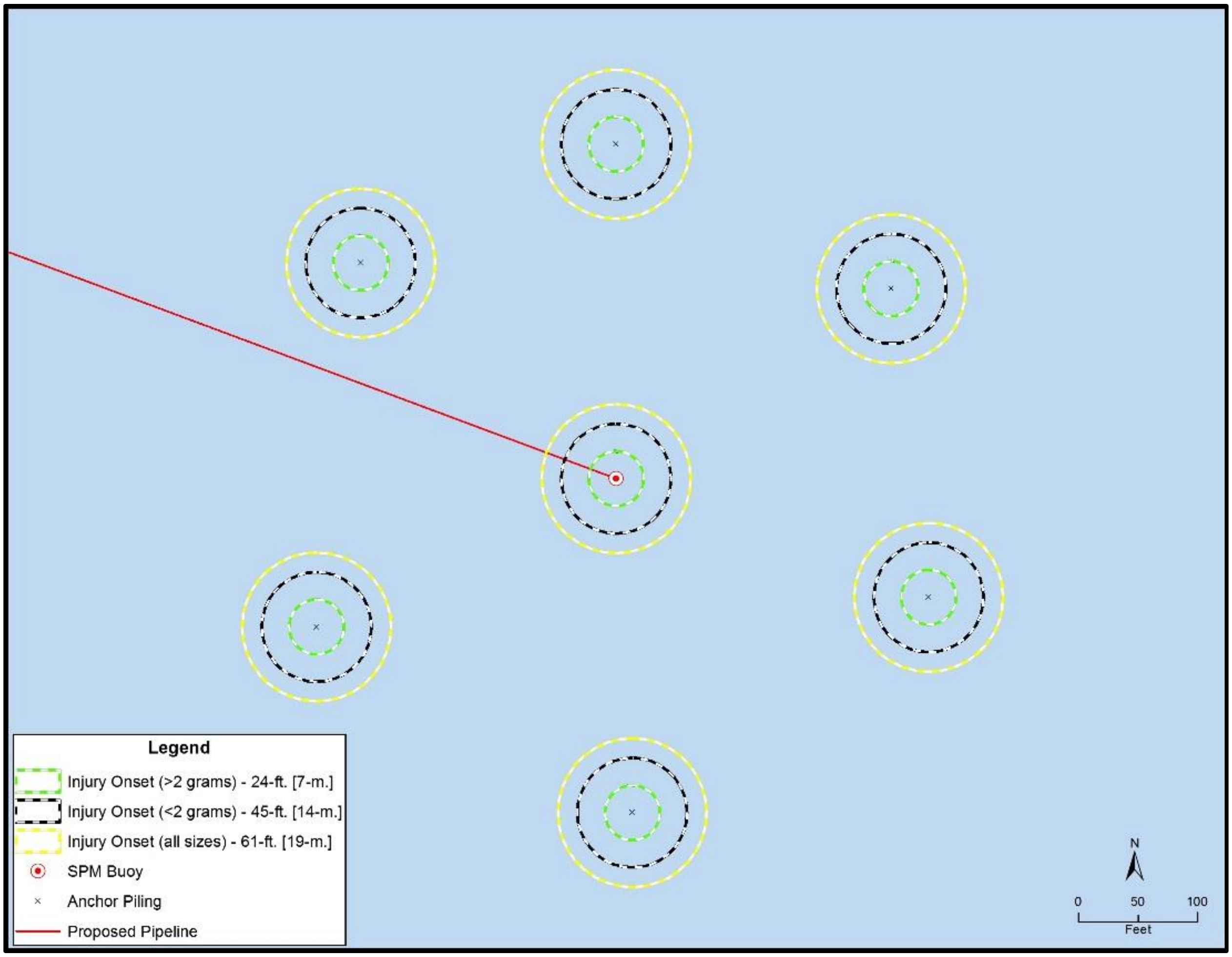


Figure 7-28: Zones of Influence for Effects on Fish due to Pile-Driving

Species-Specific Impacts

Installation of the proposed pipelines and SPM buoy system will result in an increase in airborne and underwater noise, which will be most pronounced at the sites of the HDDs, near Padre Island, and at the SPM buoy system, about 14.7 mi offshore. Sources of continuous noise, such as underwater pipeline installation and vessel activity, will have a negligible contribution to total ambient underwater sound levels, as described above. Noise from support vessels (and vessels in general) are dependent on the size and speed, with larger, faster vessels creating more noise (BOEM 2017). Although increases in underwater noise from transiting vessels could mask important biological sounds, they will be temporary in nature. Therefore, impacts from and underwater sound due to these continuous sources will be negligible and are unlikely to result in temporary noise levels that are injurious to marine species. However, impulsive sound from pile-driving will exceed thresholds established by NOAA for the protection of marine species, and impacts are addressed by species group in greater detail below. Sources and levels of airborne noise, which may affect marine and coastal birds, are addressed in Section 12.

Fish

As described in Section 7.2.2.1, sound from pile-driving that exceeds the injury thresholds may result in injury or mortality to fish. Pile-driving for the Project would produce peak sounds above the injury SEL threshold up to 45 ft. (14 m) from the source, and above the peak threshold at about 61 ft. (19 m) from the source. Noise-related disturbance resulting in behavioral effects could occur over a greater distance. As described above, this estimate represents a conservative, worst-case estimated of the ZOI since some of the piles that will be installed for the Project are of a smaller diameter than the 60-inch-diameter piles used in this analysis. In addition, the transmission loss constant used to estimate the ZOI may be conservative, since transmission loss depends on many physical factors including depth and bathymetry.

As estimated sound levels for pile-driving exceed the threshold for behavioral effects and injury to fishes, pile-driving activities could result in the mortality, injury, or disturbance of fishes that are present in the vicinity of pile-driving activity. Because pile-driving for the Project would be limited to the 5-week period required for construction of the SPM buoy system, and given the small size of the ZOIs, impacts are expected to be short-term and minor, and would not result in population-level effects.

Sea Turtles

Noise from pile-driving would be audible to sea turtles in the Project vicinity; potential physical and behavioral effects on sea turtles are described above. Noise created by pile driving at the SPM buoy system is expected to exceed the levels of behavioral and physical effects designated by NMFS for the protection of sea turtles (as described in Table 7-18).

By using a standard transmission loss constant of 15 to account for attenuation over distance, we estimate that the distance to the behavioral RMS level for sea turtles is about 2,813 ft. (858 m; NMFS 2017). The distance to the injury threshold is about 328 ft. (100 m). Texas Gulf Terminal will use of biological monitors during pile-driving activities and will cease pile-driving if a sea turtle is identified within the injury zone; pile-driving would not restart until the turtle had left the area of its own accord, thereby avoiding injury. However, sea turtles could be affected by pile-driving noise within the larger zone of influence for behavioral changes. Texas Gulf Terminals will ensure proper coordination with NMFS to identify what measures will need to be implemented during pile-driving to minimize non-injurious impacts on sea turtles

In addition to pile-driving, construction of the SPM buoy system may require helicopter transits between shore and the Project site. Helicopter overflights in close proximity to sea turtles may elicit a startle response and short-term disruption of behavior (BOEM 2017). These impacts are anticipated to be temporary and minor.

Marine Mammals

As described in Section 7.2.4.4, sound is important to marine mammals, and noise can result in a variety of behavioral and physical effects. Noise associated with pile driving can adversely affect marine mammals if the sound is very loud or occurs close to them. Noise from pile-driving would be audible to marine mammals in the Project vicinity. Noise created by pile driving at the SPM buoy system is expected to be approximately 185 dB re 1 µPa SEL without mitigation, which is above the levels of harassment and temporary injury designated by NMFS for the protection of marine mammals (as described in Table 7-10). In addition, the noise associated with pile-driving is above the level of permanent injury designated by NMFS for low-frequency cetaceans.

By using a standard transmission loss constant of 15 to account for attenuation over distance, we estimate that the distance to the behavioral RMS level for marine mammals is about 1.3 mi (2.2 km; NMFS 2017). The distance to the permanent threshold shift injury threshold of 183 dB for low-frequency cetaceans is about 46 ft. (14 m), while pile-driving noise is not expected to exceed the permanent injury threshold of 185 dB established for mid-frequency cetaceans. While the occurrence of large marine mammals in the Project vicinity is unlikely, dolphin species could occur in the Project area and, if present, could be affected (via temporary injury or harassment) by pile-driving noise. Texas Gulf Terminals will use biological monitors during pile-driving activities and will cease pile-driving if a marine mammal is identified within the injury zone; pile-driving would not restart until mammal had left the area of its own accord, thereby avoiding injury. As the zone of influence for behavioral effects is too large to be effectively monitored, Texas Gulf Terminals will ensure proper coordination with NMFS to identify what measures will need to be implemented during pile-driving to minimize non-injurious impacts on marine mammals.

Construction of the SPM buoy system may require helicopter transits between shore and the Project site. Helicopter overflights in close proximity to local dolphins may elicit a startle response, abrupt dives or turns, or other changes in behavior as the aircraft approaches (BOEM 2017). These impacts are anticipated to be temporary and minor.

Marine and Coastal Birds

Temporary increases in noise associated with installation of the Project facilities, including airborne noise from pile-driving, could result in temporary impacts on birds in the vicinity of construction. Because marine birds are highly mobile, they would likely avoid areas of active construction. Given the distance from shore, noise would not impact coastal birds. Therefore, impacts on birds from construction of the Project are anticipated to be temporary and minor.

7.3.1.5 Hydrostatic Testing

Once the pipelines are installed they would be cleaned using a cleaning pig and hydrostatically tested in accordance with the Department of Transport (DOT) safety standards at 49 CFR 192 and applicable permit conditions to verify their integrity and ensure their ability to withstand the maximum allowed operating procedure (MAOP). Hydrostatic testing would be conducted in segments and consists of capping the ends of a pipe section, filling the pipeline with water, pressurizing the pipeline, and maintaining that test pressure for a minimum of 8 hours. After testing is completed, the line will be depressurized and the water discharged. Any necessary chemical treatment of the hydrostatic test water prior to discharge would be in accordance with applicable permits. Hydrostatic testing of two 30-inch-diameter pipelines would require approximately 5.5 million gallons of seawater.

During hydrostatic testing, water would be pumped into the pipe and filtered through a 100-micron mesh screen (mesh opening = 0.0059 inches [0.15 mm]) to prevent debris and foreign material from entering the pipeline. The mesh screening is likely to preclude impingement/entrainment of larger and more mobile fish that could withstand the water withdrawal rates; however, ichthyoplankton and some juvenile fish may become entrained on/impinged on the screens. Any organisms entrained into the pipelines during hydrostatic testing are anticipated to be lost prior to discharge.

As previously discussed, NOAA's SEAMAP sampling stations near the proposed SPM buoy system location (see Figure 7-11) had an average of 14,746 eggs and 22,289 larvae in one million gallons of seawater; however, to be conservative, SEAMAP densities are generally multiplied by 3 to account for net extrusion. Therefore, using the adjusted, conservative egg and larvae densities, the use of 5.5 million gallons (20,820 m^3) of seawater would result in the loss of approximately 243,309 eggs and 367,768 larvae (all taxa combined). The loss of planktonic organisms associated with hydrostatic testing is not believed to result in a reduction in fish or prey species at the population level; therefore, the food web and fisheries populations will incur a negligible adverse impact through water intakes during construction.

7.3.1.6 Construction Vessel Operations

The presence of construction vessels traveling to and from the DWP components could affect the faunal community through vessel strikes, inadvertent spills of contaminants, and an increase in lost marine debris.

Increased vessel traffic increases the likelihood of collision between ships and marine mammals, resulting in possible injury or death to some animals. Most species of non-threatened and non-endangered marine mammals in the GOM are the smaller delphinids that often choose to ride the bow waves of nearby vessels and seem adept at avoiding injury. However, a study by Nowacek et al. (2001) identified changes in the behavior of bottlenose dolphins in the presence of vessels. These behavioral changes included longer interbreath intervals, decreased interanimal distance, changes in heading, and increased swimming speeds.

To minimize the potential for impacts on marine mammals, BOEM Notice to Lessees (NTL) No. 2016-G01, *Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*, will be followed by all Project construction and support vessels. The NTL states that a distance of 148 ft. (45 m) or greater should be maintained between vessels and the smaller cetaceans. The NTL also specifies reduced speeds of 10 knots when traveling near groups of cetaceans and a travel path parallel to that of the animals. In compliance with the NTL, vessel personnel will report any sightings of injured or dead marine mammals to the appropriate authorities. Given the high mobility of the dolphin species potentially occurring in the Project area, and with adherence to NTL No. 2016-G01, the increase in vessel traffic associated with Port construction is not expected to directly impact non-threatened and non-endangered marine mammals.

The increase in vessel traffic could also lead to additional pollution within the water column in the form of routine discharges and inadvertent spills. Although impacts on water quality from routine discharges will affect the marine water column in offshore environments, and the estuarine water column and benthic community in the Laguna Madre, the discharges will be in accordance with applicable regulations, will be localized, and will dissipate quickly given the dilution capacity of the GOM.

Potential spills of construction-related fuels and chemicals can result in adverse impacts to local water quality, which may affect fauna in the immediate vicinity of a spill. Each of the vessels involved in Project construction 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 prior to construction, which will identify measures to prevent, contain, and clean up any inadvertent spills. Each vessel operator will monitor its own operations 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, the diesel fuel would immediately begin dissipating. Because diesel fuel is a mixture of relatively light hydrocarbons, spreading, evaporation, dispersion, and dissolution will occur rapidly, and virtually the entire volume of fuel will have dissipated within 12 to 24 hours (ITOPF 2002). Furthermore, no oil or mixtures containing more than 15 parts of oil per million may be discharged within 50 mi (80 km) offshore (MARPOL 73/78).

Marine mammals, sea turtles, and fish can ingest or become entangled in marine debris that is lost from fishing vessels and offshore activities associated with oil and gas development. Although up to 49 percent of marine debris is considered to be from land-based sources, incidental debris loss from service vessels and OCS structures also contributes to the debris in the GOM (BOEM 2017). About 13 percent of debris found at PINS has been attributed to offshore oil and gas activity (Miller et al. 1995). Plastic bags and plastic fragments are the most commonly reported debris items in the digestive tracts of cetaceans. Per U.S. and MARPOL regulations, 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. To further minimize the potential for lost debris during offshore construction activities, Texas Gulf Terminals Inc. will adhere to NTL No. 2015-BSEE-G03, *Marine Trash and Debris Awareness and Elimination*. This NTL states, among other things, that marine discharge of trash and debris is prohibited under 30 CFR 250.300, that prominent placards regarding marine debris and trash disposal be placed in relevant areas, and that offshore employees and contractors must complete marine trash and debris awareness training at the start of employment and annually thereafter. With adherence to the NTL and applicable federal regulations, impacts on wildlife and protected species from debris lost as a result of Project construction is anticipated to be negligible.

7.3.2 Operation

Impacts on wildlife and protected species during operation of the Project would generally be limited to presence of the SPM buoy system, port calls by the VLCCs (eight per month), the sporadic transit of support vessels and helicopters to and from the offshore port, and the presence of the restricted zones. Once installed, the pipelines would be buried a minimum of 5 ft. (2 m) below the seafloor; although the habitats and respective faunal communities disturbed during construction would take various amounts of time to recover to pre-construction levels, no additional impacts would be incurred during operations. Although not anticipated to occur, a release of petroleum products from the SPM buoy system or pipelines would also impact the aquatic environment.

7.3.2.1 Deepwater Port Presence

Once constructed, the SPM buoy system components will act as an artificial hard structure, allowing sessile invertebrates with a substrate on which to attach. Oil and gas platforms in the GOM 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 (Gallaway and Lewbel 1982). In addition, the SPM buoy system and components attaching it to the seafloor will likely cause fishes to congregate, creating a locally diverse fish assemblage. Because of the hard structure provided for marine species in an area of otherwise ubiquitous soft-bottom habitat, the presence of the Project structures is considered a long-term, beneficial impact.

The SPM buoy system will require operational lighting for 24-hour operations, as well as navigational beacons. Project lighting may cause behavioral changes in nearby fauna, including attraction of predator and prey species. Bright lights on turtle nesting beaches can be detrimental to sea turtles because they can cause an alteration in critical nocturnal turtle behavior such as adult nest site selection and returning to the sea, as well as hatchling movement to the sea (Witherington and Martin 1996). USFWS and NOAA Fisheries have indicated that the lights on similar DWPs may attract sea turtle hatchlings, exposing them to risk of impingement on the intake screens for water intakes. However, the SPM buoy system would be about 15 mi (24 km) from the PINS, the closet known sea turtle nesting site. Consequently, sea turtle hatchlings are not expected to encounter the terminal and the proposed lighting is expected to have no effect on sea turtles.

Lighting is known to be a concern for trans-GOM migratory birds. Many neotropical birds migrate from Mexico to North American by crossing the GOM nonstop over 575 mi (925.4 km) of open water in the spring and fall. The proposed SPM buoy system would be located near the western edge of this migratory pathway; thus, many of these trans-GOM migrants may encounter the proposed terminal. These birds are known to be attracted to artificial lighting on offshore facilities, and artificial light can seriously disrupt bird migration patterns. Measures will be taken to minimize the amount of total lighting used on the proposed terminal to that required for safety. To reduce the disruptive effects of lighting, all lighting at the terminal should be shielded towards the water to keep the dispersion of light to a minimum. The shields would prevent the lights from shining skyward, instead directing the light to shine only on work areas. Shielded lighting has resulted in significant reductions in bird mortality.

The SPM buoy would be attached to the seafloor via anchor chains attached to piles (six of each). As the buoy is floating and will move with the waves, currents, and VLCC activity, the anchor chains will also move, resulting in scour in areas where the anchor chains may drag on the seafloor. Although this chain sweep will occur throughout the life of the Port, resulting in continual disturbance of the benthic community within and immediately adjacent to the chains, the buoy would be limited to a swing circle with a radius of 125 ft. (38 m). Given the small footprint of the swing circle, the continual disturbance to the benthic community is considered negligible.

Noise Effects

Airborne noise generated by the Project could impact terrestrial wildlife and marine and coastal birds in the Project area; however, impacts on ambient noise from airborne sources are expected to be long-term and negligible in the Project area. A detailed description of the airborne noise sources associated with operation of the Project is included in Section 12. During operations, underwater noise from the pipelines will be limited to the sound of liquid flow underwater. Ongoing operation of equipment on the SPM buoy system, as well as loading and support vessel activity, will also generate noise. Sources and levels of underwater noise are addressed below.

Fluids, such as oil and gas, flowing through pipelines generate sound levels that are related to flow velocity. Measurements of a 10-inch-diameter natural gas pipeline conducted by Glaholt *et al.* indicated gas pipeline noise is of low intensity (2004). While similar data are not available for oil pipelines, sound levels from operation of the pipeline are not anticipated to exceed ambient levels. The pipelines will be buried approximately 3 ft. (0.9 m) below the seafloor; burial will have a damping effect on any flow-related sound. Operation of the buried pipelines is not expected to impact ambient underwater sound levels.

While measurements of underwater sound levels from single-point mooring buoys similar to the proposed Project are not available, underwater sound levels generated by floating production storage and offloading facilities (FPSO), which gather oil and gas from multiple sub-sea wells, store, and offload the product to shuttle tankers, have been quantified. Erbe *et al.* (2013) estimate the mean underwater sound level associated with FPSOs to be 181 dB re: 1 µPa, which is similar to the sound levels associated with large commercial vessels that operate in the GOM (Richardson *et al.* 1995). Given the greater scope of activity on an operating FPSO, underwater sound levels generated during Project operations are expected to be lower. As described in Section 7.3.1.3, underwater sounds generated from the operation of fixed structures are estimated to range between about 20 and 40 dB above background levels. The sound levels associated with operation of the proposed Project are expected to be similar. The underwater noise associated with the project will result in a long-term, localized increase in noise levels.

Cumulatively, the operational noise will result in a long-term increase in ambient noise levels in the immediate vicinity of the SPM buoy system, which could result in masking of biologically important sounds and behavioral modifications to individuals or groups within range, likely in the form of area avoidance. However, impacts are unlikely to result in noise levels that are injurious to marine species.

In addition to continuous operation of equipment at the facilities, intermittent service vessel activity for supply and VLCCs calling at the SPM buoy system (about 96 times per year). Noise from vessels will be transient in the immediate Project vicinity, limited to the time when they are approaching, loading, and leaving the SPM buoy system. A minimum of two support tugs will be on location at the SPM buoy system during operations. Support vessels, are expected to be between 279 and 180 ft. (55 and 85 m) long. Underwater sound levels of these small ships range from 170 to 180 dB re: 1 µPa at a distance of 1 m (3 ft.) (Richardson *et al.* 1995). VLCCs are expected to be the size of large commercial vessels and supertankers, ranging from about 443 to 1,116 ft. (135 to 340 m) long; similarly sized vessels produce underwater sound levels at low frequencies ranging between 169 and 198 dB: 1 µPa, and can exceed 205 dB re: 1 µPa for broadband sound levels (Richardson *et al.* 1995). VLCCs that will call at the SPM buoy system are similar to other vessels operating in the GOM, as described in Section 7.3.1.3. Further, vessels transiting to the SPM buoy system will generally use established shipping lanes. No significant increase in vessel traffic is anticipated in the Project area, and therefore underwater noise impacts from vessel traffic during operations will be negligible.

7.3.2.2 VLCC Water Use

During facility operations, VLCCs will require the uptake and discharge of seawater for cooling of engines, pumps and other equipment, and in support of hoteling operations. Vessels will be required to meet all standards of discharge water quality and volumes while at the DWP. Water quality impacts resulting from vessel discharges is discussed in Section 3: Water Quality. The water column will be disturbed via the intake and discharge of water, as could any pelagic or planktonic species present in the immediate area of these activities. Benthic communities in the Project vicinity are not expected to be affected by operation of the Project due to the depth of the water in which it will be located. As VLCCs would remain offshore, no impacts on inshore habitats would occur.

The estimated amount of water withdrawn due to vessel use is estimated to be about 250.9 million gallons per year, representing only a small fraction of the amount of water available within the Project area. Seawater will be pulled in through near-surface sea chests covered with a wide mesh. Typically, seawater will be drawn in through the lower sea chest, which is located towards the bottom of the vessel, approximately 66 ft. (20 m) below the water surface for a VLCC based on fully loaded draft. A lesser portion of water withdrawal might occur through the upper sea chests, which are typically located approximately 6 ft. (2 m) higher than the lower sea chests. The mesh openings, although relatively large, will preclude entrainment of most adult pelagic species. Intake velocities for cooling water intakes typically remain below

0.5 ft/sec, which will be low enough to allow adult and juvenile fish to avoid being caught in the inflow of the screens, thus minimizing entrainment effects (USEPA 2001). However, planktonic organisms will likely be entrained and entrained eggs and larvae are assumed to experience 100 percent mortality. Factors that affect the numbers of individuals that are impinged or entrained include: the distance of the water intake from shore; depth of the water intake; through-screen intake velocity; screen size; pumping capacity; differences in life history; distribution patterns of organisms; quality and availability of habitat; and water quality at the intake (GBNEP 1993, Saila et al. 1997). In addition, the number of eggs and larvae entrained depends on the distribution of eggs and larvae, which is highly variable and related to the distribution of spawning adults (Gledhill and Lyckowski-Shultz 2000).

According to the SEAMAP data, average observed abundance in the sampling area are 5.89 larvae and 3.90 eggs per 3.3 ft^3 (1 m^3). The potential entrainment of fish eggs and larvae was obtained by multiplying densities observed during the SEAMAP studies by three to account for net extrusion. That adjusted density (17.66 larvae and 11.69 eggs per 3.3 ft^3 [1 m^3], or 66,868 larvae and 44,239 eggs per million gallons) was multiplied by the estimated annual intake volume of seawater by VLCCs at the DWP (250.9 million gallons). According to these calculations, approximately 16.8 million larval fish and 11.1 million fish eggs may be entrained through the VLCC systems or impinged on the intake screens each year. As identified in Table 7-13, the predominant taxa would include Engraulidae (38.5 percent of the observed abundance), Gobiidae (12.0 percent), Clupeiformes (8.3 percent), and Atlantic bumper (5.7 percent). However, these estimates assume that the abundance of larvae observed in the summer/fall would be present during all months of the year, that all larvae observed within the depth-integrated samples would be at the depth of the VLCC water intakes, and that the VLCCs would be present and operating year-round at the DWP. Although eggs are not identified to species/taxa, it is assumed that the eggs present in the Project area will be similar to those taxa identified in the larval dataset. As previously noted, the peak seasonality of most species is during the summer and fall months (see Table 7-11), and some larvae occur at different depths and/or exhibit vertical migrations throughout the water column, which may result in migration to waters deeper or shallower than the intake structures at various times throughout each 24-hour period (Sogard et al. 1987, Lyczkowski-Shultz and Steen 1991). Therefore, the impingement/entrainment estimates noted above likely overestimate the abundance of larvae that could become entrained within the VLCC systems at the DWP.

Although the number of eggs and larvae that would be annually entrained appears high, many fish species are broadcast spawners that release a high number of eggs that are subject to high mortality rates. Some of the most prevalent taxa identified in the SEAMAP data include two families that are part of a larger Order of fish (Clupeiformes), as identified in the hierarchical structure below. These fishes are broadcast spawners that, upon maturity, release high numbers of eggs (Carpenter 2002).

Order: Clupeiformes

- Family: Engraulidae
  - Species: Bay Anchovy (*Anchoa mitchilli*): 45,110 eggs/female/year
  - Species: Broad-striped anchovy (*Anchoa hepsetus*): 1,298 eggs/gram of female body weight/year
- Family: Clupeidae
  - Species: Gulf menhaden (*Brevoortia patronus*): 37,000 to 151,000 eggs/female per batch (multiple batches per year)
  - Species: Scaled herring (*Harengula jaguana*): 5,563 to 52,753 eggs/female/year
  - Species: Atlantic thread herring (Opisthonema oglinum): 13,638 to 67,888 eggs/female/year

As the natural mortality rates of eggs and larvae are high, the relatively small volume of seawater intake and discharge associated with VLCC intakes is not anticipated to result in population level effects to ichthyoplankton. The overall effect of the water intake and discharge is expected to be long term but minor.

Discharges from vessel cooling water systems are heated discharges, with the temperature of the discharge typically in the range of 5 to 10 °F (3 to 6 degrees Celsius [°C]) higher than the temperature of seawater initially withdrawn. This discharge will result in a heated plume that will return to ambient temperatures as it moves away from the tanker. Dilution and dispersion will limit the impacts from discharge to be minor and localized impacts. Further, the VLCCs and support 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, such that they will not result in any significant impacts on the quality of the water column habitat.

7.3.2.3 Inadvertent Product Releases

The probability of a major crude oil spill is extremely low (see Section 14). The major elements of the Project that could leak crude oil include: the SPM buoy system, the Offshore Pipelines from shore to the SPM buoy system, and the flexible hoses connecting the pipelines to the SPM buoy system and the SPM buoy system to the loading tankers.

<u>*Sea Turtles*</u>
In the event of an oil spill, some individual sea turtles would likely be exposed to the resulting oil on the surface, in the water column, in *Sargassum* habitat along convergence zones, and where volatile organic compounds and oil droplets enter the air over unweathered oil. Nesting females, eggs, and hatchlings may be exposed in the event that sandy beaches become fouled with oil during the nesting season. In addition to impacts on individual sea turtles, a spill could degrade sea turtle habitats including the shelf and marine waters of the GOM, SAV, *Sargassum*, and sandy beaches (see Section 3: Water Quality, and Section 5: Inshore and Offshore Aquatic Environment]).

Sea turtles may be exposed to oil via inhalation, ingestion, and dermal contact (Deepwater Horizon [DWH] Natural Resource Damage Assessment [NRDA] Trustees 2016). Sea turtles breathe at the ocean surface, where they may inhale volatile petroleum compounds where they are most highly concentrated and where the greatest amount of oil would likely occur (DWH NRDA Trustees 2016). Sea turtles may ingest oil-contaminated water and prey, and oil compounds may be transferred to developing embryos from adult females (DWH NRDA Trustees 2016). In addition, potentially due to indiscriminate feeding behavior in convergence zones where young turtles may consume anything floating, sea turtles are known to ingest petroleum (Shigenaka 2010; DWH NRDA Trustees 2016).

Oiled sea turtles and turtles breathing at the surface of oiled surface waters are at risk for aspiration on oil and oil compounds, and inhalation exposure may result in inflammation and lung congestion (DWH NRDA Trustees 2016). While few studies assess the toxicological effects of oil on sea turtles, ingestion may result in dehydration and decreased digestive function (Mitchelmore et al. 2017). Dermal contact and physical fouling with oil can impact the diving ability of sea turtles, which may contribute to physical exhaustion, suffocation, and potential thermal stress (Stacy 2012). If not rehabilitated, heavily oiled sea turtles are typically subject to mortality.

In addition, oil spill response activities including vessel traffic and beach cleanup can impact sea turtles. For example, sand removal and heavy traffic on nesting beaches can result in the loss of nests or hatchlings and compaction of sand over nests, which may affect hatchling emergence (Shigenaka 2010). Relocation of nests or capture and release of hatchlings may mitigate these impacts (Shigenaka 2010).

Following the DWH oil spill, the DWH NRDA Trustees estimate between 4,900 and 7,600 juvenile and adult sea turtle mortalities; larger numbers of small juveniles were also lost; and foregone production of adult sea turtles may have population-level effects (2016). During the DWH oil spill, 3.2 million barrels (bbl) of oil were released into the GOM over a period of 87 days; however, the worst-case scenario spill associated with the Project would release a total of 63,480 bbl over 10 days. Upon release, the oil would immediately begin to weather and evaporate, and the level, timeframe, and large geographic area of oil exposure that affected sea turtles and other resources during the DWH oil spill would not occur. However, sea turtles present in the vicinity of an oil spill could be impacted and, because of the threatened and endangered status of these species, any loss would be significant. While direct mortality of sea turtles could occur in the immediate area of a spill where concentrations of contaminants and the potential for fouling would be highest, impacts would occur over a short-term period and the population-level injury estimated by the DWH NRDA Trustees following that incident would not occur.

Marine Mammals

In the event of an oil spill, some individual marine mammals would likely be exposed to the resulting oil on the surface, in the water column, and where volatile organic compounds and oil droplets enter the air over unweathered oil. Dolphins and whales have been observed swimming in oil-contaminated waters, and would not necessarily avoid a large spill if it were to occur (Dias et al. 2017). In addition to impacts on marine mammals, a spill could degrade their habitats including the shelf and marine waters of the GOM, as described in Section 3: Water Quality.

Exposure pathways for marine mammals include inhalation, ingestion, and dermal contact (DWH NRDA Trustees 2016). Marine mammals breathe, rest, and swim at the surface, where the greatest amount of oil would likely occur (DWH NRDA Trustees 2016). Marine mammals near the surface of large oil spills may inhale volatile petroleum compounds, where they are the most highly concentrated (Geraci 1990 in NRC 2003, Takeshita *et al.* 2017). While foraging in the water column, droplets of oil may be ingested along with contaminated prey; some marine mammals (such as bottlenose dolphins) also forage in sediments, which could become contaminated. When marine mammals pass through floating oil, their skin can become fouled (NRC 2003).

Inhalation of volatile petroleum compounds may result in inflammation and lung congestion (Geraci & St. Aubin 1990 as cited by Dias et al. 2017). Oil that comes into contact with the skin of marine mammals may result in skin and eye irritation, and can foul the baleen of large whales (NMFS 2018). Ingestion can lead to gastrointestinal injury, vomiting, and absorption of oil into the body tissues (Takeshita *et al.* 2017). As summarized by Schwacke *et al.,* studies of bottlenose dolphins following the DWH oil spill found evidence of poor health, reproductive failure, and increased mortality; health effects included lung disease and an impaired stress response (2017).

Recent research following the DWH oil spill has found that long-term, chronic effects of oil exposure can result in decreased survival and lowered reproductive success (Takeshita *et al.* 2017). As described above for sea turtles, the level, timeframe, and large geographic scale of oil exposure that affected marine mammals during the DWH oil spill would not occur for the worst-case scenario spill for the Project. Further, as described in Section 12 “Meteorology, Air Quality, and Noise”, airborne volatile petroleum compounds, such as benzene, would be dispersed and diluted to low concentrations within a short distance of the oil. If a marine mammal were present during an oil spill, it would be impacted and could sustain impacts as described above; however, the population-level injury estimated by the DWH NRDA Trustees following that incident would not occur.

Marine and Coastal Birds

Marine and coastal birds that occur in the Project area would likely be exposed to oil in the event of a spill due to direct contact with oil in affected habitats including surface waters, beaches, and wetlands. Birds may be exposed to oil due to direct contact, ingestion of oil during preening of fouled feathers, and ingestion of contaminated prey (DWH NRDA Trustees 2016). Birds may also inhale volatile components of oil if present. If areas of heavy oiling coincide with rookeries or habitats in which birds congregate, large numbers of individuals may be affected. Seabirds (including pelicans and cormorants), waterfowl, and bald eagles are considered to be highly vulnerable to impacts from oil spills due to their behavior characteristics (for example, frequent diving for food or prolonged roosting on the water surface; NOAA-ORR 1992).

Oiling can affect the waterproofing and insulating ability of feathers, reducing a bird’s ability to swim, float, or fly (DWH NRDA Trustees 2016). If water penetrates the feathers, birds may experience mortality due to hypothermia; starvation and drowning could also result (Leighton 1990). In addition, ingestion and inhalation of oil can result in cell damage, immune suppression, anemia, heart abnormalities, and reduced gastrointestinal function; these impacts may affect growth, organ function, and reproductive effects (DWH NRDA Trustees 2016). Bird embryos are particularly sensitive to oil, and may die due to suffocation if the egg is covered in oil or due to toxic effects from smaller quantities of oil penetrating the shell (Leighton 1990; DWH NRDA Trustees 2016).

In the event of an operational spill resulting from the Project, birds in the immediate vicinity of the release or in contaminated habitats could experience direct mortality or other, sub-lethal effects. The greatest potential impacts of a spill associated with the Project would be expected offshore near the SPM buoy system, where the density of avifauna is low. In addition, birds are mobile, and some species, such as gulls, may be able to avoid oiled habitats (NOAA_ORR 1992). Upon release, the oil would immediately begin to weather and evaporate, reducing the potential for impacts on birds. The localized, short-term, adverse impact of the worst-case scenario oil spill associated with the Project would likely result in mortality and other impacts on individual birds; however, it is not expected to result in population-level effects.

Benthic Community

Benthic infauna and epifauna, as well as closely associated demersal fish and shrimp, that occur in the Project area would likely be exposed to oil in the event of a spill due to direct contact with oil and/or contaminated sediments, if released by the pipelines at the sea floor; via contaminated marine snow (aggregations of marine articles that sink from the surface or water column to the sea floor); or via contaminated food (DWH NRDA Trustees 2016). Many benthic organisms are not highly mobile and may be unable to avoid contaminated habitats.

Impacts of oil toxicity on marine organisms (including benthic invertebrates) include impaired feeding mechanisms and growth rates, reduced fecundity, developmental abnormalities, and reduced reproductive effort (Capuzzo *et al.* 1988, NRC 2003). Exposures to sufficiently high concentrations of oil can lead to mortality. Long-term exposure can result in changes in the reproductive and developmental potential of benthic organisms, resulting in population-level changes (Capuzzo *et al.* 1988, NRC 2003). Changes in the recruitment and density of benthic organisms may occur following a spill; decreased toxicity is associated with population recovery as the localized concentrations of petroleum hydrocarbons decrease post-spill (NRC 2003).

Following the DWH oil spill, analysis of long-term population data did not identify significant changes in aquatic invertebrate or fishery populations (DWH NRDA Trustees 2016). In the event of an operational spill resulting from the Project, benthic organisms in the immediate vicinity of the release or in contaminated habitats could experience direct mortality or other, sub-lethal effects. The localized, short-term, adverse impact of the worst-case scenario oil spill associated with the Project would not be significant.

Other Marine Species (Fish and Plankton)

As described in Sections 3, 4, and 5, the water column, coastal wetlands, *Sargassum*, respectively, and other habitat used by fish in the Project area could become contaminated in the event of an oil spill. Residual oil on beach sediments has also been demonstrated to have toxic effects on fish embryos and eggs (NRC 2003). Fish (including ichthyoplankton) may become exposed to oil present in contaminated habitats; in addition, fish may be exposed through consumption of contaminated prey. Eggs of many fish species remain suspended in the water near the surface and could become exposed to oil at the surface.

Oil spills in shallow or confined water (such as enclosed freshwater or brackish ponds) may result in the mortality of large numbers of juvenile and adult fish; however, in open water, impacts on fish are typically limited as juvenile and adult fish are mobile and able to minimize exposure to oil (NOAA-ORR 2018). Early life stages of fish are typically more sensitive to oil toxicity than adults (DWH NRDA Trustees 2016, NRC 2003). Contact with surface oil or with dissolved hydrocarbons can result in the mortality of fish embryos and larvae (Carls and Rice 1990). As summarized by the DWH NRDA Trustees, toxicity studies conducted after the DWH spill found that the surface mixture of water and oil is toxic to early life stages of fish and invertebrates in the GOM, and that exposure to UV light increases toxicity (2016).

Sub-lethal exposure of eggs is associated with decreased larval size and yolk reserves, which may reduce larval survival (Carls and Rice 1990). Other sub-lethal effects on fish may include reduced growth, immune suppression, developmental effects (including impaired cardiovascular development), and reduced swim performance (see summaries in DWH NRDA Trustees 2016 and NRC 2003). These impacts can reduce an individual's survivorship and reproduction.

In the event of an operational spill resulting from the Project, eggs and larvae in the immediate vicinity of the spill would likely be subject to oil-induced mortality. Mortality rates for ichthyoplankton are naturally high, and therefore the localized mortality associated with a spill is not expected to affect fishery populations. Following the DWH oil spill, analysis of long-term population data did not identify significant changes in fishery populations (DWH NRDA Trustees 2016). Given the scale of the worst-case scenario spill associated with the Project would be small in comparison with the DWH spill, significant, population-level effects are not anticipated. Pelagic and demersal fish are unlikely to be exposed to concentrations sufficient to result in mortality, although fish within contaminated habitats could be subject to sub-lethal, toxic effects. Therefore, the localized, short-term, adverse impact of the worst-case scenario oil spill associated with the Project would not be significant.

As described above for ichthyoplankton, in the event of a spill, phytoplankton and zooplankton in the vicinity of the incident would likely be exposed to oil in the water column, particularly near the surface slick. While direct mortality of plankton would likely occur in the immediate area of a spill where concentrations of contaminants would be highest, impacts would occur over a short-term period and localized mortality is not anticipated to have significant population-level effects.

7.1.1.1 Support Vessel Mooring and Ancillary Operations

Support vessels will regularly transit from shore to the SPM buoy system and between the SPM buoy system and incoming VLCCs. In addition, a minimum of two supply tugs will be onsite at the SPM buoy system during operations. The presence of additional vessels traveling to and from the DWP components could affect the faunal community through vessel strikes, inadvertent spills of contaminants, and an increase in lost marine debris; however, the potential for these impacts would be mitigated as discussed in Section 7.3.1.5 and are not anticipated to significantly affect faunal communities.

7.1.1.2 Restricted Operations Zone

The safety zone established for the SPM buoy system and VLCCs would restrict non-Project related activities within approximately 760 ac (307 ha) of the marine environment which would otherwise be available for fishing opportunities. In addition, the hard structures associated with the SPM buoy system would provide new structure for epifaunal colonization and fisheries recruitment over time; therefore, as the safety zone would prohibit fishing activities, this new habitat and faunal community would be protected from fishing pressures.

7.3.3 Decommissioning

At the end of its useful life (25 years), the Project would be decommissioned. Decommissioning of the proposed inshore and onshore pipeline facilities would consist of purging the pipe of crude oil liquids and filling it with saltwater or brackish water, cutting all piping at the ground surface or mud line. Such activities will cause sediment displacement and temporary increased water turbidities in wetlands and adjacent waters, but would have minimal impacts on fauna and their habitat. The onshore storage facility would similarly be cleaned and abandoned.

The Project components associated with the offshore SPM buoy system and pipelines would be disassembled and brought to shore. Decommissioning of the SPM buoy system is expected to disturb both pelagic and soft bottom habitats, as well as transient areas of *Sargassum*. The removal of SPM buoy system structures will cause a temporary increase in turbidity to both the lower water column and the seafloor, but will have minimal impacts on fauna and their habitat. The planned decommissioning sequence is provided in Section 1: Project Description, Purpose, and Need; however, a decommissioning plan would be prepared prior to any decommissioning activities taking place. It is estimated that decommissioning would take approximately 10 weeks to complete.

Regulated intakes/discharges from vessels and vessel traffic may affect the upper water column and associated faunal assemblages. Noise will be localized where Project components were removed. Blasting will not be required during decommissioning. Adverse impacts on wildlife and protected resources from removal of the Project components will be similar to those discussed for construction and are considered minor and temporary.

7.4 Cumulative Impacts

As described in the Introduction, cumulative impacts are the combined result of the impacts of an action that, when considered with the impacts of other actions, would result in resource impacts. The geographic and temporal scope of projects considered in this cumulative impact analysis, as well as a description of each past, present, or reasonably foreseeable future project considered, is provided in the Introduction.

Activities that could impact the marine environment in the Project area include offshore oil and gas exploration and production; waterway improvement projects, and marine traffic associated with the oil and gas industry, as well as recreation. Although activities associated with land-based projects can impact the marine environment, it is more than likely that these onshore projects will not result in additive negative impacts when combined with the Texas Gulf Terminals Project.

There are currently 1,113 platforms and 6,554 mi (10,548 km) of pipeline in BOEM's Western Planning Area and the state waters of Texas (BOEM2017). Between 561 and 1,788 additional production structures and between 3,049 and 6,930 mi (4,907 and 11,153 km) of new pipeline are projected to be installed in the Western Planning Area over the next five years. Effects to the environment and biological resources from these structures are similar and typically localized. The contribution of the proposed Project is considered negligible relative to the total number of platforms in the GOM. The potential for Project impacts to a resource or the environment are small when compared to other activities in the Western Planning Area.

Activities associated with the waterway improvement project activities identified in Table 8.2-1, have the potential to affect water quality, which could result in minor impacts to fish and other marine taxa. These impacts would be additive to the proposed Project's activities if the actions are concurrent with installation of proposed pipelines, and during anchoring and other bottom disturbing activities during construction of the SPM buoy system. Generally, impacts from these types of projects will be short term, and their effects (turbidity and sedimentation) would be localized, and limited to the area where active construction takes place. As these projects are all over 19 mi from the proposed Project, any cumulative effects of construction of the Project, when considered with these projects would be negligible.

Currently there are no identified in-water projects within the immediate vicinity of the Project; however, there are ongoing regional activities within the Western Planning Area. This area, like the rest of the GOM, is heavily used by recreational and commercial fishing vessels and contains known popular fishing areas. Recreational and state-regulated commercial fishing activities occurring in the Project area can result in bycatch of various fish and invertebrate species. In addition, fishing vessels and other recreation boat traffic could impact managed species through vessel collisions and subsequent spills, or through increased vessel noise.

Pile-driving will be the greatest source of noise associated with the Project; however, given the short-term nature of pile-driving impacts, Project construction is not expected to contribute to a significant cumulative impact on noise with other activities in the GOM. As described in Sections 12 and 13 (Meteorology, Air Quality, and Noise; and Navigation and Navigation Safety, respectively), given the level of existing commercial vessel traffic in the GOM, the contribution of the Project to cumulative vessel traffic consistent with existing uses of the waterways transited by these vessels. Therefore, associated noise impacts will be negligible.

Ongoing marine traffic associated with recreational activities and offshore oil and gas exploration have the potential for inadvertent releases of petroleum products, which could result in impacts on the marine biological communities similar to those described above for the Project. In the event of a spill, operators would be required to implement oil spill response procedures in accordance with applicable federal regulations to remove oil from the environment and mitigate impacts. Given the low probability of a spill associated with the proposed Project, and the implementation of federal regulations, the potential for cumulative impacts due to inadvertent releases of petroleum is unlikely. However, the Project could contribute to a minor to major cumulative impact if multiple spills were to occur in a short time-frame, and the worst-case scenario spill associated with Project operations could result in significant impacts as described in Section 7.3.2.3.

It has been determined that the Proposed Action will have no effect on smalltooth sawfish, humpback whale, Bryde's whale, sperm whale, bald eagle, interior least tern, Gulf Coast jaguarundi, ocelot, black-laced cactus, south Texas ambrosia, and slender rush pea. It has also been determined that the Proposed Action may affect, but is not likely to adversely affect the largetooth sawfish, Nassau grouper, oceanic white-tipped shark, green sea turtle, Kemp's ridley sea turtle, hawksbill sea turtle, loggerhead sea turtle, leatherback sea turtle, Sei whale, blue whale, fin whale, West Indian manatee, red knot, piping plover, whooping crane, and Northern aplomado falcon. Given the temporary, minor effects of Project implementation protected species, and given that other projects would also be subject to the ESA, it is expected that the cumulative impacts of the Project on protected species, combined with the multiple projects listed above, would also be minimal and temporary in nature.

As discussed in Section 1 "Project Description, Purpose, and Need", onshore facilities to support construction activities, including contractors' office and fabrication sites, will be located at existing facilities. Temporary disturbance of Laguna Madre and the GOM waters along north Padre Island will be associated with on and nearshore installation of the pipelines. Even if the proposed Project is built at the same time as other projects identified in Table 8.2-1, cumulative impacts on the marine environment is not expected as activities associated with the other projects will be sufficiently removed from the Project area. Once installation is complete, the Offshore and Inshore Pipelines will be buried and as such will not contribute to cumulative impacts.

The operation and decommissioning of the Project will have much lower impacts than those described above for construction; therefore, will not be cumulatively significant.

7.4.1 Ocean Acidification

Ocean acidification is the dissolution of atmospheric carbon into the ocean, which decreases its pH. The ocean absorbs about 30 percent of the carbon dioxide (CO2) that is released into the atmosphere (NMFS2018); the resultant changes in pH of the surface ocean waters has decreased by 0.1 pH over the past 200 years, which equates to a 30 percent change in acidity (NMFS 2018). The increase in acidity results in a decrease in available carbonite ions, which are used by numerous marine species to build shells and skeletons (NMFS 2018); these "calcifying" organisms (e.g., corals, crustaceans, mollusks, calcareous algae, echinoderms) are generally considered to be at the highest risk from ocean acidification impacts due, in part, to increased energy requirements to build and maintain these calcareous structures in an increasingly acidic ocean (USEPA 2018). By the year 2100, it has been estimated that surface waters could be about 150 percent more acidic than present day levels (NMFS 2018).

Numerous studies have been conducted to assess the impacts of ocean acidification on marine organisms. While it is generally reported that calcifying organisms exhibit larger negative responses than non-calcifying organisms, negative effects have been identified for rates of survival, growth, development, reproduction, and abundance for individuals of both groups (Kroeker et al. 2010, Kroecker et al. 2013). Kroecker et al. (2013) assessed meta-data from 228 studies on ocean acidification and found that, when all calcifying and non-calcifying taxa were combined (where non-calcifying organisms included fish, fleshy algae, seagrass, and diatoms), survival and calcification rates were most affected by ocean acidification scenarios predicted for the year 2100 (27 percent reductions each), followed by development (19 percent), abundance (15 percent), and growth (11 percent); however, the magnitude of the effects varied by taxa. For example, no difference in growth was identified in crustaceans, although growth for mollusks was reduced; and growth of non-calcifiers was identified as either positively affected (fleshy algae and diatoms) or showed no effect (fish).

Research supports that more active organisms (e.g., mobile crustaceans and fish) may be less sensitive to ocean acidification (Kroecker et al. 2013, Melzner et al. 2009). However, impacts on these species may still occur. Larval clownfish, and many species of coastal pelagic larvae, appear to use olfactory cues to identify and navigate to adult habitat; however, Munday et al.(2009) found that olfactory cues were disrupted in larval clownfish reared in acidified environments and that these larvae became strongly attracted to olfactory stimuli that they would normally have avoided. The effects of ocean acidification were also studied in adult predatory fish and similar olfactory disruption was found; the predators were more prone to avoid the smell of injured fish (prey), spending about 20 percent less time in water streams containing prey odor compared to the experimental controls (Cripps et al. 2011).

As described above, ocean acidification could have detrimental effects on a range of species, including on species that make up the lower trophic levels of the food web. If effects at these lower trophic levels (such as a reduction in the populations of prey organisms) occurred due to ocean acidification, effects on the higher trophic levels (e.g., marine mammals, birds) could also occur. Emissions from construction and operation of the Project would contribute to the amount of carbon in the atmosphere (see Section 12 – Air Quality) and could incrementally contribute to ocean acidification. However, as ocean acidification is a global concern, the construction and operation of the proposed Project would not result in measurable impacts on any such global change.

7.5 Mitigation Measures

Construction of the proposed Project will employ BMPs during onshore construction activities, including the clearing of vegetation, excavating the pipeline trench, welding and laying the pipe, backfilling the pipeline trench, re-establishing preconstruction contours, and restoring permanent vegetation. After clearing is completed but before grading begins, erosion/sediment control measures will be installed where necessary to minimize runoff and sedimentation into adjacent lands, wetlands, waterbodies, roads, or other areas. After completion of construction, the Project site will be graded, and disturbed areas will be revegetated.

Impacts to wildlife habitats have been avoided and minimized, to the extent practicable, by reducing the construction right-of-way to 100 ft. [30 m] from an original width of 150 ft. [46 m], using HDD crossing methods, and strategically siting aboveground facilities to reduce the temporary and permanent impacts to wetlands. Impacts to wetlands and waters of the US, which could be habitat for wildlife and protected species, and the proposed mitigation measures are discussed in Section 4: Wetlands and Waters of the US.

The proposed Project has been developed in a manner that minimizes impacts on all habitat and species to the extent possible. In addition to siting the SPM buoy system and pipelines in soft bottom habitats which are the most prevalent and least sensitive habitat in the GOM, the following BMPs have also been incorporated into the Project:

- Using HDD construction methods for the coastal landfall approach of the pipelines to Padre Island and at three locations in the Laguna Madre, which will avoid sensitive wetland communities along the shoreline and minimize impacts on SAV.
- The SPM buoy system and associated pipelines are sited well away from sensitive live/hard bottom habitat and oyster reefs, thereby avoiding the species that use these areas.
- Designing the Project to have the smallest footprint practicable to minimize impacts on marine resources.

- Construction and support vessels under the purview of Texas Gulf Terminals will be required to NTL No. 2015-BSEE-G03, *Marine Trash and Debris Awareness and Elimination*, which will minimize the potential for marine species to ingest, or become entangled in, lost debris.
- Use of BMPs (e.g., weighted turbidity curtains) on the edge of the inshore construction workspaces to minimize the migration of turbidity and sedimentation where necessary or as required by issued permits.
- Land-based fabrication of the offshore SPM buoy system, to minimize the timing and disturbance associated with offshore installation.
- To minimize the potential for vessel strikes of marine mammals, BOEM NTL No. 2016-G01, *Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*, will be followed by all Project construction and support vessels.
- A Project-specific spill response plan will be developed prior to construction, which will identify measures to prevent, contain, and clean up any inadvertent spills from construction and support vessels.
- The Project will meet all lighting stipulations as noted in 33 CFR, Part 149, which requires limiting Terminal lighting to that required for safety and navigational concerns, in order to reduce the disruptive effects of lighting, and will down-shield lighting, to the greatest extent possible, to reduce light dispersion.

As described in Section 7.3.1.3, pile-driving associated with installation of the SPM buoy system could result in injury or harassment of fish, turtles, and marine mammals. To minimize the sound level impacts associated with pile-driving, mitigation measures are under development. While identification of mitigation is not final, measures may include:

- Use of the lowest energy hammer feasible for installation of the piles;
- The use of “soft starts,” using a lower hammer energy level to begin pile-driving, which allows sensitive species to avoid the vicinity prior to peak pile-driving noise;
- The use of a bubble curtain or other sound damping system to minimize propagation of pile-driving noise; and
- Stationing marine mammal and turtle observers on-site to survey for marine mammals and turtles prior to and during pile-driving.

The following BMPs may be employed to further reduce the potential impacts to protected species and their habitats:

- Timing construction windows to avoid sea turtle nesting season;
- Environmental monitors may be employed during construction of onshore, inshore, and offshore project components when deemed appropriate or as required by issued permits;
- Flagging around potentially hazardous or protected habitats; and
- In the event of an inadvertent return during HDD activities, the Project’s will employ the Inadvertent Returns Contingency Plan, which will be approved prior to initiating HDD installation.
-

7.6 Summary of Potential Impacts

Based on the analysis presented in the sections above, potential impacts on wildlife and protected species are summarized in the table below.

Table 7-19: Summary of Potential Impacts to Wildlife and Protected Species

Project Phase	Impact	Duration	Significance	Mitigation
Construction	Increase in turbidity, sedimentation, habitat clearing, and ambient noise	Temporary	Minor	Protected resources monitors during pile-driving,
Construction: Pile-driving	Increase in ambient noise	Temporary	Moderate	Protected resources monitors during pile-driving,
Operation	Increased noise due to ongoing facility operations; transient noise from vessels and helicopters.	Long-term	Minor	N/A
Decommissioning	Increase in turbidity and ambient noise	Temporary	Minor	N/A
Cumulative	Cumulative increase in noise due to incremental increase in vessel activity; Cumulative increase in discharges and runoff; and increased potential for inadvertent releases	Long-term	Minor	N/A

Direct impacts from construction of the Project are generally expected to be minor and short-term; however, potentially moderate impacts could occur from offshore pile-driving noise. In-water pile-driving noise is estimated to exceed harassment levels for marine mammals and may be injurious to fish within the ZOIs identified in Section 7.3.1.3. These impacts will be temporary (limited to the few weeks associated with pile-driving) and will be mitigated to acceptable levels through use of the mitigation measures identified in Section 7.3.1.3, as supplemented through future correspondence with NMFS. Other construction-related impacts include increased turbidity and sedimentation resulting from installation of the pipelines and SPM buoy system. Minor spills from construction and support vessels may result in water quality impacts, but the potential for these spills would be minimized through use of the measures in Section 7.3.1.3.

Impacts on wildlife and protected species associated with operation and decommissioning are generally expected to be minor and long-term (during operations) or temporary (during decommissioning). The annual water withdrawal due to VLCCs visiting the Port is estimated to be 250.9 million gallons, which could result in the mortality of up to 11.1 million eggs and 16.8 million larvae; however, as the natural mortality rates of eggs and larvae are high, the relatively small volume of seawater intake and discharge associated with VLCC intakes is not anticipated to result in population level effects to ichthyoplankton.

7.7 References

Armstrong, N. 1987. The Ecology of Open-bay Bottoms of Texas: A Community Profile. USFWS Biological Report No. 85(7.12). Available online at: https://www.nwrc.usgs.gov/techrpt/85-7-12.pdf.

Andrew, R.K., B.M. Howe, and J.A. Mercer. 2002. Ocean ambient sound: comparing the 1960s with the 1990s for a receiver off the California coast. Acoustic Research Letters Online 3:65–70.

Austin, J.E., and A.L. Richert. 2001. A Comprehensive Review of Observational and Site Evaluation Data of Migrant Whooping Cranes in the United States, 1943-1999. Jamestown, North Dakota: U.S. Geological Survey, Northern Prairie Wildlife Research Center. Available online at: https://pubs.usgs.gov/unnumbered/93805/report.pdf

Behler, J.L., P.C.H. Pritchard, and A.G.J. Rhodin (eds.).Â 1996.Â Special Focus Issue:Â The Leatherback Turtle, *Dermochelys coriacea*.Â Chelonian Conservation and Biology 2(2):137-324

Bozka, Larry. 2003. "Legend, Lore, & Legacy: The Sawfish Scenario". Texas Parks and Wildlife Magazine February 2003. Available at: https://tpwmagazine.com/archive/2003/feb/

Briedermann L. 1990. Schwarzwild (Wild boar). 2nd Edition, VEB Deutscher Landwirtschaftsverlag, Berlin Democratic Republic of Germany. 539 pp. Behavior, Control/Management, Damage, Diseases/Parasites, Ecology, Economics, Food Habits, Genetics, History, Hunting, Morphology, Population Biology, Predation, Reproduction, Taxonomy.

Brooks, R.A., S.S. Bell, C.N. Purdy, and K.J. Sulak. 2004. The benthic community of offshore sand banks: a literature synopsis of the benthic fauna resources in potential MMS OCS sand mining areas. USGS Outer Continental Shelf Studies Ecosystem Program Report USGSSIR-2004-5198 (CEC NEGOM Program Investigation Report No. 2004-01, February 2004); Minerals Management Service, OCS Study MMS.

Bureau of Ocean Energy Management (BOEM). 2011. Outer Continental Shelf Oil and Gas Leasing Program: 2012 – 2017. Draft Programmatic Environmental Impact Statement. November 2011.

———. 2012. Gulf of Mexico OCS Oil and Gas Lease Sales 2012-2017. Final Programmatic Environmental Impact Statement. U.S. Department of the Interior. Available online at: https://www.boem.gov/uploadedFiles/BOEM/Oil_and_Gas_Energy_Program/Leasing/Five_Year_Program/2012-2017_Five_Year_Program/2012-2017_Final_PEIS.pdf.

———.. 2016. National Aviation Management Plan. Available at: https://www.boem.gov/Aviation-Plan/. Accessed January 2018.

———.. 2017. Gulf of Mexico OCS Region. Volume 1. Oil and Gas Leasing Program: 2017-2022. Final Programmatic Environmental Impact Statement. Accessed online: https://www.boem.gov/BOEM-EIS-2017-009-v1/

Burgess, G.H., J. de Carvalho, and J.L. Imhoff. 2009. An evaluation of the status of the largetooth sawfish, *Pristis perotteti*, based on historic and recent distribution and qualitative observations of abundance. Internal report to NOAA.

Byrnes et. Al. 2017. Habitats and Biota of the Gulf of Mexico: Before the Deepwater Horizon Oil Spill. Volume 1. Water Quality, Sediments, Sediment Contaminants, Oil and Gas Seeps, Coastal Habitats, Offshore Plankton and Benthos, and Shellfish. Edited by C. Herb Ward.

Campbell, L. 1995. Endangered and threatened animals of Texas, their life history and management. Texas Parks and Wildlife Department, Resource Protection Division, Endangered Resources

Branch, Austin, Texas. 130 pp.

Campbell, L. 2003. Endangered and Threatened Animals of Texas – Their Life History and Management. Texas Parks and Wildlife Department, Austin. 129 pp. Available online at: https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_0013.pdf.

Canadian Wildlife Service and U.S. Fish and Wildlife Service. 2007. International recovery plan for the whooping crane. Ottawa: Recovery of Nationally Endangered Wildlife (RENEW), and U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 162 pp. Available online at: https://www.fws.gov/uploadedFiles/WHCR%20RP%20Final%207-21-2006.pdf.

Capuzzo, J., M. Moore, and J. Widdows. 1988. Effects of toxic chemicals in the marine environment: predictions of impacts from laboratory studies. Aquatic Toxicology 11 (303-311). Available online at: https://web.whoi.edu/seagrant/wp-content/uploads/sites/24/2015/01/WHOI-R-88-001-Judith-McDowell-Capuzzo.pdf.

Carls, M.G. and S. D. Rice. 1990. Abnormal Development and Growth Reductions of Pollock Theragra chalcogramma Embryos Exposed to Water-Soluble Fractions of Oil. Fishery Bulletin 88(1).

Carter, J., G.J. Marrow, and V. Pryor. 1994. Aspects of the ecology and reproduction of Nassau grouper, Epinephelus striatus, off the coast of Belize, Central America. Proceedings of the Gulf and Caribbean Fisheries Institute, 43:65–111.

Carpenter, K.E. (ed). 2002. The Living Marine Resources of the Western Central Atlantic. Volume 2: Bony Fishes, Part 1 (Acipenseridae to Grammatidae). FAO Species Identification Guide for Fishery Purposes and American Society of Ichthyologists and Herpetologists Special Publication No. 5. Rome, FAO. 2002. Pp 601-1374.

Cripps, I.L., P.L. Munday, and M.I. McCormick. 2011. Ocean acidification affects prey detection by a predatory reef fish. PLoS ONE 6(7): e22736. https://doi.org/10.1371/journal.pone.0022736.

Davis, R.W., J.G. Oretga-Ortiz, C.A. Ribic, W.E. Evans, D.C. Biggs, P.H. Ressler, R.B. Cady, R.R. Leben, K.D. Mullin, and D. Wursig. 2002. Cetacean habitat in northern oceanic Gulf of Mexico. Deep-Sea Research I 49 (2002) 121-142.

Dixon, James R. 2014. Amphibians and reptiles of Texas, Third edition. 162 pp. Texas A&M University Press, College Station, Texas, USA. Available online at: https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/1990/881/carls.pdf

Deepwater Horizon Natural Resource Damage Assessment Trustees (DWH NRDA Trustees). 2016. Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan (PDARP) and Final Programmatic Environmental Impact Statement. Available online at: http://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/Front-Matter-and-Chapter-1_Introduction-and-Executive-Summary_508.pdf.

Dias, L. J. Litz, L. Garrison, A. Martinez, K. Barry, T. Speakman. 2017. Exposure of cetaceans to petroleum products following the Deepwater Horizon oil spill in the Gulf of Mexico. Endangered Species Research 33 (119-125). Available online at: http://www.int-res.com/articles/esr2017/33/n033p119.pdf

Ditty, James G.; Zieske, G.G.; and Shaw, R.F. 1988. Seasonality and Depth Distribution of Larval Fishes in the Northern Gulf of Mexico above latitude 26.00'N. Fishery Bulletin: Volume 86, No. 4. Pages 811-823. Available online at: https://www.researchgate.net/publication/249992220_Seasonality_and_depth_distribution_of_larval_fishes_in_the_northern_Gulf_of_Mexico_above_latitude_2600%27N

Drake, K.R., J.E. Thompson, K.L. Drake, and C. Zonick. 2001. Movements, habitat use and survival of non-breeding Piping Plovers. Condor 103:259-267. Available online at: https://www.jstor.org/stable/1370374?seq=1#page_scan_tab_contents

Dunn, J. L. and Alderfer, J. 2011. National Geographic field guide to the birds of North America. (pp.116-117, 128-129, 236-237, 244-245, 424-425, 476-477). Washington D.C., National Geographic Society.

Dulvy, N.K., L.N.K. Davidson, P.M. Kyne, C.A. Simpfendorfer, L.R. Harrison, J.K. Carlson, and S.V. Fordham. 2014. Ghosts of the coast: global extinction risk and conservation of sawfishes. Aquatic Conservation 26(1):134-153.

Dutra R.P. et al. 2016. Phylogenetic systematics of peccaries (Tayassuidae: Artiodactyla) and a classification of South American Tayassuids. Journal of Mammalian Evolution. DOI. 10.1007/s10914-016-9347-8. Available online at: https://link.springer.com/article/10.1007/s10914-016-9347-8.

Elliot-Smith, E. and S.M. Haig. 2004. Piping plover (*Charadrius melodus*). In The birds of North America, edited by A. Poole. Cornell Lab of Ornithology, Ithaca, New York, USA. Available online at: http://bna.birds.cornell.edu.floyd.lib.umn.edu/bna/species/002

Erbe, Christine, Robert McCauley, Craig McPherson, Alexander Gavrilov. 2013. Underwater noise from offshore oil production vessels. Journal of the Acoustic Society of America. 133 (6). Available online at: https://asa.scitation.org/doi/pdf/10.1121/1.4802183.

Exotic and Invasive Species. 2018a. Texas Invasive Plant Council. Invasives 101: Available online at: https://www.texasinvasives.org Accessed June 2018.

———. 2018b. Texas Invasive Plant Council. Invasives 101. Available online at: https://www.texasinvasives.org/plant_database/detail.php?symbol=URMA3. Accessed March 2018.

———. 2018c. Texas Invasive Plant Council. Invasives 101. Available online at: https://www.texasinvasives.org/plant_database/detail.php?symbol=LELE10. Accessed March 2018.

———. 2018d. Texas Invasive Plant Council. Invasives 101. Available online at: https://www.texasinvasives.org/plant_database/detail.php?symbol=PECI. Accessed March 2018.

———. 2018d. Texas Invasive Plant Council. Invasives 101. Available online at: https://texasinvasives.org/plant_database/detail.php?symbol=SAMO5

———. 2018e. Texas Invasive Plant Council. Invasives 101. Available online at: https://texasinvasives.org/plant_database/detail.php?symbol=EICR

———. 2018f. Texas Invasive Plant Council. Invasives 101. Available online at: https://texasinvasives.org/plant_database/detail.php?symbol=PIST2

———. 2018h. Texas Invasive Plant Council. Invasives 101. Available online at: https://texasinvasives.org/plant_database/detail.php?symbol=HYVE3

Flint, Warren R. and Rabalais, Nancy N. 1980. Environmental Studies South Texas Outer Continental Shelf 1975-1977. Volume 1. Ecosystem Description. The Bureau of Land Management. Washington D.C. University of Texas Marin Science Institute. Port Aransas Marine Laboratory. Available online at: https://www.boem.gov/ESPIS/3/4046.pdf

Ferrara, C.R., R.C. Vogt, R.S. Sousa-lima, B.M.R. Tardio, and V.C.D. Bernardes. 2014. Sound communication and social behavior in an Amazon River turtle (Podocnemis expansa). Herpetologia 70(2):149-156.

Foley, K.A., C. Caldow, E. Hickerson. 2007. Gulf of Mexico Science. First confirmed record of Nassau grouper Epinephelus striatus (Pisces: Serranidae) in the Flower Garden Banks National Marine Sanctuary. Pp. 162-165.

Frankel, A.S., C.W. Clark, L.M. Herman, and C.M. Gariele. 1995. Spatial distribution, habitat utilization, and social interactions of humpback whales, *Megaptera novaeangliae*, off Hawai'i, determined using acoustic and visual techniques. Canadia Journal of Zoology 73:1134-1146.

Franckowiak, G. and Poche, R. 2017. Short-term home range and habitat selection by feral hogs in northern Texas. The American Midland Naturalist, 179(1):28-37. Published By Notre Dame.

Fulling, G.L, K.D. Mullin, and C.W. Hubard. 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Fishery Bulletin 101(4): 923-932.

Gales, R.S. 1982. Effects of Noise of Offshore Oil and Gas Operations on Marine Mammals- An Introductory Assessment. Research Report 1980-81. Bureau of Land Management, US Department of the Interior, Naval Oceans System Center. San Diego, California. Available online at: http://www.dtic.mil/dtic/tr/fulltext/u2/a123700.pdf

Gallaway, B. and G. Lewbel. 1982. The Ecology of Petroleum Platforms in the Northwestern Gulf of Mexico: A Community Profile. Bureau of Land Management Gulf of Mexico OCS Regional Office – Open File Report 82-03. Available online at: https://www.nwrc.usgs.gov/techrpt/82-27text.pdf.

Galveston Bay National Estuary Program. (GBNEP-30). 1993. Sediment quality assessment survey of the Galveston bay system.

Gardner, M. B. 1981. Effects of turbidity on feeding rates and selectivity of blue&. Transactions of the American Fisheries Society 110:446-450.

Garza, C.R. 2014. Manatee sighting on SPI excites residents. Brownsville Herald, August 8, 2014. Available online at http://www.brownsvilleherald.com/news/local/article_c856a3e4- 1f71-11e4-950e0017a43b2370.html.

Garza, Sarah J., Tabak, Michael A., Miller, Ryan S., Farnsworth, Matthew L., and Burdett, Christopher L. 2017. Abiotic and biotic influences on home-range size of wild pigs (*Sus scrofa*). Journal of Mammalogy 99(1):97-107,2018. DOI:10.1093/jmammal/gyx154. Available online at: https://www.researchgate.net/publication/321491585_Abiotic_and_biotic_influences_on_home-range_size_of_wild_pigs_Sus_scrofa.

Geraci, J. R. 1990. Physiologic and toxic effects on cetaceans. In: Sea Mammals and Oil: Confronting the Risks. J. R. Geraci, and D. J. St. Aubin [eds.]. Academic Press. San Diego, CA, pp. 167-197.

Geraci, J. R., and D. J. St. Aubin (Eds.). 1990. Sea Mammals and Oil: Confronting the Risks. Academic Press, San Diego, 282pp. Available online at: https://www.journals.uchicago.edu/doi/abs/10.1086/417496.

Germano, J.D. 1994. Environmental mediation and open water disposal. In Dredging '94. Proceedings of the Second International Conference on Dredging and Dredged Material Placement, E. Clark McNair, Jr.(ed.). New York: American Society of Civil Engineers, 160–169.

Gerristen, J., and J.R. Strickler. 1977. Encounter probabilities and community structure in zooplanktaon: a mathematical model. Journal of Fisheries Research Board of Canada 34:73-82.

Gil-Weir, Karine C.; Grant, William E.; Slack, R. Douglas; Wang, Hsiao-Hsuan; and Fujiwara, Masami. 2012. Demography and Population trends of Whooping Cranes. The Authors Journal of Field Ornithology. 83(1): 1-10.

Gioeli, K. and K. Langeland. 1997. Brazilian Pepper-tree Control. Publication SS-AGR-17. Agronomy Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.

Glaholt, R., J. Marko, and P. Kiteck. 2004. Investigations into Gas Pipeline Operational Noise and Its Potential to Impact Toothed Whales and Baleen Whales. Presented at Environmental Concerns in Rights-of-Way Management 8th International Symposium, September 2004.

Gledhill, Christopher T., & Lyczkowski-Shultz, Joanne. 2000. Indices of larval king mackerel (*Scomberomorus cavalla*) abundance in the Gulf of Mexico for use in population assessments. Southeast Fisheries Science Center. National Marine Fisheries Service, NOAA. Pages 684-691

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. National Oceanic and Atmospheric Document NA17FC1052. Available online at: https://gulfcouncil.org/wp-content/uploads/March-2004-Final-EFH-EIS.pdf.

Gulf States Marine Fisheries Commission (GSMFC). 2018. Southeast Area Monitoring and Assessment Program. Dataset provide by Glenn Zapfe (NOAA) to Jennifer McCoy (EDGE Engineering and Science) on April 29, 2018.

Gunter, G., and L. Knapp. 1951. Fishes, new, rare or seldom recorded from the Texas coast. Texas Journal of Science, 3(1): 134-138.

Haig, Susan M.; Ferland, Cheron L.; Cuthbert, Francesca J.; Dingledine, Jack; Goossen, J. Paul; Hecht, Anne; and McPhillips, Nell,. 2005. A Complete Species Census and Evidence for Regional Declines in Piping Plovers. USGS Staff -- Published Research. 683.

Hallegraeff, G.M. 2010. Ocean climate change, phytoplankton community response, and harmful algal blooms: a formidable predictive challenge. Journal of Phycology 46: 220-235.

Hanselka C.W. and Paschal J.C. 1991. Prickly pear cactus: A Texas rangeland enigma. Rangelands 13(3). Available online at: https://journals.uair.arizona.edu/index.php/rangelands/article/view/11005/10278

Hawkins, A.D. and A.A. Myrberg, Jr. 1983. Hearing and sound communication under water, pp. 347-405. In: B. Lewis (ed.), Bioacoustics: A Comparative Approach. Academic Press: London.

Hayes, S.A.. E. Josephson, K Maze-Foley, and P.E. Rosel. 2017a. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2016. NOAA Technical Memorandum NMFS-NE-241. Available online at: https://www.nefsc.noaa.gov/publications/tm/tm241/tm241.pdf.

Hayes, S.A.. E. Josephson, K Maze-Foley, and P.E. Rosel. 2017b. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2017. Draft. Available online at: https://www.fisheries.noaa.gov/national/marine-mammal-protection/draft-marine-mammal-stock-assessment-reports.

Heemstra, P.C., and J.E. Randall. 1993. FAO species catalogue. Vol. 16. Groupers of the world (Family Serranidae, Subfamily Epinephelinae). An annotated and illustrated catalogue of the grouper, rockcod, hind, coral grouper and lyre tail species known to date. FAO Fisheries Synopsis. No. 125, Vol. 16. Rome, FAO.

Hildebrand, H.H., H. Chavez, and H. Compton. 1964. Aporte al conocimiento de los peces del arrecife Alacranes, Yucatan (Mexico). Ciencia (Mex.) 23 (3):107-134.

Hildebrand, J.A. 2005. Impacts of anthropogenic sound, pp. 101-158. In: Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson (eds.), Marine Mammals and Noise. San Diego: Academic Press.

Hildebrand, J.A. 2009. Anthropogenic and natural sources of ambient noise in the ocean. Marine Ecology Progress Series 395:5-20. Available online at: http://cetus.ucsd.edu/Publications/Publications/PAPERS/HildebrandMEPS2009.pdf.

Hoese, H. D., and R. H. Moore. 1998. Fishes of the Gulf of Mexico: Texas, Louisiana, and adjacent waters. Texas A&M Univ. Press, College Station. 422 pp.

Howe, M.A. 1989. Migration of radio-marked whooping cranes from the Aransas-Wood Buffalo population: patterns of habitat use, behavior, and survival. U.S. Fish Wildlife Service, Fish and Wildlife Technical Report 21. 33 pp. Available online at: https://pubs.er.usgs.gov/publication/5230196.

International Tanker Owners Pollution Federation Limited (ITOPF). 2002. "Fate of Marine Oil Spills." Technical Information Paper. No. 2. Available online: http://www.itopf.com/fileadmin/data/Documents/TIPS%20TAPS/TIP2FateofMarineOilSpills.pdf

Janečka, J.E., M.E. Tewes, L.L. Laack, A. Caso, L.I. Grassman Jr., A.M. Haines, D.B. Shindle, B.W. Davis, W.J. Murphy, R.L. Honeycutt. 2011. Reduced genetic diversity and isolation of remnant ocelot populations occupying a severely fragmented landscape in southern Texas. Animal Conservation 14(6): 1-11. Available online at: https://zslpublications.onlinelibrary.wiley.com/doi/pdf/10.1111/j.1469-1795.2011.00475.x.

Jaquet, N., and D. Gendron. 2002. Distribution and relative abundance of sperm whales in relation to key environmental features, squid landings and the distribution of other cetacean species in the Gulf of California, Mexico. Marine Biology (2002) 141:591-601.

Jasny, Michael. 2005. Natural Resources Defense Council. Sounding the Depths II: The Rising Toll of Sonar, Shipping and Industrial Ocean Noise on Maine Life. Online at: http://www.nrdc.org/wildlife/marine/sound/sound.pdf.

Jay-Russell, M. et al. 2014. Enteric human pathogens of wild boar, feral swine, and javelina (Order: Artiodactyla). Conference: Vertebrate Pest Conference. Volume 26.

Johansson, A.T., and M.H. Andersson. 2012. Ambient Underwater Noise Levels and Norra Midsjöbanken during Construction of the Nord Stream Pipeline. Naturvårdsverket. ISSN 1650-1942.

Johnson, L.L., T.K. Collier, and J.E. Stein. 2002. An analysis in support of sediment quality thresholds for polycyclic aromatic hydrocarbons (PAH) to protect estuarine fish. Aquatic Conservation: Marine and Freshwater Ecosystems. 12 (5):517-538.

Jubinsky, G. 1995. Chinese Tallow (*Sapium sebiferum*). Florida Department of Environmental Protection, Bureau of Aquatic Plant Management. Pub. No. TSS-93-03. 12 pp.

Keddy-Hector, D. P. 2000. Aplomado falcon (*Falco femoralis*). In The birds of North America: Life histories from the 21st century, edited by A. Poole and F. Gills. No. 549. Philadelphia, Pennsylvania.

Kroeker, K.J., R.L. Kordas, R.N. Crim, and G.G. Singh. 2010. Meta-analysis reveals negative variable effects of ocean acidification on marine organisms. Ecology Letters (2010) 13:1419-1434.

Kroeker, J.J., R.L. Kordas, R. Crim, I.E. Hendriks, L. Ramajo, G.S. Singh, C.M. Duarte, and Jean-Pierre Gattuso. 2013. Impacts of ocean acidification on marine organisms: quantifying sensitivities and interaction with warming. Nature Climate Change 19(6):1884-1896.

Kuyt, E. 1992. Aerial radio-tracking of Whooping Cranes migrating between Wood Buffalo National Park and Aransas National Wildlife Refuge, 1981-84. Occas. Pap. 74. Can. Wildl. Serv. Ottawa.

Landry, A.M. n.d. Sea turtle research at TAMUG. Sea Turtle and Fisheries Ecology Research Lab, Texas A&M University at Galveston. Available at: http://txmn.org/cradle/files/2010/07/TP-Sea_Turtle_Research-1.pdf.

Landry, A.M. No Date. Sea turtle research at TAMUG. Sea Turtle and Fisheries Ecology Research Lab, Texas A&M University at Galveston. Available at: http://txmn.org/cradle/files/2010/07/TPSea_Turtle_Research-1.pdf.

K.A. Langeland, H.M. Cherry, et al. 2008. Identification and Biology of Nonnative Plants in Florida's Natural Areas – Second Edition. University of Florida-IFAS Publication # SP 257.

Leighton, Federick A. 1990. The toxicity of petroleum oils to birds. University of Saskatchewan, Canadian Cooperative Wildlife Health Center. Available online at: https://www.researchgate.net/publication/237154429_The_toxicity_of_petroleum_oils_to_birds

Lessa, R., F.M. Santana, and R. *Paglerani*. 1999. Age, growth, and stock structure of the oceanic whitetip shark, *Carcharhinus longimanus*, from the southwestern equatorial Atlantic. Fisheries Research 42(1999) 21-30.

Lingle, G.A., Wingfield, and J.W. Ziewitz. 1991. The migration ecology of whooping cranes in Nebraska, U.S.A. in J. Hams, ed., Proceedings 1987 International Crane Workshop, Pages 395-401. International Crane Foundation, Baraboo, Wisconsin. Longley, W. H. 1970. Sandhill cranes at the Carlos Avery Wildlife Area. The Loon 4:124-128.

Mapston M.E., 2010. Feral Hogs in Texas. Texas Cooperative Extension. Texas Agrilife. Available at: http://feralhogs.tamu.edu/files/2010/05/B-6149-Feral-Hogs-in-Texas.pdf. Accessed February 2018.

Lyczkowski-Shultz, J., and J. Steen Jr., 1991. Diel Vertical Distribution of Red Drum, *Sciaenops ocellatus* Larvae in the Northcentral Gulf of Mexico. Fishery Bulletin: Vol 89 (631-641).

Massei, G., and L. Tonini. 1992. The management of wild boar in the Maremma Natural Park. Pp. 443-445. In F. Spitz, G. Janeau, G. Gonzalez, and S. Aulagnier (eds.), Ongules/Ungulates 91: Proceedings of the international symposium. Toulouse, France, September 2-6, 1991. Société Francaise pour l'Etude et la Protection des Mammifères, and Toulose: Institut de Recherché sur les Grands Mammifères, Paris & Toulouse, France. 661 pp. Control/Management, Ecology.

Marine Mammal Commission. (2007). Marine mammals and noise: A sound approach to research and management. 370 pp. Available at:

http://www.mmc.gov/sound/committee/pdf/soundFACAreport.pdf

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine seismic surveys – a study of environmental implications. APPEA Journal 692-708. Internet website: http://www.anp.gov.br/meio/guias/sismica/biblio/McCauleye2000.PDF. Accessed April 20, 2011.

Melzner F, Gutowska MA, Langenbuch M, Dupont S, Lucassen M, Thorndyke MC, Bleich M (2009) Physiological basis for high CO2 tolerance in marine ectothermic animals: preadaptation through lifestyle and ontogeny? Biogeosciences, 6, 2313–2331.

Meylan AB, Witherington BE, Brost B, Rivero R, Kubilis PS. 2006. Sea turtle nesting in Florida, USA: assessments of abundance and trends for regionally significant populations of *Caretta, Chelonia, and Dermochelys*. In: Frick M, Panagopoulou A, Rees AF, Williams K, editors. Book of abstracts Twenty–sixth Annual Symposium on Sea Turtle Biology and Conservation. Int. Sea Turtle Soc., Athens, Greece.; p. 306–307.

Miller GH, Sabatelli FJ, Naples L, Hare RS, Shaw KJ. The most frequently occurring aminoglycoside resistance mechanisms-combined results of surveys in eight regions of the world. The aminoglycoside resistance study groups. J Chemother 1995;7:17–30.

Minerals Management Service (MMS). 2000. Physical/Biological Oceanographic Integration Workshop for the DeSoto Canyon and Adjacent Shelf. U.S. Department of the Interior. MMS Gulf of Mexico OCS Region. OCS Report MMS 2000-074 Available online at: https://www.boem.gov/ESPIS/3/3180.pdf.

Minerals Management Service (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 1. Chapters 1-10. U.S. Department of the Interior. MMS Gulf of Mexico OCS Region. OCS Report MMS 2002-052 Available online at: https://www.boem.gov/BOEM-Newsroom/Library/Publications/2002/2002-052-vol1.aspx

Minerals Management Service (MMS). 2004. Review of Existing and Emerging Environmentally Friendly Offshore Dredging Technologies. U.S. Department of the Interior MMS. OCS Report MMS 2004-076. Available online at: https://www.boem.gov/Non-Energy-Minerals/2004-076.aspx.

———. . 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. Draft Environmental Impact Statement.OCS Report MMS 2006-062. Available online at: https://www.boem.gov/BOEM-Newsroom/Library/Publications/2006/2006-062-Vol1.aspx.

Mitchell, W.A., Martin, C.O., Theriot, R.F. 2000. Riparian Shorebirds Potentially Impacted by the USACE Reservoir Operations. Army of Engineers Waterways and Experiment Station Vicksburg MS Engineer Research and Development Center, September 2000 pp 16.

Mitchelmore, C.L., Bishop, C.A., Collier, T.K.. 2017. Toxicological estimation of mortality of oceanic sea turtles oiled during the Deepwater Horizon Oil Spill. Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science. Available online at: http://www.int-res.com/articles/esr2017/33/n033p039.pdf.

McDonald, M.A., J.A. Hildebrand, and S.M. Wiggins. 2006. Increases in deep ocean ambient noise in the Northeast Pacific west of San Nicolas Island, California. Journal of the Acoustical Society of America 120: 711–718. Available online at: https://pdfs.semanticscholar.org/a420/89eb92de91a4cda0c5969077f9aa0bb800de.pdf.

Moein, S.E., J.A. Musick, J.A. Keinath, D.E. Barnard, M.L. Lenhardt, and R. George. 1995. Evaluation of seismic sources for repelling sea turtles from hopper dredges, pp. 90-93. In: L.Z. Hales (ed.), Sea Turtle Research Program: Summary Report. Technical Report CERC-95.

Mrosovsky, N. 1972. Spectographs of the sounds of leatherback turtles. Herpetologica 29(3):256-258.

Muhling, B., R. Smith, L. Vazquez-Yeomans, J. Lamkin, E. Johns, L. Carrillo, E. Sosa-Cordero, E. Malca. 2013. Larval fish assemblages and mesoscale oceanographic structure along the Mesoamerican Barrier Reef System. Fisheries Oceanography. Available online at: http://www.aoml.noaa.gov/phod/docs/Muhling_etal_2013.pdf.

Munday PL, Dixson DL, Donelson JM, Jones GP, Pratchett MS, Devitsina GV, Døving KB (2009) Ocean acidification impairs olfactory discrimination and homing ability of a marine fish. Proceedings of the National Academy of Sciences of the United States of America, 106, 1848–1852.

Mullin, Kieth D.,Fulling, Gregory L., and Hubard, Carrie, W. 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Southeast Fisheries Science Center. National Marine Fisheries Service. Available online at: http://aquaticcommons.org/15181/.

National Marine Fisheries Service (NMFS), USFWS, and Semarnat. 2011. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. National Marine Fisheries Service. Silver Spring, Maryland. Available online at: http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_kempsridley_draft2.pdf.

———. . 2003. Environmental Assessment on the Effects of Scientific Research Activities Associated with Development of a Low-Powered High-Frequency Sonar System to Detect Marine Mammals. Office of Protected Resources. Silver Springs, MD. Available online at: http://www.nmfs.noaa.gov/pr/pdfs/permits/1048-1717_ea.pdf.

———. . 2015. Essential Fish Habitat – Gulf of Mexico. National Oceanic and Atmospheric Administration NMFS Southeast Region Habitat Conservation Division. Available online at: http://sero.nmfs.noaa.gov/habitat_conservation/efh.html

———. . 2016. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 p. Available online at: http://www.nmfs.noaa.gov/pr/acoustics/Acoustic%20Guidance%20Files/opr-55_acoustic_guidance_tech_memo.pdfNational Marine Fisheries Service

———. . 2017. Pile Driving Calculations. Available online at http://www.dot.ca.gov/hq/env/bio/files/NMFS%20Pile%20Driving%20Calculations.xls.

———. . 2018. Impacts of Oil on Marine Mammals and Turtles. National Oceanic and Atmospheric Administration. Online at: http://www.nmfs.noaa.gov/pr/pdfs/health/oil_impacts.pdf. Accessed January 2018.

National Marine Fisheries Service (NMFS). 2013. Nassau Grouper, *Epinephelus striatus* (Bloch 1792) Biological Report. Available at: http://www.nmfs.noaa.gov/pr/species/documents/nassau_bioassessrpt_final.pdf. Accessed April 2018.

———. 2014. Endangered and Threatened Wildlife and Plants; Final Endangered Listing of Five Species of Sawfish Under the Endangered Species Act. 79 Federal Register 73977 (12 December 2014), pp 73977-74005.

———. 2015. Final Essential Fish Habitat 5-Year Review for Atlantic Highly Migratory Species. Silver Spring, MD. 127 p.

———. 2015a. Fin Whale (*Balaenoptera physalus*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/whales/fin-whale.html. Accessed April 2018.

———. 2015b. Largetooth Sawfish (*Pristis pristis*). Available at: http://www.nmfs.noaa.gov/pr/species/fish/largetooth-sawfish.html. Accessed April 2018.

———. 2015c. Sei Whale (*Balaenoptera borealis*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/whales/sei-whale.html. Accessed April 2018.

———. 2015d. Smalltooth Sawfish (*Pristis pectinata*). Available at: http://www.nmfs.noaa.gov/pr/species/fish/smalltooth-sawfish.html. Accessed April 2018.

———. 2016a. Blue Whale (*Balaenoptera musculus*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/whales/blue-whale.html. Accessed April 2018.

———. 2016b. Endangered and Threatened Wildlife and Plants; Proposed Threatened Listing Determination for the Oceanic Whitetip Shark Under the Endangered Species Act (ESA). 81 Federal Register 96304 (29 December 2016), pp 96304-96328.

———. 2016c. Endangered and Threatened Wildlife and Plants: Notice of 12-month Finding of a Petition to List the Gulf of Mexico's Bryde's Whale as Endangered Under the Endangered Species Act (ESA). 81 FR 88639 (08 December 2016), pp 88639-88656.

———. 2017a. Bryde's Whale (*Balaenoptera edeni*). Available at: https://www.fisheries.noaa.gov/species/brydes-whale-gulf-mexico. Accessed April 2018

———. 2017b. Humpback Whale (*Megaptera novaengliae*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/whales/humpback-whale.html. Accessed April 2018.

———. 2017c. Sperm Whale (*Physter microcephalus*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/whales/sperm-whale.html. Accessed April 2018.

———. 2017d. Proactive Conservation Program: Species of Concern. Available at: http://www.nmfs.noaa.gov/pr/species/concern/. Accessed April 2018.

———. 2018. Endangered and Threatened Wildlife and Plants; Listing the Oceanic Whitetip Shark as Threatened Under the Endangered Species Act. 83 Federal Register 4153 (30 January 2018), pp 4153-4165.

National Research Council (NRC). 2003. Ocean Noise and Marine Mammals. Committee on Potential Impacts of Ambient Noise in the Ocean on Marine Mammals. Oceans Studies Board. Division on Earth and Life Sciences. The National Academic Press, Washington D.C. 221 pages. Available online at: https://www.ncbi.nlm.nih.gov/books/NBK221262/

NatureServe. 2016a. NatureServe Explorer: An online encyclopedia of life [*Haematopus palliates*]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed June 2018.

———. 2016b. NatureServe Explorer: An online encyclopedia of life [*Rynchops niger*]. Version 7.1.

NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed June 2018.

———. 2016c. NatureServe Explorer: An online encyclopedia of life [*Rallus crepitans*]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed June 2018.

———. 2016d. NatureServe Explorer: An online encyclopedia of life [*Phalacrocorax auritus*]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed June 2018.

———. 2016e. NatureServe Explorer: An online encyclopedia of life [*Gelochelidon nilotica*]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed June 2018.

———. 2016f. NatureServe Explorer: An online encyclopedia of life [*Larus argentatus*]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed June 2018.

———. 2016g. NatureServe Explorer: An online encyclopedia of life [*Rallus elegans*]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed June 2018.

———. 2016h. NatureServe Explorer: An online encyclopedia of life [*Thalasseus maximus*]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed June 2018.

———. 2016i. NatureServe Explorer: An online encyclopedia of life [*Ammodramus maritimus*]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed June 2018.

———. 2016j. NatureServe Explorer: An online encyclopedia of life [*Onychoprion fuscatus*]. Version 7.1. NatureServe, Arlington, Virginia. Available at: http://explorer.natureserve.org. Accessed June 2018.

Navarro-Lopez, L.D., J.H. Rappole, and M.E. Tewes. 1993. Distribution of the Endangered Ocelot (*Felis pardalis*) in Texas and Northeastern Mexico, pp. 157–169. In Avances en el Estudio de los Mamiferos de Mexico. Publicaciones Especiales, Vol. 1. Asociacion Mexicana de Mastozoologia, A.C. Mexico, D.F.

Neff, J.M. 2005. Composition, environmental fates, and biological effect of water based drilling muds and cuttings discharged to the marine environment: A synthesis and annotated bibliography. Prepared for Petroleum Environmental Research Forum (PERF) and American Petroleum Institute by Battelle. Duxbury, MA 73 pp.

Newstead, D.J. 2012. Habitat use of North Padre Island and Laguna Madre habitats by piping plover and red knots in the vicinity of current and proposed wind energy development. Interim Report the Endangered Species Program Texas. Texas Parks and Wildlife Department Available online at: http://www.cbbep.org/habitat-use-of-north-padre-island-and-laguna-madre-habitats-by-piping-plovers-charadrius-melodus-and-red-knots-calidris-canutus-in-the-vicinity-of-current-and-proposed-wind-energy-development/

Newstead, D.J., L.J. Niles, R.R. Porter, A.D. Dey, J. Burger, and O.N. Fitzsimmons. 2013. Geolocation reveals mid-continent migratory routes and Texas wintering areas of red knots (*Calidrius canutus rufa*). Wader Study Group Bulletin 120:53-59. Available online at:

http://www.waderstudygroup.org/article/1844/

National Oceanic and Atmospheric Administration (NOAA). 2013. Hogfish harvest closing in the Gulf of Mexico Federal Waters on December 2, 2013. Southeast Fishery Bulletin. FB13-101.

———. 2015a. Species in the Spotlight: Survive to Thrive. Recovering Threatened and Endangered Species FY 2013-2014 Report to Congress. Retrieved from: http://www.nmfs.noaa.gov/pr/laws/esa/final_biennial_report_2012-2014.pdf

———. 2015b. Kemp's Ridley Turtles (*Lepidochelys kempii*). Webpage.

———. 2015c. U.S. MPA Data from the MPA Inventory. Available at: http://marineprotectedareas.noaa.gov/pdf/helpfulresources/ inventory/mpai_tabulardata.

———. 2015d. North Gulf of Mexico (Ecoregion 13) marine protected areas. 5pp. Available at: http://marineprotectedareas.noaa.gov/pdf/helpful-resources/inventory/ngulfmexico0115.pdf

———. Teaching resources, Climate.gov (NOAA, 2016); https://www.climate.gov/teaching.

———. 2016a Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing: Underwater acoustic thresholds for onset of permanent and temporary threshold shifts. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, NOAA Technical Memorandum NMFS-OPR-55 July 2016.

———. 2016b. Commercial landings provided by David Gloeckner, NOAA Fisheries. Data provided March 25, 2016.

———. 2016c. Gulf of Mexico Gillnet Fishery. Webpage. Retrieved from: http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/gom_gn.html

———. 2016d. Sea Turtles. Available online at: http://www. nmfs.noaa.gov/pr/species/turtles//.National Oceanic and Atmospheric Administration

———. 2017. Final Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan: Essential Fish Habitat and Environmental Assessment. Office of Sustainable Fisheries. Atlantic Highly Migratory Species Management Division. 442 pages. Available online at: https://www.fisheries.noaa.gov/bulletin/final-amendment-10-essential-fish-habitat.

National Oceanic and Atmospheric Administration – Office of Response and Restoration (NOAA-ORR). 2018. How Oil Spills Affect Fish and Whales. Online at: https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/how-oil-spills-affect-fish-and-whales.html.

Noel, B.L., and C.R. Chandler. 2008. Spatial distribution and site fidelity of non-breeding piping plovers on the Georgia coast. Waterbirds 31.2:241-251.

Nowacek, D.P., P.L. Tylack, and R.S. Wells. 2001. A platform for continuous behavioral and acoustic observation of free-ranging marine mammals: overhead video combined with underwater audio. Marine Mammal Science 17(1): 191-199.

Nunny, R., E. Graham, and S. Bass. 2008. Do sea turtles use acoustic cues when nesting? NOAA Tech. Mem. NMFS SEFSC No. 582:83. Internet website: http://www.nmfs.noaa.gov/pr/pdfs/species/ turtlesymposium2005.pdf. Accessed April 19, 2018.

OSPAR Commission. 2009. Overview of the impacts of anthropogenic underwater sound in the marine environment. Online at: https://qsr2010.ospar.org/media/assessments/p00441_Noise_background_document.pdf.

Palmer, R.S. 1967. Piping plover. In: The Shorebirds of North America, edited by G.D. Stout. Viking Press, New York.

Phillips, Neal W. and James, Bela M. 1988. Offshore Texas and Louisiana Marine Ecosystems Data Synthesis. Volume 1: Executive Summary. Minerals Management Service (MMS) Gulf of Mexico OCS Region. OCS Study MMS 88-0066. Available online at: https://www.boem.gov/ESPIS/3/3700.pdf

Plants of Texas Rangelands. 2018a. Department of Ecosystem Science and Management AgriLife Extension Texas A&M University. Virtual Herbarium: Chinese tallow tree. Available online at: http://rangeplants.tamu.edu/plant/chinese-tallow-tree/. Accessed March 2018.

———. . 2018b. Department of Ecosystem Science and Management AgriLife Extension Texas A&M University. Virtual Herbarium: Saltcedar, Tamarisk. Available online at: http://rangeplants.tamu.edu/plant/saltcedar-tamarisk/. Accessed March 2018.

———. . 2018c. Department of Ecosystem Science and Management AgriLife Extension Texas A&M University. Virtual Herbarium: Chinaberry. Available online at: http://rangeplants. tamu.edu/plant/chinaberry/. Accessed March 2018.

Popper, Arthur N., Hawkins, Anthony D., Fay, Richard R., Mann, David A., Bartol, Soaya, Carlson, Thomas J., Coombs, Sheryl, Ellison, William T., Gentry, Roger L., Halvorsen, Michele B., Lokkeborg, Svein, Rogers, Peter H., Southall, Brandon, L., Zeddies, David G, and Tavolga, William N. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles. Available online at: https://www.researchgate.net/profile/Arthur_Popper/publication/279347068_Sound_Exposure_Guidelines/links/5596735d08ae99aa62c777b9/Sound-Exposure-Guidelines.pdf.

Popper, A. N., and M.C. Hastings. 2009. The effects of human-generated sound on fish. Department of Biology, University of Maryland, College Park U.S.A. and Applied Research Laboratory, The Pennsylvania State University. Jounral of Integrative Zoology. Volume 4. Pages 43-52. Available online at: https://www.nrc.gov/docs/ML1434/ML14345A581.pdfHastings, M. and A. Popper. 2005. Effects of Sound on Fish. Available online at: https://www.nrc.gov/docs/ML1434/ML14345A573.pdf.

Qian, Jochens Y., Kennicut, Ii MC. 2003. Spatial and temporal variability of phytoplankton biomass and community structure over the continental margin of the northeast Gulf of Mexico based on pigment analysis. Available online at: https://www.researchgate.net/publication/222118259_Spatial_and_temporal_variability_of_phytoplankton_biomass_and_community_structure_over_the_continental_margin_of_the_northeast_Gulf_of_Mexico_based_on_pigment_analysis

Reeves, Randall R.; Clapham, Phillip J.; Brownell, Robert L. Jr.; and Silber, Gregory K., "Recovery Plan for The Blue Whale (*Balaenoptera musculus*)" (1998). Publications, Agencies and Staff of the U.S. Department of Commerce. 118.

Rhoads, D.C., P.L. McCall, and J.Y., Yingst. 1978. Disturbance and production on the estuarine seafloor. American Scientist 66: 577-586.

Rice, S. D., Thomas, R. E., Carls, M. G., Heintz, R. A., Wertheimer, A. C., Murphy, M. L., et al. (2001). Impacts to Pink Salmon Following the Exxon Valdez Oil Spill: Persistence, Toxicity, Sensitivity, and Controversy. Reviews in Fisheries Science, 9(3), 165–211. doi:10.1080/20016491101744

Richardson, W.J, C.R. Greene, C.I. Malme and D.H. Thomson (eds.). 1995. Marine Mammals and Noise. Academic Press, San Diego. 576p.

Rhodin, A.G.J. (ed.). 2005. Special Focus Issue: The Kemp's Ridley Sea Turtle, *Lepidochelys kempii.* Chelonian Conservation and Biology 4(4):755-976.

Rowe G.T. 2017. Offshore Plankton and Benthos of the Gulf of Mexico. In: Ward C. (eds) Habitats and Biota of the Gulf of Mexico: Before the Deepwater Horizon Oil Spill. Springer, New York, NY. Available online at: https://link.springer.com/chapter/10.1007/978-1-4939-3447-8_7

Salmeron, Olivia Garcia; Zevala, Jorge Hidalgo; Mateos, Adriana, Jasso; and Romero, Rosario Centeno. 2011. Regionalizations of the Gulf of Mexico From Space-time chlorophyll-a concentration variability. Ocean Dynamics. Available online at: https://www.researchgate.net/publication/227309084_Regionalization_of_the_Gulf_of_Mexico_from_space-time_chlorophyll-a_concentration_variability

Saila, S.B., E. Lorda, J.D. Miller. R.A. Sher, and W.H. Howell. 1997. Equivalent Adult Estimates for Losses of Fish Eggs, Larvae, and Juveniles at Seabrook Station with Use of Fuzzy Logic to Represent Parametric Uncertainty. North American Journal of Fisheries Management 17:811-825. Available online at: https://onlinelibrary.wiley.com/doi/abs/10.1577/1548-8675(1997)017%3C0811:EAEFLO%3E2.3.CO;2

Samuel, Y., S.J. Morreale, C.H. Greene, and M.E. Richmond. 2005. Underwater, low-frequency noise in coastal sea turtle habitat. J. Acoust. Soc. Am. 117(3):1465-1472.

Schmidly, D.J. 2004. The Mammals of Texas. University of Texas Press, Austin, Texas. Texas A&M University Kingsville. Available online at: http://www.tamuk.edu/about/what_is_a_javelina.html.

Schwacke, L., L. Thomas, R. Wells, W. McFee, A. Hohn, K. Mullin, E. Zolman, B. Quigley, T. Rowles, J. Schwacke. 2017. Quantifying injury to common bottlenose dolphins from the Deepwater Horizon oil spill using an age-, sex- and class-structured population model. Endangered Species Research 33 (265-279). Available online at: https://repository.library.noaa.gov/view/noaa/15430

Shaw, Richard F., Lindquist, David C., Benfield, Mark C., Farooqi, Talat, and Plunket, John T. 2002. Offshore Petroleum Platforms: Functional Significance for Larval Fish Across Longitudinal and Latitudinal Gradients. Coastal Marine Institute, Minerals Management Service (MMS) Gulf of Mexico OCS Region. OCS Study MMS 2002-077. Available online at: http://platformresearch.msi.ucsb.edu/bibliography/o-shore-petroleum-platforms-functional-signi-cance-larval-sh-across-longitudinal-and

Shigenaka, Gary. 2010. Oil and Sea Turtles, Biology, Planning, and Response. National Oceanic and Atmospheric Administration. National Ocean Service. Office of Response and Restoration. Available online at: https://response.restoration.noaa.gov/sites/default/files/Oil_Sea_Turtles.pdf.

Simmonds, Mark, Sarah Dolman and Lindy Weilgart, Ed. Oceans of Noise, a WDCS Science Report. 169pp. Available online at: https://uk.whales.org/sites/default/files/oceans-of-noise.pdf

Simpson, R. 2010. Defining areas of potential ocelot habitat. The Endangered Species Program Final Report 12-13-2010. Texas Parks and Wildlife, Austin, Texas. Available online at: https://tpwd.texas.gov/business/grants/wildlife/section-6/docs/mammals/e108_final_report.pdf

Smith, C.L. 1971. A revision of the American groupers: Epinephelus and allied genera. Bulletin of the American Museum of Natural History. 146:69-241.

SpaceX Biological and Conference Opinion. 2013. Summary of the final biological and conference opinion on the effects to the endangered ocelot (*Leopardus paradalis*), endangered gulf coast jaguarundi (*Herpailurus yagouaroundi cacomitli*), endangered northern aplomado falcon (*Falco femoralis septentrionalis*), endangered Kemp's ridley sea turtle (*Lepidochelys kempii*), endangered hawksbill sea turtle (*Eretmochelys imbricata*), endangered leatherback sea turtle (*Dermochelys coriacea*), threatened green sea turtle (*Chelonia mydas*), threatened loggerhead sea turtle (*Caretta caretta*), threatened piping plover (*Charadrius melodus*) and its critical habitat, and proposed to be listed as threatened red knot (*Calidris canutus rufa*) from the proposed issuance of federal aviation administration launch license authorizing SpaceX to launch Falcon 9 heavy orbital vertical launch vehicles and a variety of reusable suborbital launch vehicles from private property, Boca Chica, Cameron County, Texas. Consultation No. 02ETCC00-2012-F0186. USFWS Coastal Ecological Services Field Office, Corpus Christi, Texas.

Sogard, S., D. Hoss, and J. Govoni. 1987. Density and Depth Distribution of Larval gulf Menhade, Brevoortia Patronus, Atlantic Croaker, *Micropogonias Undulatus*, and Spot, *Leiostomus Xanthurus*, in the Northern Gulf of Mexico. Fisheries Bulletin: Vol. 85, No. 3.

Stacy, Brian A. (2012). Summary of findings for sea turtles documented by directed captures, stranding response, and incidental captures under response operations during the BP DWH MC252 oil spill. Technical Working Group Report. Available online at: https://www.fws.gov/doiddata/dwh-ar-documents/894/DWH-AR0149670.pdf

Steenkamp, G. 2003: Oral biology and disorders of tusked mammals. Vet. Clin. Exot. Anim. 6, 689-725.

Stucker, J.H., F.J. Cuthbert, B. Winn, B.L. Noel, S.B. Maddock, P.R. Leary, J. Cordes, and L.C. Wemmer. 2010. Distribution of non-breeding Great Lakes piping plovers (*Charadrius melodus*) along Atlantic and Gulf of Mexico coastlines: ten years of band sightings. Waterbirds 33.1: 2232. Available online at: https://pubs.er.usgs.gov/publication/70037137

Takeshita, R., L. Sullivan, C. Smith, T. Collier, A. Hally, T. Brosnan, T. Rowles, and L. Schwacke. 2017. The Deepwater Horizon oil spill marine mammal injury assessment. Endangered Species Research 33 (96-106). Available online at: http://www.int-res.com/articles/esr2017/33/n033p095.pdf

Taylor, R. B., and E. C. Hellgren. 1997. Diet of feral hogs in western South Texas plains. The Southwest Naturalist, 42(1):33-39. Food Habits.

Tewes, M.E., and D.D. Everett. 1986. Status and distribution of the endangered ocelot and jaguarundi in Texas, pp. 147–158. In Cats of the World: Biology, Conservation, and Management, edited by S.D. Miller and D.D. Everett. Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville.

Tewes, M.E., and D.J. Schmidly. 1987. The Neotropical Felids: Jaguar, Ocelot, Margay, and Jaguarundi. Pages 697–712 in Wild Furbearer Management and Conservation in North America (M. Novak, J.A. Baker, M.E. Obbard, and B. Malloch, eds.). Ministry of Natural Resources, Ontario.

Texas Marine Mammal Stranding Network. 2016. Rescue Profile: Dennis / Tex. Available at: http://www.tmmsn.org/rescue_rehab/rescue_profile/Dennis.htm. Accessed August 2016.

Texas Natural Diversity Database (TXNDD). 2018. Element Occurrence data export. Wildlife Diversity Program of Texas Parks and Wildlife Department. January 2018.

Texas Parks and Wildlife Department (TPWD). 2018a. Interior Least Tern (*Sterna antillarum athalassos*). Available at: https://tpwd.texas.gov/huntwild/wild/species/leasttern/. Accessed June 2018.

———. 2018b. Piping Plover (*Charadrius melodus*). Available at:

https://tpwd.texas.gov/huntwild/wild/species/piplover/. Accessed June 2018.

———. 2018c. Northern Aplomado Falcon (*Falco femoralis*). Available at: https://tpwd.texas.gov/huntwild/wild/species/aplomfal/. Accessed June 2018.

———. 2018d. Whooping Crane (*Grus Americana*). Available at: https://tpwd.texas.gov/huntwild/wild/species/whooper/. Accessed June 2018.

———. 2018e. American Oystercatcher (*Haematopus palliates*). Available at: https://tpwd.texas.gov/huntwild/wild/species/oystercatcher/. Accessed June 2018.

———. 2018f. Brown Pelican (*Pelecanus occidentalis*). Available at: https://tpwd.texas.gov/huntwild/wild/species/bpelican/. Accessed June 2018.

———. 2018g. Reddish Egret (*Egretta rufescens*). Available at: https://tpwd.texas.gov/huntwild/wild/species/reddishegret/. Accessed June 2018

TPWD. 2018h. Exotic and Invasive Species. Accessed online at: https://tpwd.texas.gov/huntwild/wild/species/exotic/

TPWD. 2018i. Marine Invasive Species. Accessed online at: https://tpwd.texas.gov/fishboat/fish/didyouknow/coastal/invasivegalveston.phtml

———.. 2018j Texas Artificial Reefs Interactive Mapping Application. Available at: http://tpwd.texas.gov/gis/ris/artificialreefs/. Accessed January 2018.

Tolleson, D., W. Pinchak, L. Hunt, and D. Rollins. 1995. Feral hogs in the Rolling Plains of Texas: Perspectives, problems, and potential. Pp. 124-128. In R. E. Masters and J. G. Huggins (eds.), Twelfth Great Plains wildlife damage control workshop proceedings. Tulsa, Oklahoma. Control/Management, Damage. Available online at: https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1453&context=gpwdcwp

Turtle Island Restoration Network. "The Largest Sea Turtle Cold Stunning Event Texas Has Ever Seen." February 1, 2018. Available at: https://seaturtles.org/newssection/coldstunningintx/. Accessed April 2018.

Tyack, Peter L. 2008. Implications for Marine Mammals of Large-Scale Changes in the Marine Acoustic Environment. Journal of Mammology. 89(3): 549-558. U.S. Department of Agriculture Natural Resources Conservation Service. 2008. General Soil Map of Texas. Available online at http://www.lib.utexas.edu/maps/texas/texas-general_soil_map2008.pdf.

U.S. Environmental Protection Agency (USEPA). 1999. The ecological Condition of Estuaries in the Gulf of Mexico. USEPA Office of Research and Development, Washington DC. 80 Pages. Available online at: https://www.epa.gov/gulfofmexico/ecological-condition-estuaries-gulf-mexico

USEPA. 2001. Technical Development Document for the Final Regulations Addressing Cooling Water Intake Structures for New Facilities. USEPA Office of Water. EPA-821/R/01/036. Available online at: https://www.epa.gov/sites/production/files/2015-04/documents/cooling-water_phase-1_tdd_2001.pdf.

U.S. Fish and Wildlife Service (USFWS). 1985. Determination of endangered and threatened status for piping plover. Federal Register 50:50726–50734.

———. 1989. Contaminants Assessment of the Corpus Christi Bay Complex, Texas 1988-1989. USFWS Corpus Christi Ecological Services Field Office. Corpus Christi, Texas.

———. 2001. Endangered and Threatened Wildlife and Plants; Final Determination of Critical Habitat for Wintering Piping Plovers. Federal Register 66(132):36036-36143.

———. 2003a. Manatee Recovery Plan. "West Indian Manatee". Available at:https://www.fws.gov/verobeach/MSRPPDFs/WestIndianManatee.pdf. Accessed April 2018.

———. 2003b. Recovery plan for the great lakes piping plover (*Charadrius melodus*). Fort Snelling, Minnesota. 141 pp.

———. 2007a. Leatherback Sea Turtle (*Dermochelys coriacea*) 5-Year Review: Summary and Evaluation. Corpus Christi, Texas: USFWS Corpus Christi Ecological Services Field Office.

———. 2007b. National Bald Eagle Management Guidelines Critical Habitat Map. Available at: https://www.fws.gov/southdakotafieldoffice/NationalBaldEagleManagementGuidelines.pdf. Accessed February 2017.

———. 2007c. Northern Aplomado Falcon (*Falco femoralis septentrionalis*). Fact Sheet U.S. Department of Defense and U.S. Fish & Wildlife Service. Available at: https://www.fws.gov/endangered/esalibrary/pdf/aplomado_falcon_ fact_sheet.pdf. Accessed April 2018.

———. 2008a. Revised designation of critical habitat for the wintering population of the piping plover (*Charadrius melodus*) in North Carolina. Federal Register 73(204):62816–62841.

———. 2008b. Slender Rush-pea (*Hoffmannseggia tenella*) 5-Year Review: Summary and Evaluation. USFWS Corpus Christi Ecological Services Field Office. Corpus Christi, Texas.

———. 2009a. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for Wintering Population of the Piping Plover (*Charadrius melodus*) in Texas. Federal Register 74(95):23476-23600.

———. 2009b. Whooping Cranes and Wind Development – An Issue Paper. USFWS Regions 2 and 6.

———. 2009c. Black Lace Cactus (*Echinocereus reichenbachii* var. albertii) 5-year Review: Summary and Evaluation. USFWS Corpus Christi Ecological Services Field Office. Corpus Christi, Texas.

———. 2010a. Draft Ocelot (*Leopardus pardalis*) Recovery Plan, First Revision. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, New Mexico.

———. 2010b. South Texas Ambrosia (*Ambrosia cheiranthifolia*) 5-Year Review: Summary and Evaluation. USFWS Corpus Christi Ecological Services Field Office. Corpus Christi, Texas.

———. 2011. Species Assessment and Listing Priority Assignment Form – Red Knot (*Calidris canutus* ssp. rufa). U.S. Fish and Wildlife Service, Northeast Region, Hadley, Massachusetts.

———. 2012. Comprehensive Conservation Strategy for the Piping Plover (*Charadrius melodus*) in its Coastal Migration and Wintering Range in the Continental United States. USFWS East Lansing, Michigan.

———. 2013a. Endangered and Threatened Wildlife and Plants; Rufa Red Knot Background Information and Threats Assessment. Available at: https://www.fws.gov/northeast/redknot/pdf/20141125_REKN_FL_supplemental_doc_FINAL.pdf.

Accessed April 2018.

———. 2013b. Gulf Coast Jaguarundi Recovery Plan (*Puma yagouaroundi cacomitli*), First Revision. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, New Mexico.

———. 2014a. Northern Aplomado Falcon (*Falco femoralis septentrionalis*) 5-Year Review: Summary and evaluation.

———. 2014b. Rufa red knot background information and threats assessment; supplement to Endangered and Threatened Wildlife and Plants; Final Threatened Status for the Rufa Red Knot (*Calidris canutus rufa*) [Docket No. USFWS-R5-ES-2013-0097; RIN AY17].

———. 2017. Species Profile Website. Available online at: https://ecos.fws.gov/ecp/species-reports.U.S. Fish and Wildlife Service

———. 2018a. Information for Planning and Conservation (IPaC). Available online at: http://ecos.fws.gov/ipac/.U.S. Fish and Wildlife Service

———. 2018b. Critical Habitat Map. Available online at: http://fws.maps.arcgis.com/home/webmap/viewer.html ?webmap=9d8de5e265ad4fe09893cf75b8dbfb77.

———. 2018c. Species Profile for Whooping crane (*Grus americana*). Available at: https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B003. Accessed June 2018.

———. 2018d. Factsheet on Green Sea Turtles. Available online at: https://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/green-sea-turtle.htm. Accessed April 2018.

———. 2018e. Kemp's Ridley Sea Turtle Fact Sheet. Available at: https://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/kemps-ridley-sea-turtle.htm. Accessed April 2018.

USFWS and National Marine Fisheries Service (NMFS). 1998. Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act. Available on-line at https://www.fws.gov/ENDANGERED/esa-library/pdf/esa_section7_handbook.pdf.

USFWS Interior; National Marine Fisheries Service, Commerce. 2016. Listing Endangered and Threatened Species and Designating Critical Habitat; Implementing Changes to the Regulations for Designating Critical Habitat 2016, 81 Federal Register 7413. 11 February 2016 pp 7413-7440.

Urho, L. and R. Hudd. 1989. Sub-lethal effects of an oil spill on fish (herring) larvae in the northern Quark, in the Baltic. In: Blaxter, J.H.S., J.C. Gamble, and H.V. Westernhagen, eds. The Early Life History of Fish, 1988 Oct. 3-5, Bergen, Norway. Third ICES Symposium: Rapports et Proces-Verbaux Des Reunions 191. Copenhagen: International Council for the Exploration of the Sea. p. 494.

U.S. Geological Survey (USGS). 2018. NAS -Nonindigenous Aquatic Species: Pterois volitans/miles Available at: https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=963. Accessed March 2018.

———. 1999. Chemical Quality of Sediment Cores from the Laguna Madre, Laguna Atascosa, and Arroyo Colorado, Texas. USGS Fact Sheet FS-139-99. Available online at: https://pubs.usgs.gov/fs/1999/0139/report.pdf

———. 2015. Websoil Survey. Available at: Geological Survey. National Land Cover Data. 2016. http://websoilsurvey.sc.egov.usda.gov/ App/WebSoilSurvey.aspx. Accessed December 2015. U.S. Available at: http://landcover.usgs.gov/ landcoverdata.php. Accessed April 2018.

Van de Laar F.J.T. (2007) Green light to birds: Investigation into the effect of bird friendly lighting. NAM, The Netherlands report.

West, Kristi L.; Mead, James G.; and White, Whitney. 2011. Mammalian Species. American Society of Mammalogists. Volume 43. Pages 177-189. Available online at: http://www.bioone.org/doi/full/10.1644/886.1

Williams, S.I. & Heck, K.I., Jr. 2001. Seagrass community ecology. *In* Bertness, M.D., Gaines, S.D. & Hay, M.E. [Eds.] *Marine Community Ecology*. Sinauer Associates, Inc., Sunderland, MA, pp. 317-337.

Witherington, B.E., and R.E. Martin (1996) Understanding, assessing, and resolving light-pollution problems on sea turtle nesting beaches. Fla Mar Res Inst Tech Rep TR–2.