DEEPWATER PORT LICENSE APPLICATION FOR THE BLUEWATER SPM PROJECT

VOLUME II – ENVIRONMENTAL EVALUATION

Section 6 – Aquatic Environment

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ACRONYMS AND ABBREVIATIONS

ac	acre
bbl.	million barrels
BMP	best management practices
BOEM	Bureau of Ocean Energy Management
BWTT	Bluewater Texas Terminal, LLC
CBBEP	Coastal Bend Bays and Estuaries Program
CFR	Code of Federal Regulations
cm	centimeter
CWA	Clean Water Act of 1977
CZMA	Coastal Zone Management Act of 1972
DMPU	dredge management placement unit
DOI	Department of the Interior
DWH	Deepwater Horizon
DWPA	Deepwater Port Act
E.O.	Executive Order
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EO	Executive Order
FFWCC	Florida Fish and Wildlife Conservation Commission
FMP	fishery management plans
FR	Federal Register
ft	feet
ft/sec	feet per second
GMFMC	Gulf of Mexico Fishery Management Council
GOM	Gulf of Mexico
gpm	gallons per minute
ha	hectare
HDD	horizontal directional drill
IMO	International Maritime Organization
ITOPF	International Tanker Owners Pollution Federation Limited
km	kilometer
LEDPA	Least Environmentally Damaging Practicable Alternative
m	meter
m/s	meters per second
MARPOL	International Convention for the Prevention of Pollution from Ships, adopted in 1973 and modified by the Protocol of 1978
mg/yr	million gallons per year
mi	mile
mm	millimeter
MPA	Marine Protected Area
mph	miles per hour
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act of 1969
NERR	National Estuarine Research Reserves
NHC	National Hurricane Center

NMS	National Marine Sanctuaries
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRDA	Natural Resource Damage Assessment
NTL	Notices to Lessees
NWF	National Wildlife Federation
NWR	National Wildlife Refuge
OCS	Outer Continental Shelf
P.L.	Public Law
PLEM	pipeline end manifold
PPA	Pollution Prevention Act of 1990
RBSSA	Redfish Bay State Scientific Area
RHA	U.S. Rivers and Harbors Act of 1899
RRC	Railroad Commission of Texas
SPM	single point mooring
sq km	square kilometer
sq mi	square mile
TCEQ	Texas Commission on Environmental Quality
TPWD	Texas Park and Wildlife Department
TSS	total suspended solids
TWDB	Texas Water Development Board
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VLCC	very large crude carriers
WOUS	Waters of the U.S.

6 Aquatic Environment

This section discusses the existing aquatic environment within the vicinity of the Proposed Project and the Alternative Project, and the anticipated environmental impacts associated with the construction, operation, and decommissioning of the Proposed Project and the Alternative Project. The detailed description of the Proposed and Alternative Project and the framework for the evaluation of environmental impacts is provided in Section 3 of Volume II.

6.1 Applicable Laws and Regulations

Bluewater Texas Terminal, LLC (BWTT) has reviewed the following laws and statutes that relate to the aquatic environment and provided a list of applicable regulations required to comply with the Deepwater Port Act (DWPA) during construction and operation of the Proposed Project. Applicable laws and statutes are discussed below.

6.1.1 State

6.1.1.1 Seagrass Protections

Redfish Bay contains all five native species of seagrasses and has the second largest area of continuous seagrass beds in Texas. Due to these seagrass beds, the area was proclaimed a State Scientific Area in 2000. In 2006, mandatory regulations were implemented to prohibit the uprooting of seagrasses specifically in Redfish Bay. Additionally, in 2013, the Texas Legislature passed a statewide rule prohibiting uprooting of any seagrass across the entire Texas coast (Texas Park and Wildlife Department [TPWD] 2019a). Currently, there are 34 cut points to allow for boater access to Redfish Bay while minimizing seagrass impact that are strictly enforced (TPWD 2019b). Additionally, the Mission-Aransas National Estuarine Research Reserve, which partially overlaps Redfish Bay enforces these state laws for protection of seagrasses

6.1.1.2 Clean Water Act Section 401 – Water Quality Certification

One of the requirements for obtaining a U.S. Army Corps of Engineers (USACE) Section 404 permit is certification from the Texas Commission on Environmental Quality (TCEQ) that the discharge to be permitted will comply with state water quality standards. The State of Texas sets its own water quality standards, which act as a measure of whether the quality of each waterbody in the state is kept at the level necessary to perpetuate the human and aquatic life uses. In allowing pollutants to be added to state water (which includes a broad range of substances such as chemicals, concrete, rock, sand, or other materials), both the federal government and the State of Texas are required to ensure that the discharge will not impair the ability of life existing in or depending on the water to survive and reproduce. The state is charged with confirming that the federal permit accomplishes this. While the TCEQ is the agency with primary responsibility for making sure the State of Texas adopts and enforces state water quality standards and typically conducts 401 certification reviews, the Railroad Commission of Texas (RRC) has jurisdictional authority over the transportation and storage of crude oil in the State of Texas. Therefore, for the Proposed Project, the RRC will be responsible for issuing the water quality certification which enforces state water quality standards. Water quality standards are further discussed in Section 4: Water Quality.

6.1.2 Federal and International

The Proposed Project is located in federal waters regulated by the DWPA. Therefore, BWTT has reviewed the following laws and statues that relate to the aquatic environment required to comply with the DWPA during construction and operation of the Proposed Project; Marine Protected Areas, Executive Order (EO) 13158, 65 FR 24909; Marine Protection, Research, and Sanctuaries Act of 1972, Pub. L. 92–532, 16 U.S.C. 1431, et. seq. and 33 U.S.C. 1401, et. seq.; National Wildlife Refuge (NWR) System Administration Act; Coral Reef Protection, EO 13089, 63 FR 32701; Antiquities Act of 1906 (Nation Park System); National Estuarine Research Reserves (NERR) under the CZMA; Outer Continental Shelf Lands Act administered by the Bureau of Ocean Energy Management (BOEM), Notices to Lessees (NTLs); NEPA, Public Law (P.L.) 91–190, 42 U.S.C. 4321, *et.* seq.; CWA Section 402 National

Pollutant Discharge Elimination System (NPDES) and CWA Section 10 of the Rivers and Harbor Act; Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), P.L. 104-297, 16 U.S.C. 180 et seq. Additional laws are applicable to species within aquatic environments, and are discussed in Section 8: Wildlife and Protected Resources

6.1.2.1 Marine Protected Areas

Under EO 13158, a Marine Protected Area (MPA) is any “area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein.” There are more than 1,200 MPAs in the U.S., protecting about 26 percent of U.S. marine waters (National Marine Protected Areas Center 2016). These areas have various levels of protection, depending on the managing agency and resources protected. Examples of areas covered by the broader definition of MPA include, but are not limited to, National Marine Sanctuaries (NMS), NERR, fishery management areas, state parks, and Wildlife Management Areas.

6.1.2.2 National Marine Sanctuaries Act

The National Marine Sanctuary Program was created by Title III of the Marine Protection, Research and Sanctuaries Act of 1972, which was renamed the NMS Act in 1992 (16 U.S.C. 1431 et seq.). The Secretary of Commerce, under the NMS Act, designates and protects areas of the marine environment deemed nationally significant because of various qualities (including importance due to conservation, recreation, ecology, history, science, culture, archeology, education, or esthetics). There are 13 designated NMS and two that are currently in the process of being designated (National Oceanic and Atmospheric Administration [NOAA] 2019a). Two designated NMS are in the Gulf of Mexico (GOM; the Flower Garden Banks NMS and the Florida Keys NMS); the closest (Flower Garden Banks NMS) is about 143 miles (mi) (230.1 kilometer [km]) east of the single point mooring (SPM) buoy systems.

6.1.2.3 National Wildlife Refuge System

The NWR System Administration Act, as amended by the Refuge Improvement Act of 1997, consolidated lands administered by the Secretary of the Interior, through the U.S. Fish and Wildlife Service (USFWS), into a single NWR System (USFWS 2019a). The Act specifies that the mission of the system is to “administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the U.S. for the benefit of present and future generations of Americans (USFWS 2019b).” The management and extent of public use within each NWR is dictated by various legislation and the administrative action that created the unit (USFWS 2019a).

The closest NWR to the Proposed Project is the Aransas NWR, which is approximately 17 mi (27.4 km) from the closest point of the Onshore Pipelines and is about 25 mi (40.2 km) from the offshore SPM buoy systems 2,000 feet (ft; 609.6 m) from the Proposed Project area. The Aransas NWR, which encompasses Matagorda Island and portions of the adjacent mainland, was established in 1937 to serve as “a refuge and breeding ground for migratory birds and other wildlife…” (USFWS 2019c). The Matagorda Island unit, a barrier island, is about 38 mi (61 km) long and includes salt marsh, tidal flats, and beaches. There are no public means for accessing the island, resulting in a relatively undisturbed barrier island ecosystem (USFWS 2019d).

6.1.2.4 Coral Reef Protection Act

Under EO 13089, federal agencies determine whether or not actions may affect coral reefs, thereby ensuring that any authorized activity will not reduce ecosystem conditions, and will work to protect, and if possible, enhance the ecosystems. The Proposed Project will not impact any coral reefs and the closest one (Stetson Bank, which is part of the Flower Garden Banks NMS) is approximately 159.9 mi (257.3 km) east of the SPM buoy systems.

6.1.2.5 Coastal Zone Management Act - National Estuarine Research Reserves

The National Estuarine Research Reserves (NERR), authorized by the CZMA is administered by the NOAA and managed by a lead state agency or university. This program provides protection to select coastal areas and includes a network of 29 coastal estuaries striving for long-term research, education, and coastal stewardship (NOAA 2019a).

The closest NERR to the Proposed Project area is the Mission-Aransas NERR, located approximately 1,600 ft (0.5 km) east in Port Aransas, Texas and within the Redfish Bay State Scientific Area (NOAA 2019b). This NERR is managed by the University of Texas Marine Science Institute and serves as a “living laboratory” for ongoing research of estuarine resources (NOAA 2019c).

6.1.2.6 Outer Continental Shelf Lands Act Administered by the BOEM - Notice to Lessees and Operators

The BOEM’s NTLs are formal documents that provide clarification, description, or interpretation of a regulation or Outer Continental Shelf (OCS) standard; provide guidelines on the implementation of a special lease stipulation or regional requirement; or provide a better understanding of the scope and meaning of a regulation by explaining BOEM’s interpretation of a requirement. The applicability and adherence to NTLs have been considered during siting and will continue to be considered during construction and operation of the Proposed Project.

NTL No. 2009-G39 provides and consolidates guidance for the avoidance and protection of biologically sensitive features and areas (i.e., topographic features, pinnacles, live bottoms [low relief features]), and other potentially sensitive biological features, when conducting OCS operations in water depths less than 984 ft (300 meters [m]) in the GOM. In the context of this NTL, topographic features are isolated areas of moderate to high relief that provide habitat for hard-bottom communities of high biomass and diversity and large numbers of plant and animal species, and support, either as shelter or food, large numbers of commercially and recreationally important fishes. Live bottoms (pinnacle trend features) are small, isolated, low to moderate relief carbonate reef features or outcrops of unknown origin or hard substrates exposed by erosion that provide surface area for the growth of sessile invertebrates and attract large numbers of fish. Live bottoms (low relief features) are seagrass communities, areas that contain biological assemblages consisting of sessile invertebrates living upon and attached to naturally occurring hard or rocky formations with rough, broken, or smooth topography; and areas where a hard substrate and vertical relief may favor the accumulation of turtles, fishes, or other fauna. Potentially sensitive biological features are those features not protected by a biological lease stipulation that are of moderate to high relief (about 8 ft [2.4 m] or higher), provide surface area for the growth of sessile invertebrates, and attract large numbers of fish (BOEM 2010). The Proposed Project will affect OCS Lease Blocks 698 (SPM buoy system 1) and 699 (SPM buoy system 2), as well as Lease Blocks 695, 696, and 697 (pipelines); none of these blocks are identified as restrictions per NTL No. 2009-G39. The closest blocks with an applicable stipulation are about 23 mi (37 km) to the southeast of the SPM buoy systems (BOEM 2018). Further, side-scan sonar surveys of the Proposed Project area did not identify any biological features of moderate to high relief, which will require avoidance of bottom-disturbing activities.

6.1.2.7 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 Proposed Project will qualify as a major federal action and trigger the requirement for NEPA analysis. Under the DWPA, the U.S. Coast Guard (USCG) will initiate the NEPA process and have federal jurisdiction over the entire Project under NEPA. The USCG and Maritime Administration have determined that an environmental impact statement will be prepared to support the NEPA process.

6.1.2.8 Clean Water Act Section 402 – National Pollutant Discharge Elimination System

The Federal Water Pollution Control Act Amendments of 1972, known as the CWA, authorizes the U.S. Environmental Protection Agency (USEPA) to issue NPDES permits. This authority has been delegated to 45 of the 50 states. In 1998, the USEPA delegated authority to the State of Texas (TCEQ) to implement the NPDES to permit surface water and stormwater discharges, predominately from industrial and domestic wastewater facilities, as well as from certain construction sites. The RRC has jurisdictional authority over the transportation and storage of crude oil in the State of Texas; however, the RRC has not been delegated authority by USEPA to administer the NPDES program for non-exempt oil and gas operations.

The CWA 402(l)(2) provides that EPA will not require permit for uncontaminated stormwater discharges from oil and gas exploration, production, processing, or treatment operations or transmission facilities. This exemption applies to both construction and industrial activities associated with oil and gas exploration, production, processing or treatment operations, or transmission facilities. Therefore, the Harbor Island Booster station does not require a NPDES permit.

The SPM buoy systems will operate in federal waters, outside State of Texas waters. The SPM buoy systems will not result in any discharges during operations and the vessels connected to the SPM buoy systems will be operating in the capacity as a means of transportation. Therefore, it is BWTT's understanding that neither the SPM buoy systems nor the vessels loading crude oil will come under the jurisdiction of the USEPA's NPDES Permit Program.

Minor permit authorization under the RRC Statewide Rule 8 is required for discharge of water resulting from a hydrostatic testing of a pipeline or vessel into or adjacent to water in the state. Since the RRC is not delegated authority under the NPDES, authorization for discharges of hydrostatic test waters must also be obtained from USEPA Region 6. Hydrostatic discharges will comply with the requirements of both the RRC and USEPA hydrostatic test water discharge permits.

6.1.2.9 Clean Water Act – Section 10 of the Rivers and Harbors Appropriation Act of 1899

The USACE permit authority is derived from Section 10 of the RHA; Section 404 of the CWA; Section 103 of the Marine Protection, Research, and Sanctuaries Act; and Section 4(f) of the Outer Continental Shelf Land Act. These acts give the USACE jurisdiction over all the Waters of the U.S. (WOUS). Coastal Texas waters in the Proposed Project area fall under the jurisdiction of the USACE, Galveston District. District resource and regulatory specialists evaluate permit applications for construction work in navigable waters, and/or for disposal of dredged material. Section 10 of the RHA regulates navigable waters and is required for any constructed structure for the entire Project. Section 404 regulates any disturbance to substrate, wetlands and special aquatic sites, including Project construction and operation within WOUS (e.g., wetlands and other special aquatic sites).

A single USACE permit that covers both Section 10 of the RHA, as well as Section 404 of the CWA, is required for the Proposed Project and is included as part of Volume I of this submittal. A Section 401 certification review of the Section 404 permit application from the USACE will be conducted by the RRC to maintain consistency between state and federal reviews for crude oil projects. This ensures all actions that involve or affect water quality meet the requirements and standards of all agencies involved.

6.1.2.10 Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA)

The 1996 Sustainable Fishery Act amendments to the MSFCMA 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 MSFCMA 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 U.S.C. 1802(10)).

6.2 Proposed Project Impacts

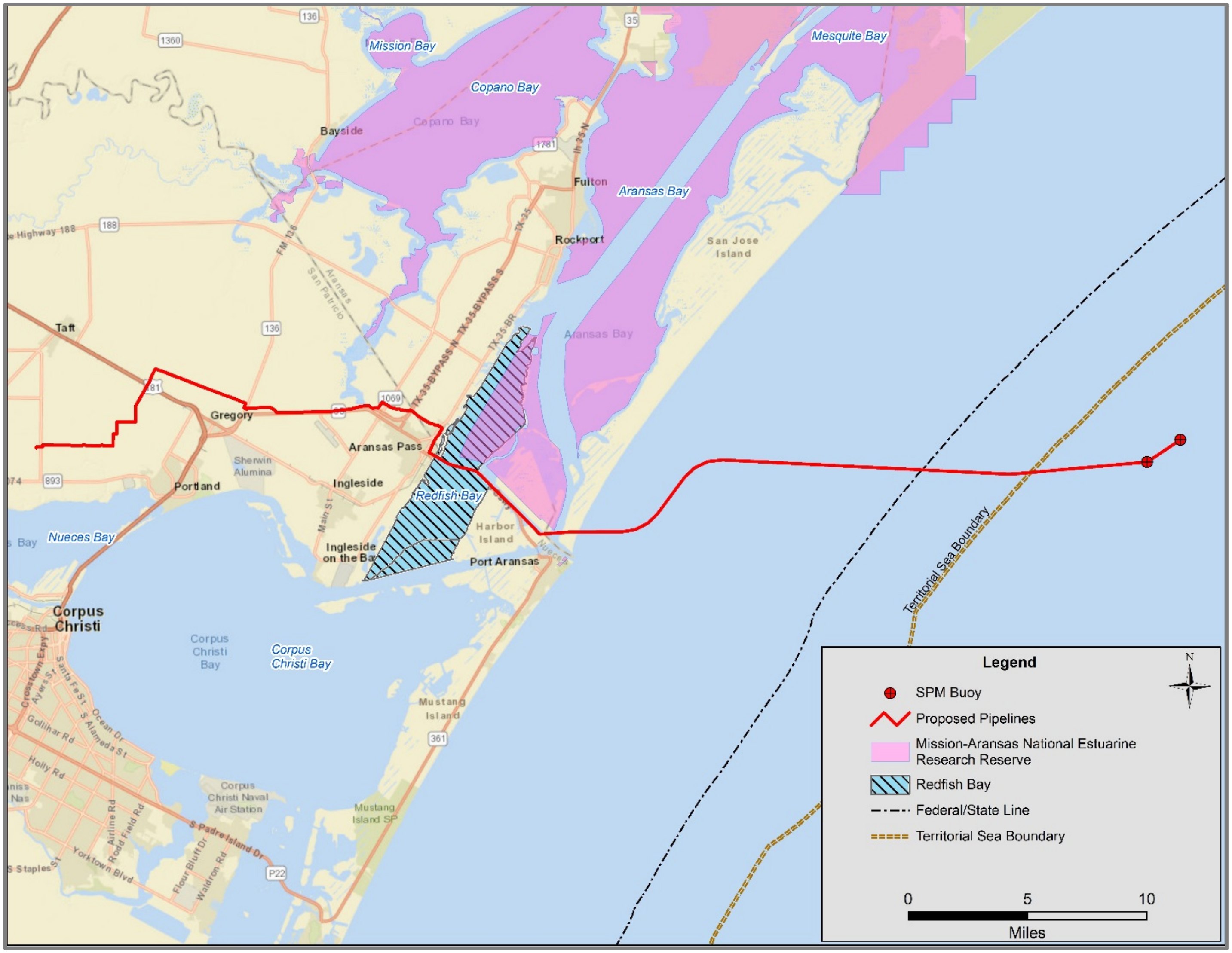
6.2.1 Proposed Project Area

Significant impacts on the aquatic habitats identified above are those that measurably impact the ecological viability and sustainability of the resource. As proposed, the Proposed Project will include installation of approximately 56.5 mi (90.9 km) of dual, 30-inch-diameter pipeline and the offshore SPM buoy systems located in 88.5 to 89.5 ft (27.0 to 27.3 m) of water, within the Exclusive Economic Zone (EEZ). Impacts on aquatic habitats will be limited to those components of the Proposed Project that cross waterbodies within the onshore environment, or are in inshore (Redfish Bay) or offshore (seaward of Mustang and San Jose Islands) 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 Proposed Project that were used to evaluated environmental consequences in the following sections.

6.2.2 Proposed Project Area Existing Conditions

The Proposed Project area considered for aquatic resources encompasses all freshwater, estuarine, and marine waters within the immediate vicinity of the Onshore Pipelines, Inshore Pipelines, Offshore Pipelines, and both SPM buoys (which make up the SPM buoy systems). The Onshore Pipelines will cross freshwater surface waterbodies, where the Proposed Project area is considered to include waterbodies within, or immediately adjacent to, the construction workspaces. The Inshore Pipelines will occur in estuarine and marine waters between Redfish Bay and San Jose Island, opposite the City of Aransas Pass and including Aransas Channel; this roughly triangular area makes up the Inshore Project area. The Offshore Pipelines and SPM buoy systems will be in the marine waters of the GOM; effects to the aquatic environment area assessed within marine waters shoreward of San Jose and Mustang Islands, out to the EEZ (Figure 6-1).

Figure 6-1: Islands, Bays and Special Use Areas in the Proposed Project Vicinity



Source: BOEM 2019

6.2.2.1 Onshore

The Onshore Pipelines will commence at the location of a planned multi-use terminal facility located south of Taft, Texas. The Onshore Pipelines will traverse east towards Gregory and continue on through Aransas Pass, Texas, transitioning into the Inshore Pipelines at the mean high tide line of Redfish Bay. A total of the 54 waterbodies including 36 ephemeral waterbodies, four intermittent waterbodies, four manmade waterbodies, six natural ponds, and four perennial streams were identified within the survey corridor for the Proposed Project. All waterbodies and ponds in the Proposed Project area are freshwater. None of these waterbodies have any designated aquatic life uses or impairment classifications. Waterbodies are generally classified as perennial, intermittent, or ephemeral. While perennial waterbodies are typically capable of supporting populations of fish, intermittent and ephemeral waterbodies generally provide limited habitat value for aquatic resources due to restricted water flow regimes.

6.2.2.2 Inshore

There is a nearly continuous estuarine ecosystem along the northern GOM coast, comprising 31 major estuarine systems (BOEM 2017). Within the 367 mi (591 km) of Texas coastline, there are 12 major and minor estuaries that differ in size and ecological/hydrological characteristics (Texas Water Development Board [TWDB] 2019a). The inshore areas (landward of San Jose and Mustang Islands and including Redfish Bay) of the Proposed Project are part of the Coastal Bend Bays and Estuaries complex, which includes three individual estuaries (Mission-Aransas, Corpus Christi, and Nueces Bays; USGS 2010a). The complex includes barrier islands, wetlands (tidal and freshwater marshes, including wind tidal flats), open bays, seagrass meadows, oyster reefs, and serpulid worm reefs (Coastal Bend Bays and Estuaries Program [CBBEP] 2018a). The Mission-Aransas Estuary consists of Aransas Bay, Copano Bay, and several smaller bays including Redfish Bay, Mission Bay, and Saint Charles Bay that span approximately 111,780 ac (45,236 ha) and receive an annual average of 490,000-acre-feet of freshwater flow from major rivers and surrounding coastal basins (TWDB 2019b). Waterbodies crossed by the Inshore Pipelines include the Intracoastal Waterway, Redfish Bay, Aransas Channel (which connects Redfish Bay to the GOM), and the Lydia Ann Channel. As discussed in Section 7: Commercial and Recreational Fisheries, many fishes and invertebrates are dependent on, or make use of, estuaries at some point in their life cycle.

In February and March of 2019, an aquatic resources survey was conducted within four irregularly-shaped polygons, which together encompassed all waters crossed by the Inshore Pipelines. The study areas covered a total of 288 ac (116.5 ha), as depicted in Figures 1 through 3 of Appendix I, Aquatic Resources Survey Report. The surveys identified eight resource or substrate types within the study area; these resources are identified in Table 6-1.

Table 6-1: Resources and Substrates in Inshore Study Areas

Resource	Acreage				
	Site A	**Site B**	**Site C**	**Site D**	**Total**
Algae bed	0.0	0.2	7.3	0.0	7.5
deep water, 8 ft (2.4 m)+	38.3	32.4	11.2	64.1	146.0
Firm, moderately firm, or soft / mud / sand	18.2	45.3	0.4	13.6	77.5
Inland	16.6	3.2	3.2	0.0	23.0
Intertidal marsh	4.9	10.1	0.8	0.1	15.9
Scattered oyster shell	0.1	<0.1	3.2	0.0	3.3
Seagrass	15.3	8.2	2.7	0.8	27.0
Shell hash	1.0	2.2	0.4	5.2	8.8
Total	**94.4**	**101.5**	**29.1**	**83.8**	**308.8**

6.2.2.2.1 COASTAL BARRIER BEACHES

The GOM shoreline is approximately 1,631 mi (2,625 km) long and includes coastlines of Florida, Alabama, Mississippi, Louisiana, and Texas (NOAA 2008). Barrier islands make up more than two-thirds of the northern GOM's coastline. They are dynamic landforms, with winds and waves constantly modifying and moving the sand, such that the island is continually accreting and eroding. Barrier islands within the GOM can be divided into five geologic subareas; the subarea affected by the Proposed Project is the Texas Barrier Island Complex. This complex extends from the Mexican border to Galveston Bay. The barrier islands within this complex are mostly accreted sediments that were reworked from river deposits, previously accreted Gulf shores, bay and lagoon sediments, and exposed seafloors (BOEM 2017).

The Inshore Pipelines will cross the southern portion of San Jose Island, a barrier island located adjacent to Aransas Pass and the Mission-Aransas NERR. San Jose Island is a privately-owned island that is managed principally for wildlife. The public is only allowed on beach areas, below the vegetation line; however, vehicles are prohibited (Port Aransas Chamber of Commerce and Tourist Bureau 2019).

Two smaller islands between San Jose Island and the mainland will also be crossed (Harbor Island and Stedman Island). Harbor Island is directly behind San Jose Island and is accessible from multiple named channels, one of which (Aransas Channel) splits the island into two halves. Harbor Island is zoned for industrial activity and is home to oil and gas facilities (Port of Corpus Christi 2019). Stedman Island is a smaller island between Harbor Island and the mainline, which is traversed by Highway 361 and powerlines, and is also home to oil and gas facilities.

6.2.2.2.2 WETLANDS

Wetlands are a subset of the WOUS that are regulated under Section 404 of the CWA. Wetlands associated with the Proposed Project are located in the outer coastal plain region which consists of low lying, flat-to-rolling terrain containing numerous streams, abundant rainfall, and a complex coastline which supports the establishment of wetlands. Generally, coastal marshes, beach/dune systems, and wet flats are seen within the outer coastal plain region. Wetlands within the Proposed Project area consist of coastal lowlands, tidal marshes, flats, estuaries, islands, mangrove wetlands, and river deltas. In addition, coastal fringe wetlands may be found within estuaries, bays, and along the shoreline of the region (USACE 2010). Wetland habitats, which are common along the coast, provide necessary needs for various shorebirds, waterfowl, and avian colonial nesting species by providing food resources as well as forage fishery species. Wetland impacts are discussed in detail in Section 5: Wetlands and Waters of the U.S.

6.2.2.2.3 OPEN BAYS

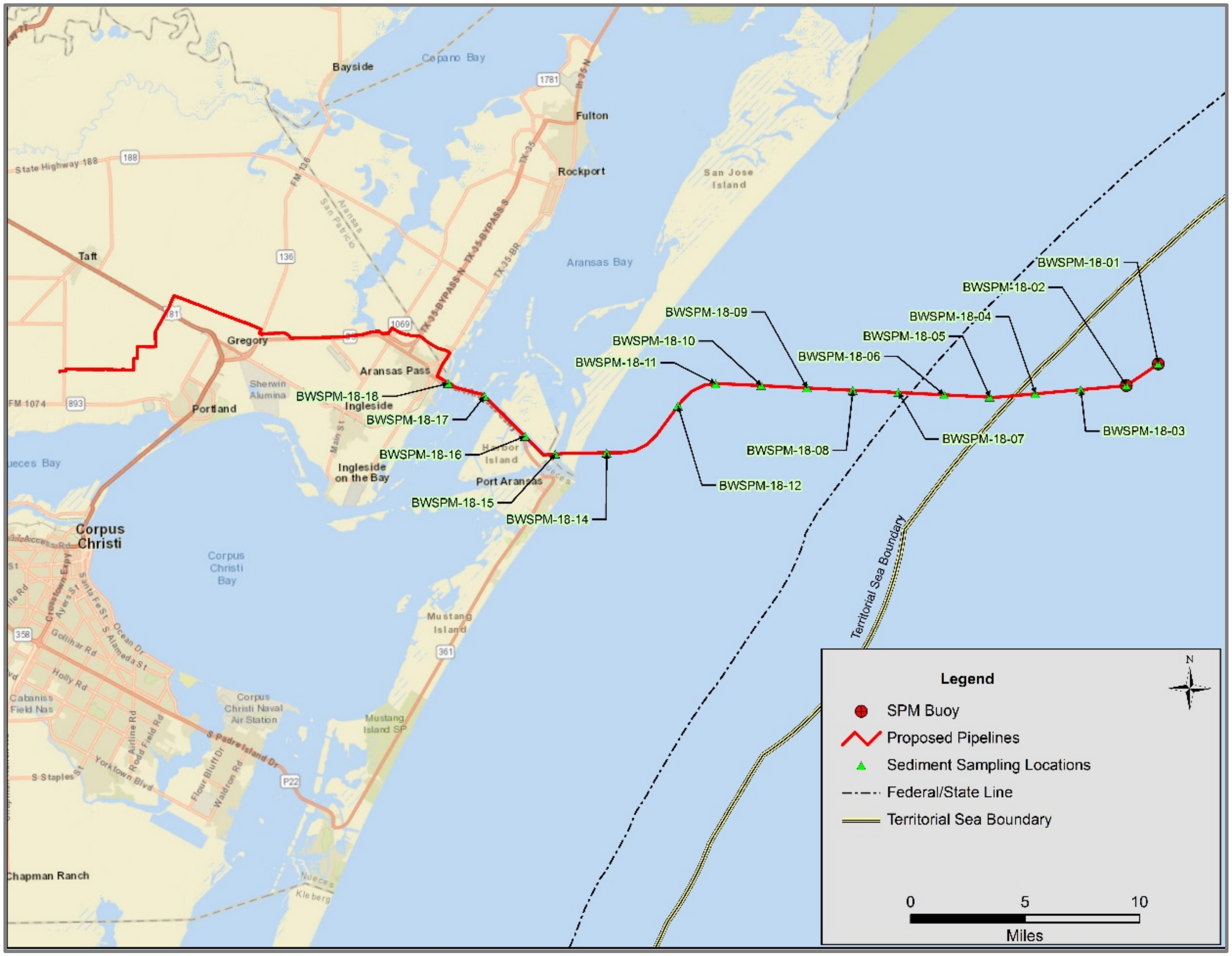
There are two open bays in the Proposed Project area, including Redfish Bay and South Bay, which are encompassed in the Redfish Bay State Scientific Area; and Aransas Bay, which is included in the Mission-Aransas NERR.

Sediment sampling conducted along the Proposed Project route indicates that the inshore sediments are primarily composed of silty sand and sandy silts containing small amounts of clay. Additionally, sampling points located ranged from 0.0172 to 0.2123 millimeters (mm) in the inshore waters. Table 6-2 provides the grain size of sampled sediments; sediment chemistry data are provided in Appendix C. Sampling stations are depicted in Figure 6-2. Benthic infauna associated with these soft-bottom habitats are discussed in Section 8.

Table 6-2: Sediment Characterization of sediments within the Inshore Pipelines Route.

Sample ID	latitude	longitude	Sand (%)	Silt (%)	Clay (%)	Gravel (%)	Phi Size	Physical Description
BWSPM-18-15	27.852330	-97.059572	97.0	2.8	0.2	0.0	0.5410	Sand
BWSPM-18-16	27.863864	-97.080982	90.4	6.0	3.6	0.0	0.4157	Sand
BWSPM-18-17	27.889593	-97.109506	29.5	58.4	12.1	0.0	-0.1189	Silt
BWSPM-18-18	27.898071	-97.135225	18.5	69.3	12.2	0.0	-0.0253	Silt

Figure 6-2: Sediment Sampling Locations within the Proposed Project Area



REDFISH BAY STATE SCIENTIFIC AREA

The Redfish Bay State Scientific Area (RBSSA) encompasses the majority of the inshore waters between the inland side of San Jose Island and the mainland, and is bounded to the west and east by the Corpus Christi Channel and Aransas Bay, respectively. The RBSSA, which also includes South Bay, is designated as a State Scientific Area due to the approximately 32,000 ac (12,950 ha) of biologically sensitive communities including seagrass beds, oyster reefs, marshes, and mangroves (TPWD 2019a, b). The RBSSA is known to contain approximately 14,000 ac (5,665.6 ha) of submerged seagrass beds with all five species of Texas seagrass species present, which makes it an important nursery habitat for shrimp, crab, and juvenile game fish. Seagrass in this area also provides food for sea turtles, shorebirds, and waterfowl, and mangroves provide roosting, feeding, and nesting habitat (TPWD 2019a, b).

Due to the presence of seagrasses and the potential for long-term scarring from propeller scars, TPWD recommends the use of airboats, johnboats, shallow water boats, or trolling motors when traversing shallow waters. Although anchoring is allowed in the area, it is illegal to allow the uprooting of any seagrass plants by submerged propeller (TPWD 2019a). The Inshore Pipelines will cross the RBSSA for a total of 6.5 mi (10.5 km); however, all open water areas will be crossed using horizonal directional drill (HDD) in order to prevent impacts to seagrass areas.

MISSION-ARANSAS NATIONAL ESTUARINE RESEARCH RESERVE

The Mission-Aransas NERR includes 185,708 ac (75,153.4 ha) of aquatic habitat that includes all or portions of Redfish Bay, Aransas Bay, Copano Bay, St. Charles Bay, and Mesquite Bay (see Figure 6-1). The goal of the NERR, which is administered by the University of Texas in partnership with multiple state and federal entities, is to promote, and improve knowledge of, the Texas coastal zone ecosystems (Mission-Aransas NERR 2019). In addition to open water habitat, this NERR includes freshwater, brackish, and salt marshes; mangroves; oyster reefs; seagrass and tidal flats; and riparian habitats (see Figure 6-1; University of Texas Marine Science Institute 2015).

6.2.2.2.4 SEAGRASS BEDS

There are approximately 235,000 ac (95,101.1 ha) of seagrass bed habitat located along the Texas coast (TPWD 2019b). Seagrasses are submerged flowering plants anchored to the seafloor that grow within bays, lagoons, and shallow coastal waters. These grasses require light for photosynthesis and are therefore highly dependent upon water quality and clarity for survival. Seagrasses support a large number of invertebrates and fish, many of which are commercially and recreationally important (Handley, Altsman, and DeMay 2007).

Redfish Bay contains the second (next to Laguna Madre) most extensive, pristine, seagrass bed along the Texas coast. This area consists of approximately 14,000 ac (5,665.6 ha) of submerged seagrass beds which provide important habitat for aquatic and avian species (USGS 2010b, TPWD 2019b). The generally shallow depths and polyhaline conditions of redfish bay support the growth of shoal grass (*Halodule beaudettei*), star grass (*Halophilla engelmannii*), manatee grass (*Cymodocea filiformis*), turtle grass (*Thalassia testudinum*), and widgeon grass (*Ruppia maritima*); however, turtle grass and manatee grass are the predominant species (USGS 2010b, TPWD 2019c).

Based on the results of the aquatic resources survey, a total of 27.0 ac (10.9 ha) of seagrasses are present within the inshore survey areas, as described above. Shoal grass was the only species identified and decreased in prevalence from Survey Site A to Survey Site D (see Table 6-1). Additional information on the seagrass areas identified, including figures of seagrass bed locations, is provided in Appendix I.

6.2.2.2.5 OYSTER REEFS

Generally, oyster reefs in the northern GOM are located in less than 9 ft (2.7 m) of water; however, they have been known to exist at depths as great as 15 ft (4.6 m) (Kilgen and Dugas 1989). Oyster reefs serve a large ecological role to fisheries, providing nursery habitat, food, and protection for adult and juvenile species (National Wildlife Federation [NWF 2013]). Oyster reefs are inhabited by a variety of aquatic species including forage fish, crabs (Brachyura), and amphipods which fill a multi-faceted roll for a variety of finfish, providing nutrient recycling; organic matter; and a food source. In the northern GOM, fish species including speckled trout (*Cynoscion nebulosus*), striped bass (*Morone saxatilis*), and sheepshead (*Archosargus probatocephalus*) are known to favor oyster reefs for foraging areas (NWF 2013, NOAA 2019d).

Oyster reef habitat is generally found near the mouths of estuaries in areas with low to moderate wave action but has also been recorded in small estuarine streams and bayous of intertidal or subtidal areas. Due to their location, which is generally subtidal, habitat associated with oyster reefs can significantly affect sedimentation rates. Historically, the majority of oyster reefs in Texas were located in Galveston Bay with some additional reefs in the Corpus Christi-Aransas Bay area (Kilgen and Dugas 1989).

NOAA's GOM Data Atlas identifies oyster reefs intermittently within Redfish Bay (Figure 6-3). The closest known reef area is approximately 220 ft (67.1 m) from the Inshore Pipelines. About 0.4 ac (0.2 ha) of oyster beds were identified within the inshore survey polygons, as described above; scattered shell and shell hash were also present (see Table 6-1 and Appendix I).

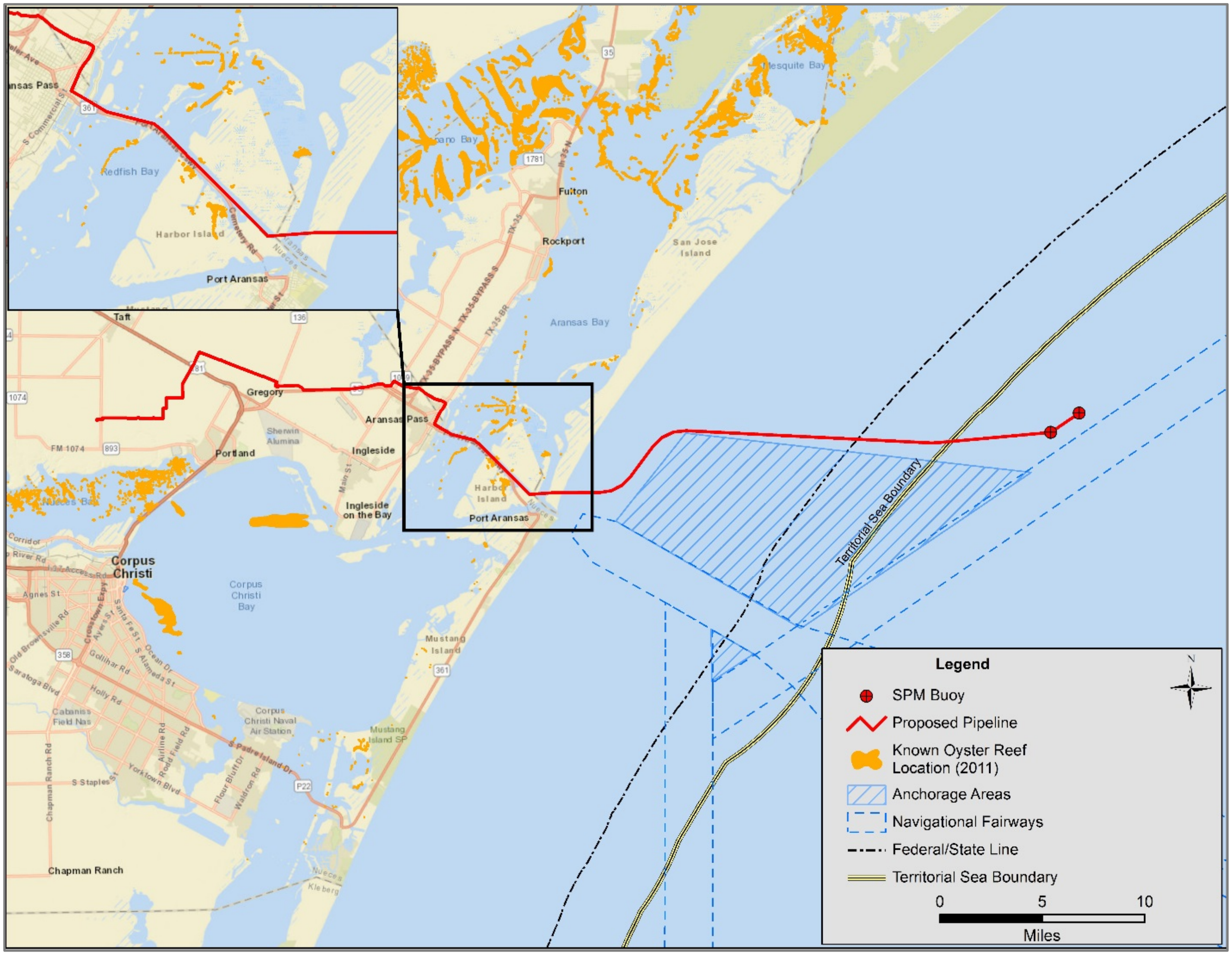
6.2.2.2.6 SERPULID REEFS

Serpulid reefs are calcareous reefs providing inland hard-bottom habitats within hypersaline bays. These reefs provide a unique hard-bottom habitat amongst areas that are generally dominated by soft-bottom sediments. Serpulid reefs formed from the calcareous tubes of polychaeta worms approximately 3,000 years ago and ceased formation 300 years ago (NWF 2013). Like oyster reefs, these reefs provide essential needs to aquatic ecosystems such as shelter, food, and protection, which can increase species populations and diversity. These ancient reefs are located just south of Baffin Bay within the Laguna Madre, approximately 48 mi (77.2 km) south of the Proposed Project area (Spiller and Blankinship 2019).

6.2.2.3 Offshore

The continental shelf portion of the GOM extends over a gradual slope from the coastline to the shelf/slope transition, which is generally considered to be in water depths of about 660 ft (201.2 m, Byrnes et al. 2017). Offshore habitats within the GOM include soft-bottom communities, hard/live bottom habitats, artificial reefs, the water column, submerged aquatic vegetation, and *Sargassum* mats, each of which support varied species assemblages. Those areas with structure (e.g., hard/live bottoms, reefs, and *Sargassum*) typically have higher species density and diversity and are often managed or considered separately than those that are more prevalent throughout the GOM (e.g., soft bottoms and the water column). The SPM buoy systems will be located on the continental shelf, at a water depth of about 88.5 to 89.5 ft (27.0 to 27.3 m); the Offshore Pipelines will transit from the SPM buoy systems, moving through progressively shallower waters until reaching the shore of San Jose Island.

Figure 6-3: Oyster Reefs in the Proposed Project Vicinity



Source: BOEM 2019, NOAA 2019e.

6.2.2.3.1 SOFT-BOTTOM HABITATS

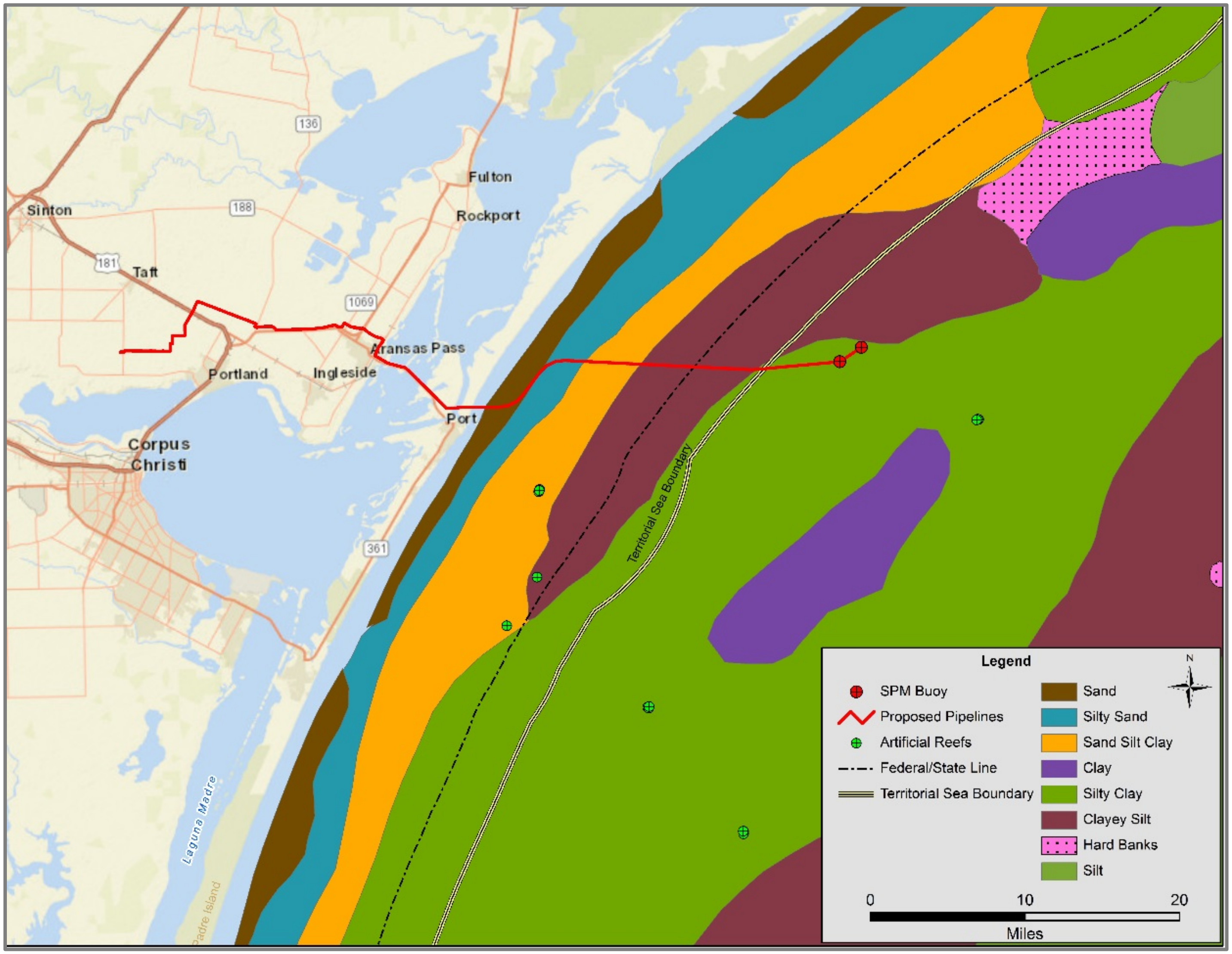
Soft-bottom habitats are the primary benthic habitat associated with the northern GOM. These habitats consist primarily of unvegetated, soft, muddy bottoms made of less stable sediments including sand, clay, silt, and gravel (NOAA 1978, Flint 1981). The soft-bottom habitat within the GOM supports flora and fauna living atop (epifauna) or within (infauna) the substrate (NOAA 1978). Infaunal communities generally include polychaete worms (bristle worms), crustaceans, and mollusks living within benthic substrates whereas epifaunal communities include crustaceans, echinoderms, mollusks, hydroids, sponges, and soft and hard-corals living near or on benthic substrates. Additionally, shrimp and demersal fish are closely associated with benthic communities. In general, infaunal density decreases with a combination of increasing fine sediments and depth (Byrnes et al. 2017). According to available data from the Florida Fish and Wildlife Conservation Commission (FFWCC) – Fish and Wildlife Research Institute, the Proposed Project will be within soft-bottom silty sands at the seaward extent of the Proposed Project, but the sediments transition to coarse and fine-grained sand as they approach the shore (FFWCC 2019; see Figure 6-4).

Sediment sampling conducted along the Proposed Project route indicates that the offshore sediments are primarily composed of silty sand and sandy silts containing small amounts of clay. Additionally, sampling points located ranged from 0.0088 to 0.1242 mm. Table 6-3 provides the grain size of sampled sediments; sediment chemistry data are provided in Appendix C. Sampling stations are depicted in Figure 2 of Appendix C. The benthos inhabiting soft-bottom habitats within the Proposed Project area are discussed in Section 8: Wildlife and Protected Resources.

6.2.2.3.2 HARD-BOTTOM HABITATS

Hard-bottom habitats are described as naturally occurring, rocky consolidated substrates consisting of exposed sedimentary bedrock or other biogenic sources such as carbonate coral reefs. Hard bottoms are generally in areas of low relief consisting of eroded limestone, sandstone, shell and shell fragments, and coral. Sessile invertebrates including hydroids, anemones, sea whips, sponges, and encrusting algae attach to and cover the hard substrate, creating what is termed as “live bottoms” (USGS 1999, Cummins et al. 1962). The attached flora and fauna of live bottoms can enhance the structural complexity of the benthic environment. The complex structure offers shelter that is utilized by small invertebrates and fishes, which, in turn may provide food for a variety of larger fish species (Gallaway et al. 2009). Hard-bottom features may include pinnacle trends (carbonate reef materials of various size and relief) and topographic features (banks). Hard-bottom habitats play an important ecological role in the marine environment and are considered biologically sensitive.

Figure 6-4: Sediment Substrate in the Proposed Project Vicinity



Source: BOEM 2019, FFWCC 2019

Table 6-3: Sediment Characterization of Sediments within the Offshore Pipelines Route

Sample ID	latitude	longitude	Sand (%)	Silt (%)	Clay (%)	Gravel (%)	Phi Size	Physical Description
BWSPM-18-01	27.902577	-96.628119	22.4	44.5	33.0	0.0	6.6561	Silt
BWSPM-18-02	27.889361	-96.651156	28.4	46.6	24.9	0.0	6.2049	Silt
BWSPM-18-03	27.887297	-96.683696	34.3	38.2	27.5	0.0	6.1736	Silt
BWSPM-18-04	27.885223	-96.716247	30.8	39.4	29.9	0.0	6.3090	Silt
BWSPM-18-05	27.883666	-96.748782	23.2	44.9	31.9	0.0	6.5712	Silt
BWSPM-18-06	27.885641	-96.781354	28.1	44.5	27.3	0.0	6.2872	Silt
BWSPM-18-07	27.887607	-96.813931	20.8	49.2	30.0	0.0	6.5501	Silt
BWSPM-18-08	27.889567	-96.846490	23.5	48.7	27.8	0.0	6.3849	Silt
BWSPM-18-09	27.891524	-96.879098	33.9	39.9	26.2	0.0	6.0256	Silt
BWSPM-18-10	27.893464	-96.911675	48.6	33.8	17.6	0.0	5.1359	Sand
BWSPM-18-11	27.895095	-96.944210	90.9	5.8	3.3	0.0	3.1968	Sand
BWSPM-18-12	27.881489	-96.971449	97.8	2.2	0.0	0.0	3.0788	Sand
BWSPM-18-13	27.859111	-96.992137	98.5	1.5	0.0	0.0	3.0081	Sand
BWSPM-18-14	27.852562	-97.022913	36.3	43.0	20.7	0.0	5.8179	Silt

Generally, the northern GOM is not considered suitable for the development of reef-building communities due to physical and geochemical factors including temperature, sedimentation, and water clarity. However, certain areas within the northwestern GOM are an exception to this as they are higher relief areas located away from the Mississippi River, where waters are clearer and warmer (Thompson et al. 1999). However, no hard-bottom habitat is present within 11 mi (48 km) of the Proposed Project (see Figure 6-4).

6.2.2.3.3 ARTIFICIAL REEFS

The natural formation of reefs began around 3,000 years ago and ended 300 years ago. In order to prevent the degradation of reefs and to supplement the natural reef habitat, artificial reefs were established beginning in the early 19th century along the coastline (NWF 2013). Artificial reefs provide valuable habitat for a variety of marine species in areas that do not have the necessary materials for hard-bottom habitat to occur. These reefs, which generally comprise of various materials such as shell, limestone, concrete rubble, and metal debris, have been known not only to attract fish, but also to increase the production of fish in an area (Stone et. al. 1979, MDMR 1999, NWF 2013). Artificial reefs are constructed for a variety of reasons, but are generally focused on increased fish population and density as well as recreational diving (South Atlantic Fishery Management Council 2019).

In the northern GOM, manmade structures such as bridge spans, decommissioned rigs, pilings, and sunken ships, are used to create artificial reef habitat which is used by invertebrates and associated species (South Atlantic Fishery Management Council 2019, NWF 2013). Within Texas, the Artificial Reef Program was created in 1990 to promote, develop, maintain, monitor, and enhance the artificial reef potential of Texas offshore waters. The program partners with various organizations to create and maintain more than 3,000 ac (1,214 ha) of artificial reefs in Texas waters. Focused efforts include turning decommissioned ships and oil platforms, as well as concrete and heavy-gauge steel, into artificial reefs (TPWD 2019d). These anthropogenic structures have been historically successful as artificial reefs and provide habitat for a variety of fish species. Platforms often support tropically-dependent species including: blennies (Blennidae), sheepshead (*Archosargus probatocephalus*), and butterflyfishes (Chaetodonitidae) (GOM Fishery Management Council [GMFMC] 2004). Tropically independent species on platforms generally consist of Atlantic spadefish (*Chaetodipterus faber*), lookdowns (*Selene vomer*), Atlantic moonfish (*Selene setapinnis*), red snapper (*Lutjantus campechanus*), large tomtate (*Haemulon aurolineatum*), groupers, and creole fish (*Paranthias furcifer*) (GMFMC 2004). A wide variety of large, transient species are also known to frequent artificial reefs.

In addition to artificial reefs, large inlets or ship channels are protected by jetties and concrete or rubble breakwaters along bay and barrier island shorelines. The flora and fauna of these jetties is a combination of epibenthic organisms from nearby offshore areas and oyster reefs, and tropical species that prefer artificial substrates (TPWD 2019e). The nearest artificial reef (Boatmen's Reef) is located approximately 5.7 mi (9.2 km) south of the Proposed Project (TPWD 2019f; see Figure 6-5).

6.2.2.3.4 WATER COLUMN

The water column includes habitat within the mass of water between the surface and the substrate, excluding benthic or structural features. Waters occur above the continental shelf within the neritic zone 656 ft (200 m) of the ocean known as the photic zone, where sunlight can penetrate, and photosynthesis can occur (BOEM 2012).

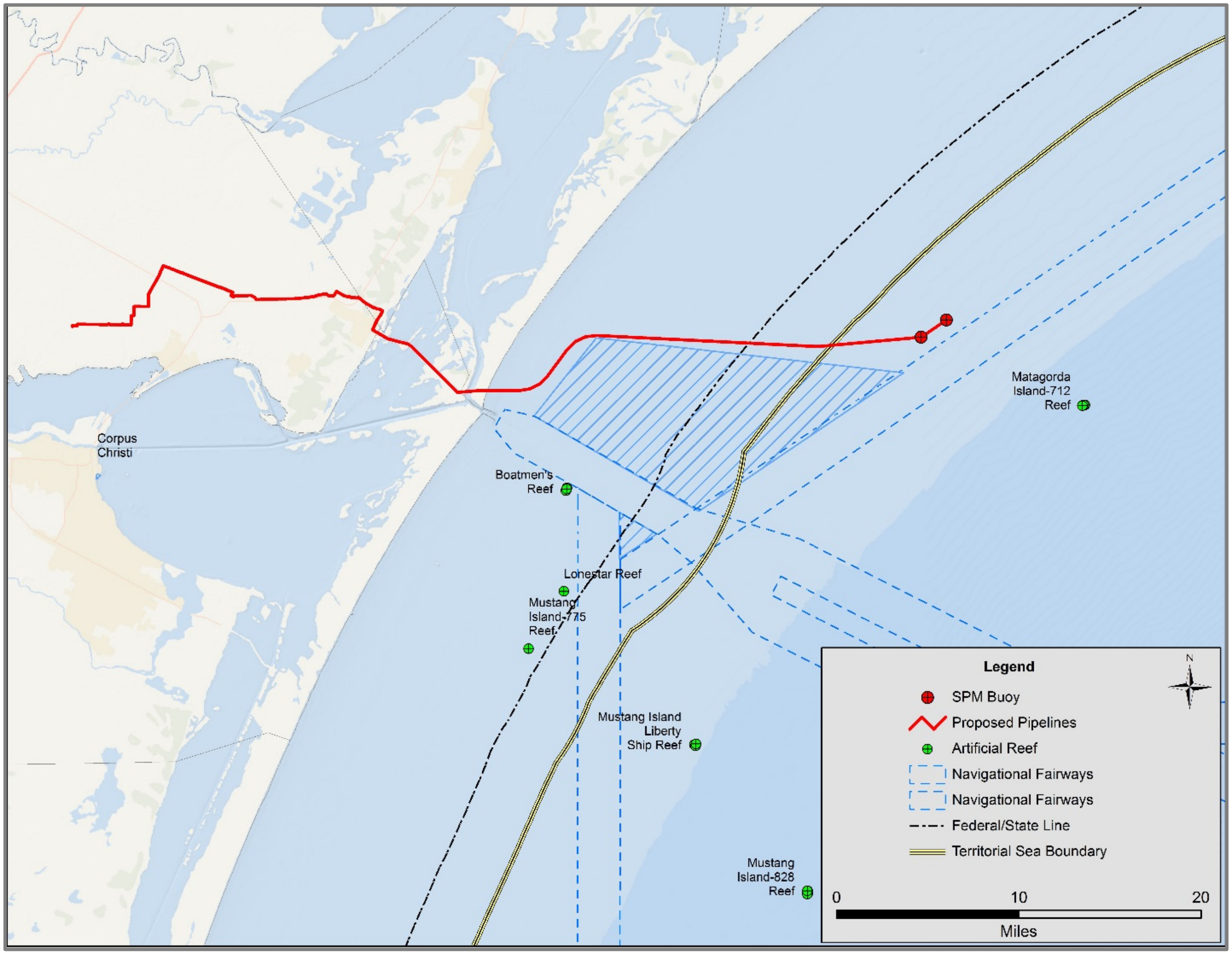
The base of the open-ocean food web is plankton, which includes small plants and algae (phytoplankton) and animals (zooplankton) that are generally at the mercy of currents. Phytoplankton are photosynthetic organisms that produce the bulk of organic matter in aquatic ecosystems. Zooplankton include organisms that remain in the planktonic community throughout their lives (holoplankton), as well as planktonic life stages of larger organisms that will eventually leave the planktonic community (meroplankton) (Byrnes et al. 2017). A relatively small component of the zooplankton community in the upper 656 ft (200 m) of the water column are ichthyoplankton, which include eggs, larvae, and juveniles (Southwest Fisheries Science Center 2019). The distribution of ichthyoplankton is a function of the location of spawning adults, currents, and sea-surface temperatures (Byrnes et al. 2017). The planktonic community is described in greater detail in Section 8: Wildlife and Protected Resources.

CIRCULATION

Within the GOM, a semi-enclosed system, water temperature and salinity vary seasonally in association with changes in river inflow, down- and upwelling, surface solar heating, and winds. The dominant circulation feature in the GOM is the Loop Current, which flows into the GOM from the straits of Yucatan through the GOM and through the Straits of Florida. At times, the current is confined to the southeastern GOM; at other times, it forms a large loop that extends onto the continental shelf of the northeastern GOM. At intervals of 5 to 19 months, warm-core eddies between 124 and 249 mi (200 and 400 km) in diameter separate from the Loop Current and travel into the western GOM and last up to one year (BOEM 2012). These warm-core eddies transport warm, salty water and serve to connect the eastern and western GOM (BOEM 2017). Other, cold-water eddies also form at the edge of the Loop Current associated with nutrient-rich, highly productive waters from upwelling (BOEM 2017). The Loop Current plays an important role in the nutrient balance of shelf waters, as well as the transport of larvae and floating *Sargassum* habitat (GMFMC 2004).

On the Texas continental shelf, where the Proposed Project facilities are planned, meteorological effects can significantly affect circulation, including interruptions by tropical cyclones during the summer months. Typically, inner-shelf currents flow in the north or east direction in the summer months, and reverse flow during the remainder of the year (BOEM 2012).

Figure 6-5: Artificial Reefs in the Vicinity of the Proposed Project.



Source: TPWD 2019f

WAVES AND TIDES

Waves are one of the primary factors controlling sediment transport, deposition, and erosion in coastal habitats. Wind direction and intensities vary seasonally, with winter cold fronts causing strong onshore winds and increased wave heights. Average wave-height in the GOM ranges from 1.6 ft (0.5 m) in the summer and 4.9 ft (1.5 m) in the winter. However, most coastal environments experience wave heights less than 2.0 ft (0.6 m) in fair weather (Byrnes et al. 2017).

The tidal range throughout the GOM is generally less than 3.3 ft (1 m); however, GOM tides are widely variable, including areas with tides described as semidiurnal (two high and two low tides per day), diurnal (one high and one low per day). The South Texas area is generally identified as having diurnal tides, although semidiurnal tides have been recorded at Aransas Pass (NOAA 2019e).

There is a marked diurnal inequality for tides within much of the GOM. This inequality is emphasized during the two periods each month when the moon's declination is high (north or south). At these times, one high water and one low water are frequently seen each day. Tides in the open ocean are typically of smaller amplitude than tides along the coastline, mainly due to shoaling.

METEOROLOGICAL CONDITIONS

The Proposed Project area in southeastern Texas has a humid, subtropical climate, where summers are long and hot and winters are short and mild. Along the southeastern Texas coast and offshore, climate is influenced by the GOM, which moderates seasonal temperatures along the coast and provides the state's major source of precipitation. Meteorological conditions are discussed in more detail in Section 13: Meteorology, Air Quality, and Noise.

HURRICANES AND CYCLONES

Tropical conditions, which are known to cause hurricanes (tropical cyclones), generally occur in the GOM from June 1 to November 30 of each year (National Hurricane Center [NHC] 2019). Hurricanes are known to greatly impact the continental shelf and are known navigational hazards for marine vessels (Keen & Glenn 1999, Holweg 2000). During these storm events, severe wind conditions increase the speed of surface currents, causing the cooling of surface waters and subsequent mixing of the stratified water column. Waves and currents can increase to velocities greater than 100 centimeters (cm) (1 m) per second on the continental shelf during these events (Havens et. al 2011). Additionally, cold fronts (along with wave conditions), and tropical cyclones may affect near-surface water temperatures, even though water temperature deeper than 328 ft (100 m) remains unaffected.

The GOM is contained within the Atlantic tropical cyclone basin. In the North Atlantic Basin, one of the two most prominent areas which pose a danger of hurricanes is the GOM (Holweg 2000). Hurricanes utilize warm, tropical air during their formation, rising upward from the ocean surface. When warm air rises off of the surface, an area of low air pressure occurs and is filled by surrounding high pressure air which is heated and begins to rise. As this process continues, circular movement within the atmosphere (including clouds) begins to spin and grow. The whole system is fed by ocean warmth as well as ocean water evaporating from the surface (National Aeronautics and Space Administration [NASA] 2019a). The abundant depth of warm water in the GOM is capable of fueling sudden and sustained intensification of tropical cyclones (Holweg 2000). The GOM has the ability to develop hurricanes during cooler periods as well due to the warm GOM air contrasting with cooler air along the continental boundary of North America (NASA 2019b).

In general, Atlantic cyclones will enter into the GOM from the Yucatan Channel. Hurricane intensity is measured on the Saffir-Simpson Scale and ranges from a Category 1 storm with sustained winds from 74 to 95 miles per hour (mph) (33.1 to 42.5 meters per second [m/s]) that produce some damage, to a Category 5 storm with sustained winds > 157 mph (70.2 m/s) that produce catastrophic damage (NHC 2019). Aransas and San Patricio Counties were impacted by 6 to 7 major hurricanes (Category 3 or above), respectively between 1900 and 2010, and the estimated return period for a major hurricane passing within 58 mi (93.3 km) of the coast of these counties is about 33 years

(NHC 2019). Hurricanes that have directly impacted the Texas coastline in recent years include Category 1 and 2 hurricanes such as Rita (2005), Humberto (2007), Ike (2008), and Harvey (2017). These hurricanes reported sustained winds of over 90 mph (40.2 m/s). The most recent Category 3 hurricane to strike the Texas coast was Hurricane Bret in 1999, which made landfall on South Padre Island with sustained winds of 115 mph (51.4 m/s).

6.2.2.4 Sargassum

Sargassum is a genus of brown algae that forms dense floating mats in tropical Atlantic waters and is transported into the GOM on circum-tropical currents. The floating mats provide habitat to a wide range of species in the water column and are an essential component of the water column habitat in the GOM. The floating mats include a diverse community of epibiota (algae, fungi, and invertebrates), more than 100 species of fish, and 4 species of sea turtle. About 10 percent of the invertebrate species and two fish species found using *Sargassum* mats are endemic (native or restricted to *Sargassum*) (GMFMC 2004).

Shrimp and crab come into contact with *Sargassum* as it drifts with the current through the GOM, comprising the bulk of the invertebrates that utilize *Sargassum* mats. *Sargassum* also acts as a vehicle for dispersal of some of its inhabitants and might be important in the life histories of many species of fish, providing them with a substrate, protection against predation, and concentration of food in the open GOM. Large predators associated with the *Sargassum* complex include amberjacks (*Seriola dumerili*), dolphin (*Coryphaena hippurus*), and almaco jacks (*Seriola rivoliana*) (GMFMC 2004).

6.2.3 Proposed Project Construction Impacts

As discussed in Section 3: Project Description and Framework for Environmental Evaluation, the environmental consequences of the Proposed Project will vary in duration and significance. Four levels of impact duration were considered: temporary, short-term, long-term, and permanent. Temporary impacts generally occur during construction, with the resource returning to pre-construction conditions almost immediately afterward. Short-term impacts are considered to be those that may continue for up to 3 years following construction. Impacts are considered long-term if the resource will require more than 3 years to recover. A permanent impact could occur as a result of any activity that modified a resource to the extent that it will not return to pre-construction conditions during the life of the Proposed Project, such as within the footprint of the Proposed Project. When determining the significance of an impact, we consider the duration of the impact, the geographic and biological context in which the impact will occur, and the magnitude and intensity of the impact. The duration, context, and magnitude of impacts vary by resource and therefore significance varies accordingly.

Refer to Appendix A for details on construction procedures and figures representing construction workspaces.

6.2.3.1 Onshore

Impacts on aquatic resources from the Onshore Pipelines could result from in-water construction, inadvertent spills, and hydrostatic testing. Construction of the pipelines through waterbodies may occur through one of three methods, including open-cut, conventional bore, and horizontal directional drill. The final method of construction through each waterbody will be determined during detailed engineering of the final pipeline route however major water body crossings are planned to be completed using HDD techniques.

In general, impacts resulting from open-cut pipeline construction at waterbody crossings could include sedimentation and turbidity, alteration or removal of in-stream and stream bank cover, and introduction or disturbance of pollutants. An open-cut crossing will result in temporary increases in turbidity downstream of the pipeline crossing, if water is flowing at the time of construction; however, the concentration of suspended solids will decrease rapidly after completion of in-water work, which will likely last a day or two at each stream. Direct loss of benthic invertebrates and protective cover may occur at open-cut crossing locations due to trenching and backfilling in the streambed. None of the waterbodies crossed are known to contain contaminated sediments that could be resuspended and transported downstream (USEPA 2004, USEPA 2019). Following construction of the Onshore Pipelines, waterbody contours will be restored to pre-construction conditions and affected areas revegetated as appropriate.

Impacts on aquatic organisms within waterbodies that will be crossed by trenchless construction methods (conventional bore and HDD) will generally be avoided since the waterbody and its banks will not be disturbed by clearing or trenching. 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 will follow the path of least resistance, fluids may come to the surface over the Onshore 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. If a release were to occur in a waterbody, the substance will settle on the streambed after discharge, resulting in the smothering of benthic organisms that are within the affected area. In the case of any inadvertent return, BWTT will implement its Project-specific HDD Inadvertent Return Contingency Plan (see Volume I Appendices), which includes measures to prevent, detect, and mitigate for inadvertent releases of drilling fluid. Water required for the HDD drilling fluid will either be withdrawn from the crossed waterbodies in accordance with applicable water withdrawal permits or will be obtained from municipal sources.

Refueling of vehicles and storage of fuel, oil, or other hazardous materials near surface waters could result in accidental spills that could impact aquatic resources through physical contamination, smothering, habitat degradation, toxic effects, and bioaccumulation. BWTT will implement a Project-specific Spill Prevention, Control, and Countermeasure (SPCC) Plan during construction, which will include spill prevention measures and clean-up methods to reduce potential impacts should a spill occur. With adherence to the mitigation measures in these plans, impacts of potential spills on aquatic resources associated with the Onshore Pipelines will be minor and temporary.

Following construction, the Onshore Pipelines will be hydrostatically tested using water obtained from municipal sources. Because surface water withdrawals are not proposed, impacts on aquatic habitat are not anticipated. Hydrostatic testing is addressed further in Section 6.2.3.3.1, below. In addition, 440,000 gallons will be withdrawn for the hydrostatic testing of HDD segments. Water withdrawals could result in temporary impacts on water flow and entrainment or impingement of fish or other aquatic organisms; however, these impacts are anticipated to be negligible.

6.2.3.2 Inshore

As described in Appendix A, the Inshore Pipelines will be constructed across the RBSSA using the HDD method; no in-water trenching is proposed for Inshore Pipeline installation. Six HDDs will be installed during construction of the Inshore Pipelines, each of which will be staged on land, avoiding in-water impacts and shoreline areas. Staging will occur on the mainland, Stedman Island, Harbor Island, and San Jose Island.

HDD construction methods result in impacts at the entry and exit points of the HDD, but typically avoid impacts between the two points. However, 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 will follow the path of least resistance, fluids may come to the surface over the 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 will 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, BWTT will implement its Project-specific HDD Inadvertent Return Contingency Plan (see Volume I Appendices), which includes measures to prevent, detect, and mitigate for inadvertent releases of drilling fluid.

Although no in-water trenching will occur in inshore waters, turbidity and the resultant sedimentation, may occur during Project-related vessel traffic in shallow waters of the RBSSA, such as that required for the monitoring of inadvertent returns from HDD activities. Turbidity refers to the insoluble, suspended particulates that impede the passage of light through water by scattering and absorbing light energy. The reduction of penetrating light reduces the depth of the photic zone which reduces the depth at which primary productivity occurs. Turbidity, although temporary, reduces the light available to the seagrasses. The resultant sedimentation, however, can cause mounds of deposited sediment that are then prone to resuspension (Handley, Altsman, and DeMay 2007). Studies have shown that seagrasses take 3 to 5 years to recover, if buried by no more than 3 inches of sediment; however, shoal grass (which is present in the RBSSA) could quickly invade buried sites and could outcompete other native species prior to their recovery (USACE and Interagency Coordination Team 2002). As BWTT has designed the Proposed Project to avoid in-water trenching, the potential for increased turbidity and sedimentation due to construction has been minimized to the extent practicable. Further, as previously indicated, the TPWD recommends the use of airboats, johnboats, shallow water boats, or trolling motors when traversing shallow waters through the RBSSA to avoid impacts on seagrasses from propeller scars. BWTT will comply with these recommendations where possible, which will also minimize the extent of localized turbidity from transiting vessels.

As discussed in Section 4: Water Quality and Appendix C, sediment sampling for the Proposed Project identified one location, in Aransas Pass adjacent to Harbor Island, which exceeds NOAA's Effects Range Low benchmark level (representing the 10^{th} percentile of the effects database) for arsenic, but not the effects range median value (representing concentrations above which effects often occur). As HDD crossing methods will be used to cross all inshore waters, no disturbance of these sediments is anticipated.

Given BWTT's use of HDD construction methods to avoid direct impacts on seagrasses, as well as any oyster beds, that may occur in the path of the Inshore Pipelines through the RBSSA, as well as its commitment to avoiding propeller scars on seagrasses, the impacts of Inshore Pipeline construction are anticipated to be negligible and temporary.

6.2.3.3 Offshore

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

At the seaward edge of the HDD (about 3,900 ft [1,188.7 m] from shore), the Offshore Pipelines will cross soft-bottom habitats between the HDD Box to their interconnection with the SPM buoy systems about 17.0 mi (27.4 km) offshore. Offshore, trenching and backfilling for installation of the pipelines will be completed using a submersible pipeline jetting sled operated from an anchored pipe-laying barge. The pipelines will be buried a minimum of 3 ft (0.9 m) below the sediment surface. Operation of the sled will redeposit some material over the pipelines, but full backfilling will occur naturally due to currents and wave movement. Based on a construction workspace width of 75 ft (22.9 m) and the 26.4 mi (42.5 km) of Offshore Pipeline length that will be installed by jetting, approximately 240.0 ac (97.1 ha) off soft-bottom habitat will be directly disturbed during construction. Increased turbidity and sedimentation from trenching activities will also result in indirect impacts on the soft-bottom and water column habitat that occurs immediately adjacent to construction workspaces, and the fauna that use them. Coarse sediments will fall out and resettle quickly while fine sediments remain suspended for a longer period of time; however, once installation is complete, local water turbidity should return to pre-construction levels without mitigation. BWTT conducted modeling to estimate the impact on total suspended solid (TSS) concentrations, a measure of turbidity, in the water column during and after trenching (see Appendix D and Section 4: Water Quality). As depicted in the model results, TSS concentrations will be highest in the immediate area of the trench and will dissipate with distance from the trench, returning to ambient levels within a maximum distance of about 2.1 mi (3.5 km). Along the trench, TSS levels will generally return to pre-construction levels within an estimated 1-2 days. Given the temporary and localized nature of increased turbidity, impacts will be temporary and minor. The concentrations of sand, silt, and clay vary along the route for the Offshore Pipelines; sites located between about 0.7 and 2.7 nm from shore have the greatest percentage of sand (between 91 and 99 percent) and will have relatively minimal impacts; however, other sites dominated by silt and clay will result in sedimentation impacts over a larger area as depicted in Appendix D.

Sedimentation may smother smaller benthic organisms that are unable to avoid the area. Based on conservative model assumptions, sedimentation exceeding 0.04 inch thick will be limited to within 250 ft (76.2 m) of the Offshore Pipelines, and the layer of sediment deposited on the seafloor will decrease with distance. Over time, any difference in deposition thickness will be reduced by ongoing hydrodynamic forces; therefore, impacts on benthic organisms from sedimentation will likely be temporary, localized and negligible (see Appendix D). It is expected that mobile nekton species will be displaced temporarily from the habitat but will return to the area almost immediately following construction. Similarly, the benthic community is expected to recolonize disturbed areas shortly after construction, such that no long-term effects on the community are expected. As further discussed in Section 4: Water Quality and Appendix C, no exceedances of the TCEQ's or NOAA's guidelines regarding sediment concentrations of contaminants were documented for sediment samples collected along the Offshore Pipelines or at the SPM buoy systems. The benthic invertebrates identified during Project-specific surveys are identified in Section 8: Wildlife and Protected Resources.

Underwater noise may be generated by installation of the Offshore Pipelines in nearshore and offshore areas; however, underwater pipeline installation will progress along the route such that construction at any one location is of short duration. Therefore, impacts from pipeline installation noise will be temporary and negligible. Similarly, noise associated with increased vessel traffic will be transient as the vessel moves between Project areas, and will be mitigated through use of low speeds, which will be required for all construction and support vessels. Increases in ambient noise could decrease the quality of habitat provided by the water column and *Sargassum* mats. Noise impacts are further discussed in Section 13: Meteorology, Air Quality, and Noise.

Overall, impacts of the Proposed Offshore Pipeline construction are anticipated to be negligible and temporary.

6.2.3.3.1 HYDROSTATIC TESTING OF THE PIPELINES

The Proposed Inshore and Offshore Pipelines will be hydrostatically tested following construction. Each test Inshore and Offshore Pipelines will include flooding of the pipeline with water and subsequent discharge of the water. The total estimated volume of test water is 16.2 million gallons for the Onshore and Inshore Pipelines combined, landward of the Harbor Island Booster Station, with a discharge rate of 3,000 gallons per minute; these Proposed Project Components will be tested using municipal water and impacts on aquatic resources are not anticipated. The Offshore Pipelines will be hydrostatically tested using 5 million gallons of seawater with a discharge rate of 3,000 gallons per minute. BWTT is investigating the use of biocides, corrosion inhibitors, and environmentally friendly oxygen scavengers for the hydrostatic testing of the Offshore Pipelines. Once more information is available, BWTT will provide supplemental information as required. During hydrostatic testing, water will be pumped through the pipe and filtered through a mesh screen (typically a 100-micron mesh screen with an opening of 0.0059 inches [0.15 mm]) to avoid the entrainment of fish. The discharges will be made in accordance with the terms of the general discharge permit governing hydrostatic testing operations of this type in the GOM and state waters. Water quality will not be impacted as a result of the hydrostatic testing of the proposed Offshore Pipelines. Hydrostatic testing procedures are further discussed in the hydrostatic testing permit application (refer to Volume I).

6.2.3.3.2 DEEPWATER PORT PILE-DRIVING AND INSTALLATION

The seafloor in the Proposed Offshore Project area is a soft-bottom environment, comprised of sandy sediments in areas closer to shore and silt or clayey silt in areas further offshore (see Figure 6-4). No hard-bottom habitat is present within the immediate Project area; the closest identified hard-bottom areas to the SPM buoy systems are about 30 mi (48.2 km) east, in water depths of about 230 ft (70.1 m). To minimize impacts associated with offshore construction, the SPM buoy systems and associated components will be fabricated onshore and delivered to the site by barge. Similarly, 12 anchor piles for each SPM buoy system will be prefabricated on land prior to installation by industry acceptable practices at the offshore location. Noise associated with installation of the anchor piles, and the resulting impacts on fauna, are discussed in Section 8: Wildlife and Protected Species. Although increases in noise will make the aquatic environment less habitable to those species, the effect will be temporary, and no lasting habitat impact will occur. Once installed, the anchor chains will be attached to the piles, and subsequently to the respective SPM buoy system. These construction activities will be of limited duration and are not anticipated to cause long-term adverse effects to the biological community.

Approximately 700 square (sq) ft (0.02 ac [<0.01 ha]) of soft-bottom habitat will be permanently removed within the footprint of the SPM buoy systems components which include 10, 18-inch-diameter piles supporting the pipeline end manifolds (PLEMs) and 24, 72-inch-diameter piles supporting the anchor chains for the SPM buoy systems. Any non-motile biological resources in the footprint of the SPM buoy systems will be lost during installation and the habitat removed for the life of the Proposed Project. Mobile organisms that are displaced during construction are expected to quickly return following construction. With the exception of the benthic community underlying the Proposed Project footprint, the benthos is expected to rapidly recover following construction (Brooks et al. 2006). Impacts beyond the permanent footprint of the Proposed Project are anticipated to be temporary. One potential benefit associated with installation of the SPM buoy systems 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 systems components will result in an increase in turbidity in the water column within and adjacent to the Proposed 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 migrate only a short distance and cover a small area relative to the total habitat available, based on the results of the TSS modeling conducted in the Offshore Proposed Project area (Appendix D). Overall, the increased turbidity and sedimentation is considered a temporary and negligible impact given the extent of locally available soft-bottom and pelagic 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. Lighting of vessels and workspaces will be limited to what is necessary to maintain safe working conditions. Although lighting may attract fishes, and their predators, to the construction area, resulting impacts are expected to be temporary and negligible.

6.2.3.3.3 CONSTRUCTION VESSEL OPERATIONS

Construction and installation activities for the Proposed Inshore and Offshore Project Components will require increased vessel traffic in the Proposed Project vicinity, which 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, any *Sargassum* mats in the immediate vicinity of a discharge, and benthic shallow water habitats, 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 in the marine environment. Each of the vessels involved in Proposed Project construction will operate in accordance with state regulations for water pollution in the inshore waters, and 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 for the offshore water. 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 immediately will 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 (International Tanker Owners Pollution Federation Limited [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) and no solid debris may be discharged from OCS structures and vessels (30 Code of Federal Regulations [CFR] 250.40 and MARPOL, Annex V, P.L. 100-220 [101 Statute 1458]). Therefore, although additional debris may enter the water column incidentally, the anticipated amount is expected to be extremely small.

In addition to impacts incurred by discharges or spills in the water column, any *Sargassum* mats directly in the path of oncoming support and transport vessels may be submerged to depths under the vessel, and portions of the mat may be destroyed by passage under the propeller. However, it is likely that some *Sargassum* mats in the path of vessels will be pushed away from the oncoming vessel due to the pressure of the bow waves and the buoyant nature of the mats. With the exception of anchoring activities, as discussed above, construction vessels are not anticipated to affect benthic habitats, particularly in deeper waters where the discharges will not reach the seafloor. Overall, potential impacts to the aquatic environmental resulting from construction vessel operations are anticipated to temporary and minor.

6.2.4 Proposed Project Operation Impacts

Impacts on the aquatic environment during operation of the Proposed Project will generally be limited to presence of the SPM buoy systems, port calls by the very large crude carriers (VLCCs) (estimated at 16 per month for the two buoys combined), the sporadic transit of support vessels to and from the offshore port, and the presence of the restricted zones (see Section 14: Navigation, Safety, and Security). Once installed, the pipelines will be buried a minimum of 3 ft (0.9 m) below the seafloor. Although the habitats disturbed during construction may take various amounts of time to recover to pre-construction levels, as discussed for construction, no additional impacts will be incurred during operations; therefore, the Onshore and Inshore Pipelines will not the aquatic environment during operation of the Proposed Project. Although not anticipated to occur, a release of petroleum products from the SPM buoy systems or pipelines will also have the potential to impact the aquatic environment.

Refer to Appendix A for details of operation procedures and figures representing the Proposed Project components.

6.2.4.1 Deepwater Port Presence

Once constructed, the SPM buoy systems 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 systems and components attaching it to the seafloor will likely cause fishes to congregate, creating a locally diverse fish assemblage. The SPM buoy systems will require operational lighting for 24-hour operations, as well as navigational beacons. Project lighting may cause behavioral changes in nearby organisms, including attraction of predator and prey species, but will have no measurable effect on the quality of the aquatic environment. Because of the hard structure provided for marine species in an area of otherwise ubiquitous soft-bottom habitat, the presence of the Proposed Project structures is considered a permanent, beneficial impact.

The SPM buoy systems will be attached to the seafloor via anchor chains attached to piles (24 total). As the buoy is floating and will move with the waves, currents, and VLCC activity, the anchor chains will also move, resulting in minor 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 soft-bottom habitat and localized turbidity, each buoy will be limited to a swing circle with a radius of 125 ft (38.1 m). Given the small footprint of the swing circle, the impact to the affected soft-bottom habitat is considered negligible.

6.2.4.2 VLCC Water Use

During facility operations, VLCCs will require the uptake of seawater for engine-cooling, pumps and other equipment, and in support of normal transit operations. The water column will be disturbed via the intake and discharge of water, as could any *Sargassum* present in the immediate area of these activities. Soft-bottom habitats in the Proposed Project vicinity are not expected to be affected by operation of the Proposed Project due to the depth of the water in which it will be located. As VLCCs will remain offshore, no impacts on inshore habitats will occur.

The quantity of seawater withdrawals and discharges from the VLCCs will vary depending on the characteristics and size of each tanker, as discussed in Section 4: Water Quality. Assuming two vessels are always present at the SPM buoy systems (one at each buoy), the amount of water withdrawn is conservatively estimated to be about 1.04 billion gallons per year, representing only a small fraction of the amount of water available within the Proposed 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 (20.1 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 (1.8 m) higher than the lower sea chests. The mesh openings, although relatively large (up to 1.4 inches; Coutts, Moore, and Hewitt 2003), will preclude entrainment of most adult pelagic species. Intake velocities typically remain below 0.5 feet per second (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.

Discharges from the VLCC's cooling water systems are heated discharges, with the temperature of the discharge typically in the range of 5 to 25 °F higher than the temperature of seawater initially withdrawn (USEPA 1999). This intermittent discharge (occurring about 30 minutes per 2 weeks) will result in a heated plume that will return to ambient temperatures as it moves away from the tanker. The VLCCs will arrive at the deepwater port with fully loaded ballast tanks; although ballast water will be discharged during loading, no uptake of seawater for ballast operations will occur at port. Dilution and dispersion will limit the impacts from discharges 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.

Operational intakes/discharges associated with ballasting and engine-cooling will temporarily degrade the water column and any *Sargassum* mats in the vicinity of a discharge. Soft-bottom habitats in the Proposed Project vicinity are not expected to be affected by water use associated with operation of the SPM buoy systems due to the depth of the water in which it will be located. As discharges will quickly dilute, their overall impact is expected to be long-term but localized and minor.

6.2.4.3 Support Vessel Mooring and Ancillary Operations

Support vessels will regularly transit from shore to the SPM buoy systems and between the SPM buoy systems and incoming VLCCs. In addition, a minimum of two supply tugs will be onsite at the SPM buoy systems during mooring operations. If two VLCCs are mooring (or disconnecting) simultaneously, then two tugs and one smaller hose/line handling boat will be present for each SPM buoy system. Although regularly occurring, these vessel transits and tug operations are not anticipated to have any lasting effect on the aquatic environment as they are consistent with ongoing vessel activity in the GOM, and as such, negligible.

6.2.4.4 Restricted Operations Zone

The safety zone established for the SPM buoy systems and VLCCs will restrict non-Project-related activities within approximately 939 ac (380 ha) of the marine environment which will otherwise be available for fishing opportunities. In addition, the hard structures associated with the SPM buoy systems will provide new structure for epifaunal colonization and fisheries recruitment over time; therefore, as the safety zone will prohibit fishing activities, this new habitat and faunal community will be protected from fishing pressures.

6.2.4.5 Inadvertent Product Release

The probability of a major crude oil spill is extremely low (see Volume I Appendices). The major elements of the Proposed Project that could leak crude oil in the marine environment include the SPM buoy systems and the pipelines. Under the worst-case discharge scenario, a volume of 120,770 barrels of crude oil would be released. Trajectory models were completed for the Proposed Project, to evaluate the coastal impact (how much oil makes landfall), in the event of a worst-case discharge from all the Offshore Components. The trajectory and time that a worst-case scenario spill from either of the SPM buoy systems would remain on the surface varies between about 12 and 18 days seasonally; with the exception of subsurface oil during the fall seasonal trajectory model, oil is projected to remain offshore and not enter inshore areas behind GOM-facing barrier islands. Modeling scenarios were run for all seasons, and only during the fall scenario would any subsurface oil reach inshore areas; otherwise, oil released at the SPM buoy systems would remain offshore. Oil spilled from locations along the Offshore and Inshore Pipelines would be more likely to reach inshore waters and coastal habitats. The results of the trajectory models assume no response efforts were employed and therefore no oil was contained, recovered, or diverted. However, in the actual situation of an unanticipated discharge, BWTT would implement its Tactical Response Plan (see Volume I) and highly-trained tactical response teams would be mobilized immediately to initiate mitigation efforts.

Inshore and offshore habitats that could be affected in the event of a spill, as described in Section 6.2, include coastal barrier beaches, wetlands (including mangroves), seagrass beds, inshore oyster reefs, soft-bottom habitats, offshore hard-bottom habitats and artificial reefs, *Sargassum*, and the water column in the RBSSA and offshore. Depending on the location of a spill, these habitats may become oiled. The degree of impact on each habitat depends on the volume of oil that reaches the affected habitat and the state of the oil (fresh or lightly or highly weathered). After oil is released into the environment, it undergoes a wide variety of physical, chemical, and biological processes that begin to transform the oil almost immediately. During the first 5 days post-spill, oil typically weathers through evaporation (particularly of the lighter hydrocarbon fractions of the oil); natural dispersion (the breakup of an oil slick into small droplets); dissolution (mixing of the water-soluble components of oil into the water); and emulsification (during which the oil forms a mousse; NOAA 2002). In addition, the formation of tarballs (small patches of oil that persist for long distances) occurs within the first days to weeks post-release (NOAA 2002). Potential impacts on coastal wetland and water quality in the event of a spill are further described in Section 4: Water Quality.

If a spill were to happen near shore, or occur offshore but reach the coast, oil would likely impact coastal barrier beaches. When oil reaches shore on a sandy beach, it may penetrate into the sand, depending on the viscosity of the oil and the grain size of the sand. Generally, more highly weathered oil (such as tarballs) penetrates the sand less readily than fresh oil, and fine-grained sand beaches are more compact and prevent deep oil penetration (NOAA 1992). Mechanical equipment can be used to remove oil from sandy beaches, and wave energy may aid clean-up. In addition, storms and wave energy remove oil from sandy beaches. While removal of contaminated sand from the shore following a spill may alter the shore profile, natural accretion of sand or beach nourishment may be used to restore the shoreline to pre-spill conditions. Therefore, impacts on coastal barrier beaches in the event that oil from a spill reaches shore, while adverse, are not likely to be significant.

Most seagrass beds in the Proposed Project area are protected from offshore spills by San Jose and Mustang Islands; however, in the event of a nearshore or onshore spill they could be damaged. Because seagrass beds remain submerged, they would not likely be fouled by a surface oil slick but could be damaged by the reduced light penetration and oxygen depletion if weather conditions resulted in oil remaining over seagrass beds for an extended period. Oil may also mix in the water column or with nearshore sediments, which are then transported to seagrass beds, resulting in contamination of seagrass tissues (Deepwater Horizon [DWH] Natural Resource Damage Assessment [NRDA] Trustees 2016). Contamination, as well as light and oxygen depletion may reduce productivity, reduce tolerance to other stress factors, reduce reproductive success, and result in potential population-level impacts on seagrasses (Runcie et al. 2015, Martin et al. 2015). Exposure of oyster reefs to oiling can result in injury of oysters and reduced reproductive output (DWH NRDA Trustees 2016). Oil exposure also affects the growth, settlement, and survival of larval oysters, which may be exposed in the water column (Vignier et al. 2016). Similar to seagrass beds, oyster reefs in the Proposed Project area are protected from offshore spills by barrier islands but could be damaged in the event of a nearshore or onshore spill. However, because the worst-case-scenario spill would occur offshore and oil reaching nearshore environments would be weathered, significant adverse impacts on seagrasses and oyster reefs are unlikely.

Sediment may become contaminated by oil in the event of a spill when oil mixes with nearshore sediments, and is then transported away from coastlines (as described above); via direct contact with oil droplets; or via transport of oil particles from the surface slick to the seafloor via marine snow (DWH NRDA Trustees 2016, Hastings et al. 2016). Hard-bottom habitats within the GOM were exposed to oil and dispersants during the DWH oil spill when, during the response effort, impacts occurred after dispersants were applied to floating oil which resulted in oil and dispersants sinking from the surface to the seafloor (USGS 2018). Further, much of the offshore crude oil proximal to the Macondo well was deposited because of entrainment with the drilling mud for the well, which facilitated the oil sinking (NOAA 2016). During the DWH oil spill, it is estimated that more than 770 sq mi (2,000 sq km) of deep-sea benthic hard- and soft-bottom habitats were injured (DWH NRDA Trustees 2016); however, the Proposed Project's worst-case scenario spill would be much less by comparison. Adverse impacts on soft-bottom habitat in the event of the worst-case scenario spill would be localized, and over time toxic particles would be weathered and removed from affected habitats. Because offshore hard-bottom habitats and artificial reefs are located at depths greater than 5 m, oil concentrations in the water column would be diluted below acute toxicity levels and any impacts would be recovered quickly (NOAA 1992). Therefore, the risk of impacts on these habitats in the event of a spill is low.

Spilled oil, moving along ocean currents, can coat *Sargassum* floating on the ocean surface. Floating oil tends to collect and drift in drift lines along the same convergent currents that transport *Sargassum*; therefore, oil may become concentrated in the same areas as *Sargassum,* resulting in greater exposure (DWH NRDA Trustees 2016). This would directly impact marine organisms as they dive, swim, and rest within Sargassum habitat. Contact with oil-coated Sargassum would impact feathers of marine birds, fur of marine mammals, and scales and shells of fish and crustaceans making it difficult to travel and allowing for the migration of oil to other nearby areas (NOAA-ORR 2018). Additionally, oil-coated Sargassum can be swallowed or consumed as food, and oil vapors can be inhaled as they volatilize at the surface. Oil-coated Sargassum also may cause stress to sea turtles and other organisms near the surface due to thermal stress resulting from a heat buildup of the dark surface coated with oil (NOAA-ORR 2018). Impacts on various species groups from oil exposure is provided in Section 8: Wildlife and Protected Resources. Following the DWH oil spill, the surface area of *Sargassum* habitat was shown to be reduced, resulting in a loss of *Sargassum* habitat (DWH NRDA Trustees 2016). Oiling of *Sargassum* also exposes the organisms using that habitat to higher concentrations of contaminants (Powers et al. 2013).

Further, *Sargassum* impacted by oil and dispersants would sink from the surface to the seafloor within 24 to 48 hours (Powers et al. 2013). This leaves organisms dependent upon these floating mats vulnerable to predators and without a source of food. In addition, this sinking allows oil to migrate to mesopelagic and benthic communities (NOAA-ORR 2018, Powers et al. 2013). As the *Sargassum* begins to sink through the water column, oil and dispersants are dissolved and significantly reduce the amount of oxygen within the water column. This leads to indirect injury and mortality to aquatic organisms as well as benthic organisms due to hypoxic conditions within the water column and on the seafloor as the mats decompose (Powers et al 2013, Fisher et al. 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 Proposed Project would release a total of 120,770 bbl. over 10 days. Upon release, the oil would immediately begin to weather and evaporate as described above, and the level, timeframe, and large geographic area of oil exposure that affected *Sargassum* and other inshore and offshore aquatic habitats during that release would not occur.

6.2.5 Proposed Project Decommissioning Impacts

Refer to Appendix A for details of decommissioning procedures and figures representing Proposed Project components.

6.2.5.1 Onshore/Inshore

At the end of its useful life, the Proposed Project will be decommissioned. Decommissioning of the Proposed Onshore and Inshore Pipelines will consist of purging the pipe of crude oil liquids and filling them with water. No decommissioning activities are anticipated to occur in onshore or inshore waterbodies. The Harbor Island Booster Station will be dismantled and removed; removal activities will be similar in scope to those discussed for the station's construction. Once the Harbor Island Booster Station has been decommissioned, the terrestrial habitat will be restored.

6.2.5.2 Offshore

The Offshore Pipelines (from the HDD exit point about 3,900 ft [1,188.7 m] offshore) will be removed, as will the SPM buoy systems. Removal of the marine pipelines and the SPM buoy systems are expected to disturb both open water and soft-bottom habitats, as well as transient areas of *Sargassum*. The removal of the pipelines and SPM buoy systems structures will cause a temporary increase in turbidity to both the lower water column and the seafloor. As part of the decommissioning sequence, the SPM buoy systems will be shut down and removed in accordance with applicable regulatory requirements. The planned decommissioning sequence is provided in Appendix A; however, a more comprehensive decommissioning plan will be prepared prior to any decommissioning activities taking place. It is estimated that decommissioning will take approximately 5 months to complete.

Regulated intakes/discharges from vessels and vessel traffic may affect the upper water column and nearby *Sargassum* mats and assemblages. Noise will be localized where Proposed Project's Offshore Components are removed; no explosives will be used. Adverse impacts on the aquatic environment from removal of the Proposed Offshore Project Components will be similar to those discussed for construction and are considered minor and temporary.

6.2.6 Summary of Proposed Project Impacts

Impacts on aquatic resources from the Onshore Pipelines will predominantly occur from open-cut construction methods, which will cause downstream sedimentation and turbidity, as well as alteration or removal of in-stream and stream bank cover. However, these impacts will be minor and temporary given the limited area of disturbance and the restoration of stream areas after completion of construction. Impacts on aquatic habitat and organisms within waterbodies that will be crossed by trenchless construction methods (conventional bore and HDD) will generally be avoided.

BWTT will use HDD construction methods to avoid direct impacts on seagrasses, oyster beds, and other aquatic habitats that may occur in the path of the Inshore Pipelines. Although minimal vessel use in the RBSSA will occur during construction (e.g., to monitor for inadvertent returns of HDD drilling fluid), BWTT's adherence to TPWD recommendations regarding vessel types used in the RBSSA will minimize potential propeller scars on seagrasses. Therefore, the impacts of Inshore Pipeline construction are anticipated to be negligible and temporary.

The Offshore Pipelines will be installed by HDD across the shoreline of San Jose Island, but will be installed by jetting from the seaward edge of the HDD (about 3,900 ft [1,188.7 m] from shore) to their interconnection with the SPM buoy systems. Based on a construction workspace width of 75 ft (22.9 m) and the 26.4 mi (42.5 km) of the Offshore Pipelines that will be installed by jetting, approximately 240.0 ac (97.1 ha) off soft-bottom habitat will be directly disturbed during construction, and a greater area of soft bottom and the water column will be indirectly affected by turbidity and sedimentation. TSS concentrations will decrease with distance from the trench, and, along the trench, TSS levels will generally return to pre-construction levels within an estimated 1-2 days. Therefore, impacts will be temporary and minor. **.** Sedimentation impacts will be localized and negligible, since sedimentation exceeding 0.04 inch thick will be limited to within 250 ft (76.2 m) of the Offshore Pipelines, and the layer of sediment deposited on the seafloor will decrease with distance. An additional 700 sq ft (0.02 ac [<0.01 ha]) of soft bottom habitat will be lost by placement of the SPM buoy systems, which will be fabricated on land and delivered to the offshore site by barge; the presence of these hard structures have will potentially result in beneficial impacts on the marine community by providing a surface area for epifaunal colonization. Sedimentation from construction may smother smaller benthic organisms; however, the benthic community will recolonize the area after construction and no long-term effects are anticipated. Mobile nekton species will be temporarily displaced from impacted habitat but will return to the area almost immediately following construction.

Underwater noise may be generated by installation of the Proposed Project in nearshore and offshore areas, transiting vessels, and during pile-driving at the SPM buoy systems. Underwater pipeline installation and transiting vessels are transient and will result in temporary and negligible increases in ambient noise. Although increases in noise will make the aquatic environment less habitable to those species, the effect will be temporary, and no lasting habitat impact will occur. In addition, some offshore construction activities will continue 24 hours a day, requiring continuous lighting that may attract fishes, and their predators, to the construction area; these impacts are expected to be temporary and negligible.

The potential for inadvertent releases of drilling fluid (from HDD crossings) or hazardous materials (from refueling activities or onsite fluid storage) during construction will be minimized by BWTT's implementation of Project-specific HDD Inadvertent Return Contingency Plan and Spill Prevention, Control, and Countermeasure Plan. Water withdrawals from surface waters for hydrostatic testing could result in temporary impacts on water flow and entrainment or impingement of fish or other aquatic organisms; however, these impacts are anticipated to be negligible. Hydrostatic test water discharges will be in accordance applicable permits and water quality will not be impacted.

Impacts on the aquatic environment during operation of the Proposed Project will generally be limited to presence of the SPM buoy systems, port calls by the VLCCs (estimated at 16 per month for the two buoys combined), the sporadic transit of support vessels to and from the offshore port, and the presence of the restricted zones. The habitats disturbed during construction of the Onshore, Inshore, and Offshore Pipelines will take various amounts of time to recover to pre-construction levels, but no additional impacts will be incurred during operations. Although not anticipated to occur, a release of petroleum products from the SPM buoy systems or pipelines will also impact the aquatic environment; the degree of impact on each habitat would depend on the volume of oil that reaches the affected habitat and the state of the oil (fresh or lightly or highly weathered).

The hard structures of the SPM buoy systems will act as artificial hard structures, allowing sessile invertebrates with a substrate on which to attach. In addition, the SPM buoy systems and components attaching it to the seafloor will likely cause fishes to congregate, creating a locally diverse fish assemblage; these impacts will be permanent and beneficial. Further, establishment of the 939-ac (380-ha) safety zone around the SPM buoy systems will preclude fishing activities, and the new habitat and faunal community will be protected from fishing pressures. Operational lighting at the SPM buoy systems and navigational beacons will be continuous and may attract predator and prey species, but will have no measurable effect on the quality of the aquatic environment. The anchor chains for the SPM buoy systems will cause minor scour of the soft-bottom habitat, as well as localized turbidity, but the area of impact will be limited and these impacts are considered negligible.

During facility operations, VLCCs will intake a total of 1.04 billion gallons of seawater per year for the various vessel systems. The offshore water column will be disturbed via the intake and discharge of water, as could any *Sargassum* present in the immediate area of these activities. Although these intakes and discharges will occur throughout operations, dilution and dispersion will limit the impacts such that they will be minor and localized. Intakes and discharges aren't expected to reach seafloor habitats. The presence and transit of support vessels will also be persistent, but will be consistent with area traffic and will result in negligible impacts on aquatic environments.

Decommissioning of the Onshore and Inshore Pipelines will consist of purging the pipe of crude oil liquids and filling them with water, but no in-water activities will occur. The approximately 240.0 ac (97.1 ha) of habitat affected by the installation of the Offshore Pipelines (through jetting) and SPM buoy systems will be similarly disturbed for decommissioning, resulting in increased turbidity and sedimentation over the 5-month decommissioning period. Adverse impacts on the aquatic environment from removal of the Proposed Offshore Project Components are considered minor and temporary.

6.3 Alternative Project

The Alternative Project would include installation of approximately 48.6 mi (78.2 km) of dual, 30-inch-diameter pipeline and the offshore SPM buoy systems located in 87 ft (27 m) of water, within the EEZ. Impacts on aquatic habitats would be limited to those components of the Alternative Project that cross waterbodies within the onshore environment, or are in inshore (Corpus Christi Bay) or offshore (seaward of Mustang 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 Alternative Project that were used to evaluate environmental consequences in the following sections.

6.3.1 Alternative Project Area

The Alternative Project area considered for aquatic resources encompasses all freshwater, estuarine, and marine waters within the immediate vicinity of the Onshore, Inshore, and Offshore Pipelines as well as two offshore SPM buoy systems (Figure 6-6). The Alternative Onshore Pipelines would commence at the same point as the Proposed Onshore Pipelines and will traverse the same route for approximately 13.5 mi (21.7 km) prior to diverging to the southeast through Ingleside on the Bay, Texas. The Alternative Onshore Pipelines would cross freshwater surface waterbodies, where the Proposed Project area is considered to include waterbodies within, or immediately adjacent to, the construction workspaces. The Alternative Project would then transition to the Alternative Inshore Pipelines at the shore of Corpus Christi on the mainland. The Alternative Inshore Pipelines would traverse Corpus Christi Bay for 8.5 mi (13.7 km) and would reach landfall at Mustang Island, crossing undeveloped lands interspersed with oil and gas facilities and residences; the whole of Corpus Christi Bay is considered the Alternative Project area for the Inshore Pipelines. The Offshore Pipelines, commencing just landward of Mustang Island's beach would transit offshore for about 15.4 mi (15.4 km) to the Alternative Project's SPM buoy systems, approximately 18.9 mi (30.4 km) southwest of the Proposed Project's SPM buoy systems; effects to the aquatic environment area assessed within marine waters shoreward of San Jose and Mustang Islands, out to the EEZ.

6.3.1.1 Onshore

The Alternative Onshore Pipelines would commence at the location of a planned future multi-use facility within disturbed lands south of Taft, Texas, and follows the Proposed Onshore Pipelines for the first 13.5 mi (21.7 km), diverging northeast of Gregory to travel south to Ingleside on the Bay. Similar to the Proposed Onshore Pipelines, the Alternative Onshore Pipelines are generally within disturbed lands used for agriculture, but also cross herbaceous lands within or adjacent to other utility corridors. Waterbodies crossed by the Alternative Project Onshore Pipeline are discussed in Section 5: Wetlands and Waters of the U.S.

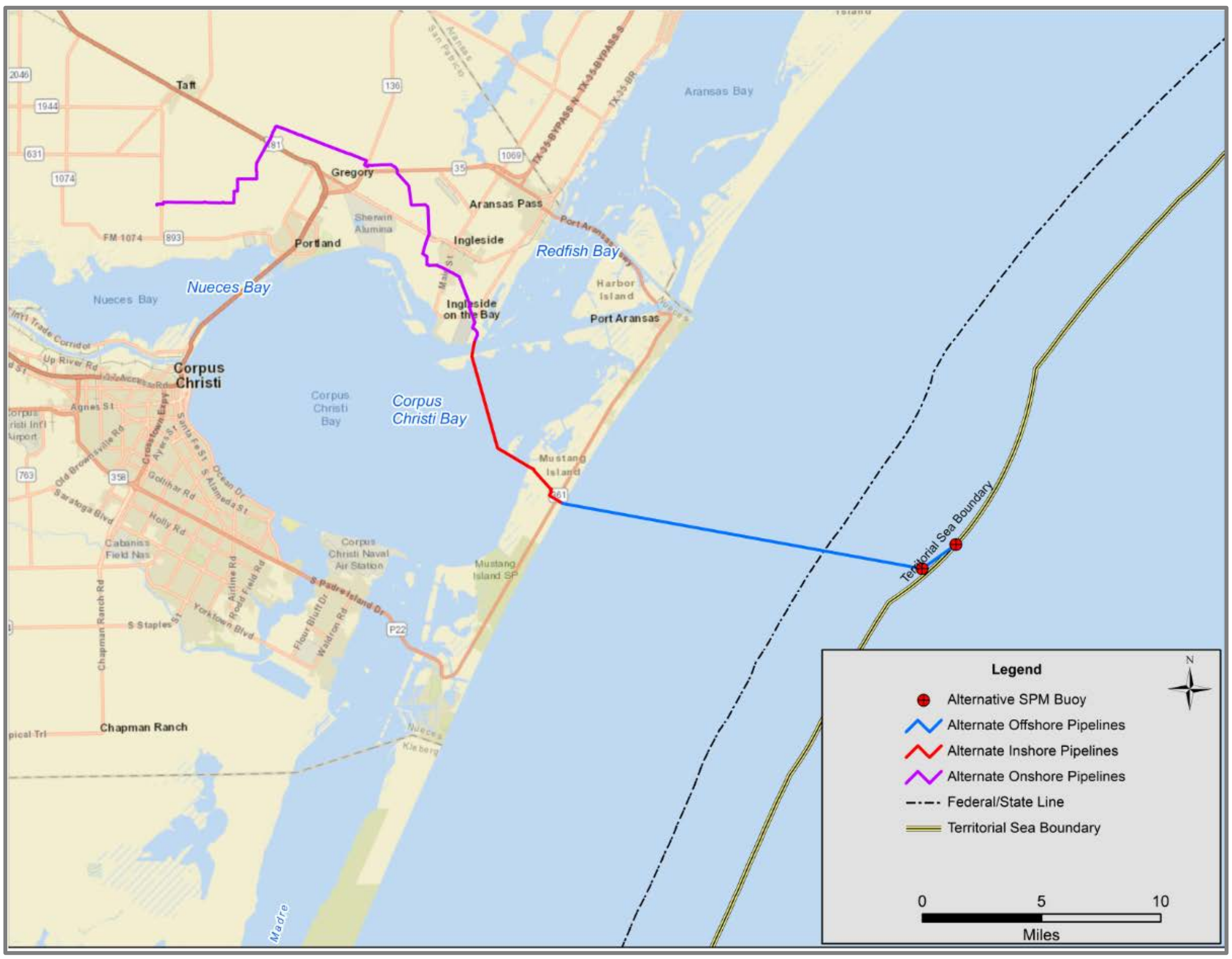
6.3.1.2 Inshore

As discussed for the Proposed Project, there is a nearly continuous estuarine ecosystem along the northern GOM coast, comprising 31 major estuarine systems (BOEM 2017). Corpus Christi Bay is one of the three individual estuaries that make up the Coastal Bend Bays and Estuaries complex (USGS 2010a).

6.3.1.2.1 COASTAL BARRIER BEACHES

The Alternative Inshore Pipelines would cross Mustang Island before transitioning to the Alternative Offshore Pipelines. Mustang Island is an approximately 3,954-ac (1600.1-ha) Island owned by the State of Texas and managed by TPWD (TPWD 2019g). This coastal barrier island is located approximately 8.9 mi (14.3 km) south of Port Aransas and is managed for public recreation activities as well as wildlife.

Figure 6.6: Alternative Project Area



Source: BOEM 2019

6.3.1.2.2 WETLANDS

Wetland impacts associated with the Alternative Inshore Pipelines are discussed in detail in Section 5: Wetlands and Waters of the U.S.

6.3.1.2.3 CORPUS CHRISTI BAY

The Alternative Inshore Pipelines would traverse Corpus Christi Bay after leaving the mainland at Ingleside on the Bay, Texas. Corpus Christi Bay, located immediately south of Redfish Bay, consists of approximately 95,997 ac (38,848.6 ha) and is the deepest of the bays (including Corpus Christi Bay, Nueces Bay, Redfish Bay, and Oso Bay) within the Corpus Christi Bay System, with an average depth of 11 ft (3.3 m). Water is exchanged with the GOM through Aransas Pass, which is also a major shipping channel, and freshwater flows into the Bay from the Nueces River and Oso Creek (TPWD 2019c). Estuarine waters from the bay system and waters from the GOM are exchanged at Aransas Pass. Seagrasses are present sporadically along the northeastern coast of Corpus Christi Bay and are prevalent at higher densities along the bay side of Mustang Island (CBBEP 2018b). Oyster beds are also known to be present in the bay.

Corpus Christi Bay is the sixth largest Port in the United States and is highly developed, serving many industrial activities, primarily related to oil and gas transportation (TPWD 2019c). The bay itself includes multiple shipping channels as well as multiple beneficial use dredge management placement unit (DMPU). These island units contain spoil from nearby dredging of ship channels, docks, and other marine operations, and also served as nesting habitat for coastal, shore, and migratory birds; DMPUs are generally restricted to the northeastern portion of the bay. In addition to the DMPU islands, Shamrock Island, currently utilized as a nature preserved operated by the Nature Conservancy of Texas, is present adjacent to Mustang Island. This island contains seagrass beds and serves as an important colonial waterbird and wading bird nesting site

6.3.1.2.4 SEAGRASS BEDS

According to the TPWD seagrass mapper (TPWD 2019h), seagrass beds are present along much of the northern shorelines of Corpus Christi Bay, although seagrass presence is most significant along the south side of Mustang Island, including Shamrock Island (see Figure 6-7).

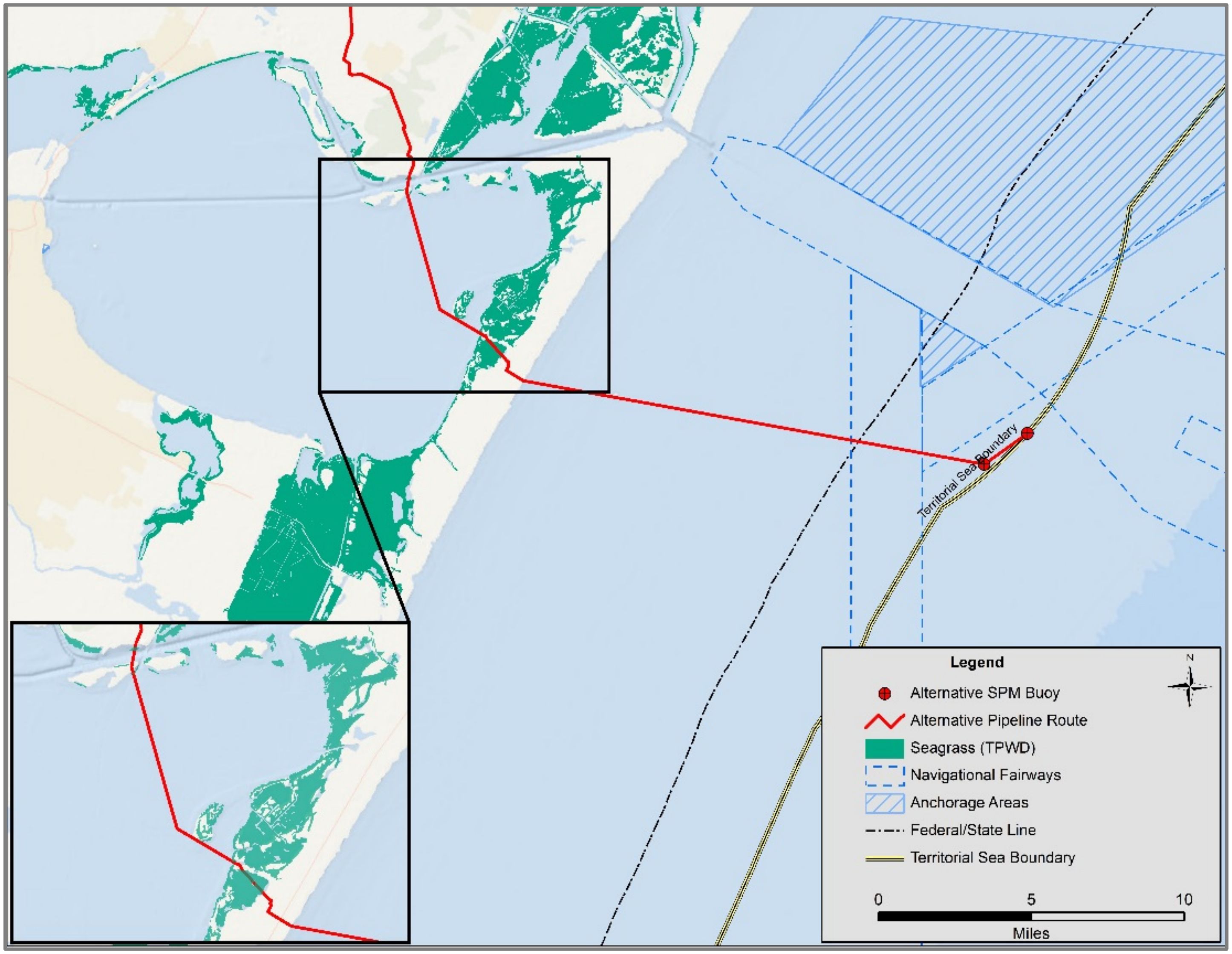
6.3.1.2.5 OYSTER REEFS

NOAA’s GOM Data Atlas identifies oyster reefs intermittently within Corpus Christi Bay (Figure 6-8). The closest known reef area is approximately 1.8 mi (2.9 km) from the Alternative Pipelines.

6.3.1.2.6 HARD-BOTTOM HABITATS

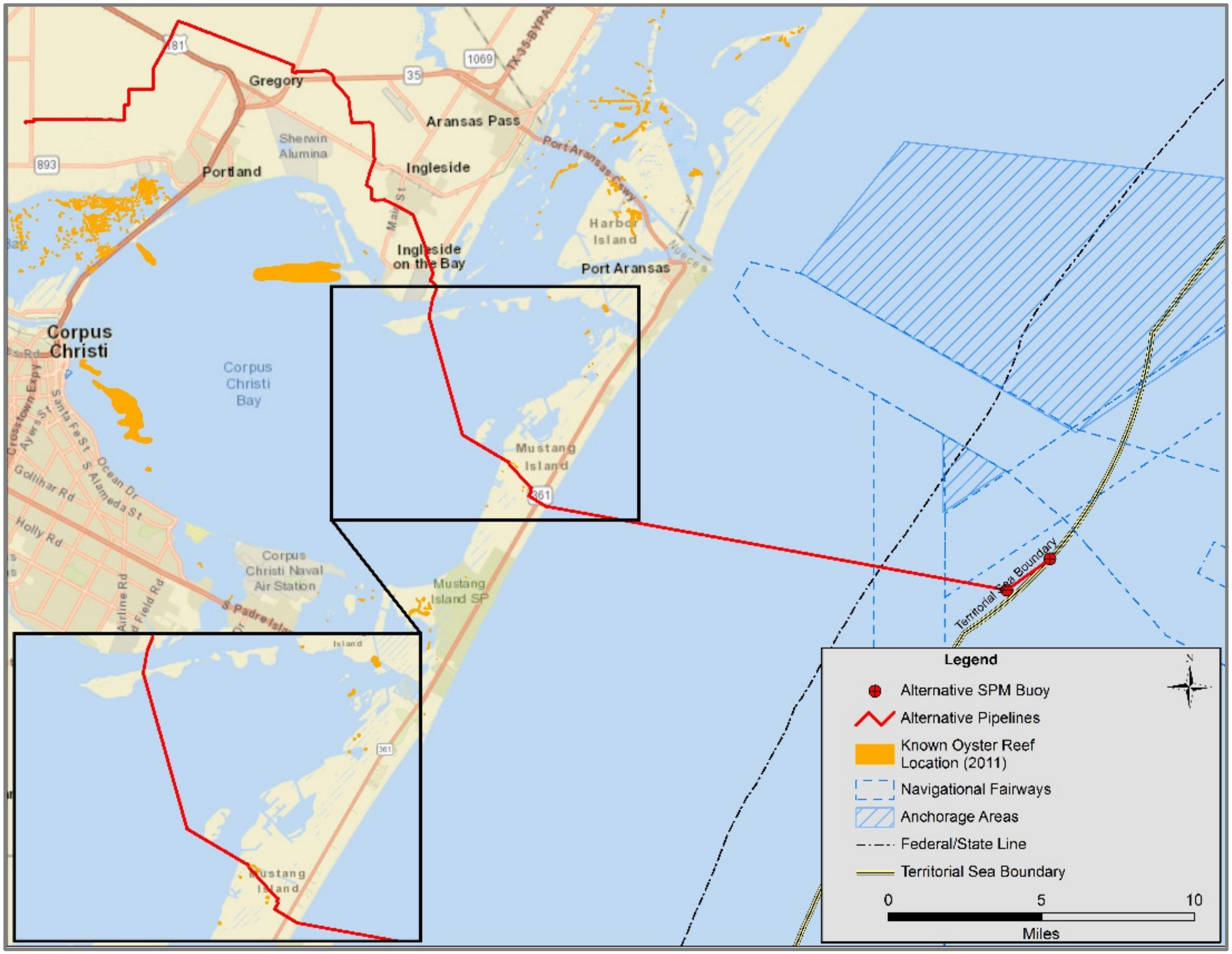
As discussed in the Proposed Project area, generally, the northern GOM is not considered suitable for the development of reef-building communities. However, certain areas within the northwestern GOM are an exception to this as they are higher relief areas located away from the Mississippi River, where waters are clearer and warmer (Thompson et al. 1999). No hard-bottom habitat is present within 26.5 mi (42.6 km) of the Alternative Project area (see Figure 6-4).

Figure 6-7: Seagrasses in Corpus Christi Bay



Source: TPWD 2019h

Figure 6-8: Oyster Reefs within the Alternative Project Area



Source: BOEM 2019, NOAA 2019e.

6.3.1.2.7 ARTIFICIAL REEFS

The nearest artificial reef (Lonestar Reef) is located approximately 0.2 mi (0.3 km) south of the Alternative Offshore Pipelines and SPM buoy systems (TPWD 2019f) (Figure 6-9). The Lonestar Reef is approximately 40 ac (16.2 ha) in size, located at a depth of 60 ft, and is composed of three sunken barges.

6.3.1.2.8 WATER COLUMN

While the Alternative Project Pipelines and SPM buoy systems would be located approximately 18.9 mi (30.4 km) southwest the Proposed Project, the water column would contain similar conditions as the water column within the vicinity of the Proposed Project. Therefore, circulation, waves and tides, meteorological conditions, hurricanes and cyclones, and *Sargassum* would be similar to that described for the Proposed Project.

6.3.1.3 Offshore

While the Alternative Project would be located about 18.9 mi (30.4 km) from the Proposed Project, the aquatic environment of the GOM is described for the Proposed Project area and would be similar for the Alternative Project.

6.3.2 Alternative Project Construction Impacts

6.3.2.1 Onshore

The Alternative Onshore Pipelines would cross the same waterbodies as the Proposed Onshore Pipelines (between MP 0.3 and MP 8.2), and would also cross two canal/ditches and Kinney Bayou via HDD. Impacts from construction of the Alternative Onshore Pipelines through these waterbodies would be consistent with those described for the Proposed Project.

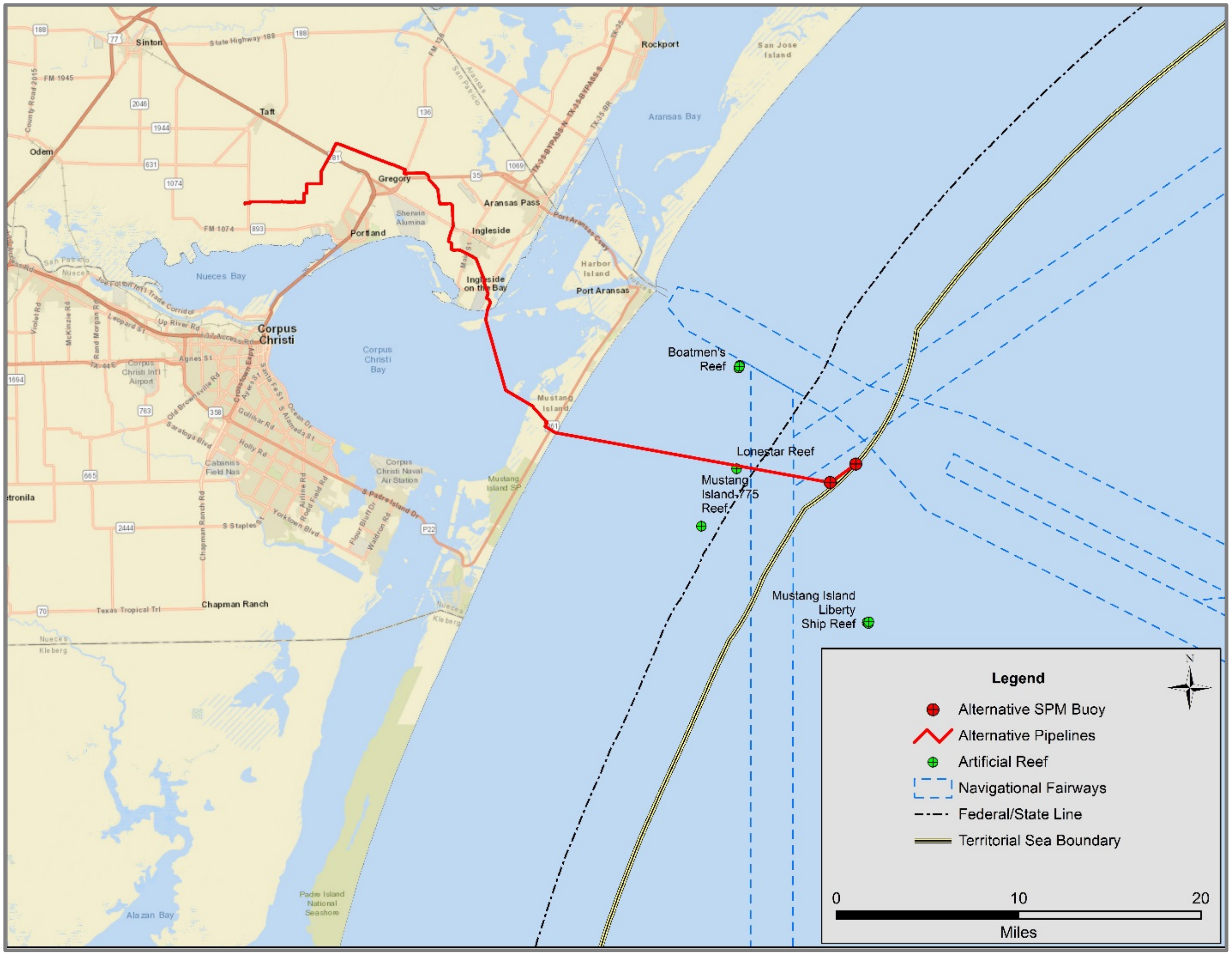
6.3.2.2 Inshore

The Alternative Inshore Pipelines would cross Corpus Christi Bay using a combination of HDD and open trench construction methods. The Alternative Inshore Pipelines would cross the Corpus Christi Ship Channel using an HDD between the mainland and a DMPU island. From the DMPU island, BWTT would trench through the open waters of Corpus Christi Bay for about 5.8 mi (9.3 km), crossing immediately adjacent to Shamrock Island and landfalling on a small upland area associated with Mustang Island. From there, another HDD would be staged to cross a shallow area containing seagrasses and landfall on Mustang Island proper. No waterbodies would be crossed on Mustang Island.

As discussed for the Proposed Inshore Pipelines, HDD construction methods would result in impacts at the entry and exit points of the HDD, but typically avoid impacts between the two points. 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.

Where the Proposed Inshore Pipelines will HDD all inshore waters and shorelines, the Alternative Inshore Pipelines would cross about 5.8 mi (9.3 km) of open water, as well as the shoreline of the DMPU island and the upland staging area associated with Mustang Island, using trenching and/or jetting. Trenching and jetting would result in increased turbidity and sedimentation in and immediately adjacent to the construction footprint. Turbidity refers to the insoluble, suspended particulates that impede the passage of light through water by scattering and absorbing light energy. The reduction of penetrating light reduces the depth of the photic zone which reduces the depth at which primary productivity occurs. As described in Section 4: Water Quality, because of the shallow depths in Corpus Christi Bay (averaging 11 ft), the initial suspension of sediments during trenching would cause a significant but temporary water quality impact in the vicinity of the pipeline. Further, trenching would require additional vessels to transit and be present in Corpus Christi Bay, causing further increase in turbidity, sedimentation, and the potential for inadvertent spills; however, given the existing vessel traffic in Corpus Christi Bay, these impacts are anticipated to be negligible.

Figure 6-9: Artificial Reefs within the Vicinity of the Alternative Project Area



Source: TPWD 2019f

Turbidity, although temporary, reduces the light available to the seagrasses. The resultant sedimentation, however, can result in mounds of deposited sediment that are then prone to resuspension (Handley, Altsman, and DeMay 2007). Studies have shown that seagrasses take 3 to 5 years to recover, if buried by no more than 3 inches of sediment; however, shoal grass (which is known to occur in the bay system) could quickly invade buried sites and could outcompete other native species prior to their recovery (USACE and Interagency Coordination Team 2002).

No seagrass is expected to be present in the middle of Corpus Christi Bay; however, seagrass is present around the perimeter of Shamrock Island and within the shallow water areas associated with Mustang Island (TPWD 2019g). To minimize impacts on seagrasses from turbidity during pipeline construction, BWTT would need to use best management practices (BMPs), such as weighted turbidity curtains, on the edges of the construction right-of-way to minimize the turbidity and sedimentation adjacent to construction workspaces. Sediment side cast from trenching would also likely need to be stored on barges rather than on the bay floor adjacent to the trench to prevent resuspension of the sediment in the water column and further mitigate increased turbidity during construction. Required mitigation and final BMPs would be determined prior to construction based on the conditions of the USACE permit.

Overall, installation of the Alternative Inshore Pipelines would have the potential to impact seagrasses and would cause increased sediment and turbidity, but those impacts would be minor and temporary with implementation of BMPs and any requirements of the USACE permit.

6.3.2.3 Offshore

Impacts from offshore installation of the Alternative Project would be generally consistent with those impacts described for the Proposed Project. Based on a construction workspace width of 75 ft (22.9 m) and the 16.2 mi (26.1 km) of the Alternative Offshore Pipelines that would be installed by jetting, approximately 147.3 ac (59.6 ha) off soft-bottom habitat would be directly disturbed during construction, and a greater area of soft bottom and the water column would be indirectly affected by turbidity and sedimentation. However, as the Alternative Project Offshore Pipelines would cross an existing vessel fairway, BWTT would be required to bury the pipelines with a greater depth of cover (10 ft [3 m]) and to place rip rap over a portion of the fairway during construction, which would remain during operations. Therefore, the volume of sediment disturbed for trenching along that 3.1 mi (5.0 km) of pipe would be greater, and localized construction would require more time, than elsewhere along the Alternative Offshore Pipelines.

In addition, the Alternative Offshore Pipelines would be within 0.2 mi (0.3 km) of Lonestar Reef, an artificial reef. As depicted in the model results for the Proposed Project in Appendix D, TSS concentrations would be highest in the immediate area of the trench and would dissipate with distance from the trench, returning to ambient levels within a maximum distance of about 2.1 mi (3.5 km). Therefore, given the proximity of Lonestar Reef to the Project, turbidity impacts during construction would be near maximum for the estimated 1-2 days in which TSS levels are generally expected to return to pre-construction levels. Given the short duration of impacts, they would be temporary and minor.

6.3.2.3.1 HYDROSTATIC TESTING OF THE PIPELINES

Impacts from hydrostatic testing of the Alternative Project would be consistent with those impacts described for the Proposed Project. However, given the decreased length required to be hydrostatically testing, the total volume of seawater required is estimated to be 3.2 million gallons (12,113 m^3).

6.3.2.3.2 DEEPWATER PORT PILE-DRIVING AND INSTALLATION

Impacts from pile-driving and offshore installation of the Alternative Project would be consistent with those impacts described for the Proposed Project.

6.3.2.3.3 CONSTRUCTION VESSEL OPERATIONS

Impacts from construction vessel operations of the Alternative Project would be consistent with those impacts described for the Proposed Project.

6.3.3 Alternative Project Operation Impacts

As with the Proposed Project, impacts on the aquatic environment during operation of the Alternative Project would generally be limited to presence of the SPM buoy systems, port calls by the VLCCs, the sporadic transit of support vessels to and from the offshore port, and the presence of the restricted zones (see Section 14: Navigation, Safety, and Security). Additionally, although not anticipated to occur, a release of petroleum products from the SPM buoy systems or pipelines would also impact the aquatic environment.

6.3.3.1 Deepwater Port Presence and New Hard-bottom Habitat

Impacts from the presence of the Alternative Project would be consistent with those impacts described for the Proposed Project. In addition, where rip rap would be installed along 3.1 mi (5.0 km) of the Alternative Offshore Pipelines in the shipping fairway, it would act as an artificial hard structure, allowing sessile invertebrates with a substrate on which to attach. Because of the hard structure provided for marine species in an area of otherwise ubiquitous soft-bottom habitat, the presence of the rip rap would be considered a permanent, beneficial impact to benthic faunal diversity.

6.3.3.2 VLCC Water Use

Impacts from VLCC water use at the Alternative Project would be consistent with those impacts described for the Proposed Project.

6.3.3.3 Support Vessel Mooring and Anchoring

Impacts from support vessel operations at the Alternative Project would be consistent with those impacts described for the Proposed Project.

6.3.3.4 Restricted Operations Zone

Impacts from restricted zones at the Alternative Project would be consistent with those impacts described for the Proposed Project.

6.3.3.5 Inadvertent Product Release

Inshore and offshore habitats that could be affected in the event of a spill, as described in Section 6.2, include coastal barrier beaches, wetlands, seagrass beds, inshore oyster reefs, soft-bottom habitats, offshore hard-bottom habitats and artificial reefs, Sargassum, and the water column in Corpus Christi Bay and offshore. Impacts on these habitats would be consistent with those impacts described for the Proposed Project. However, given the greater length of the Alternative Inshore Pipelines, and their relatively shallow placement within Corpus Christi Bay, the potential for an inshore incident in which oil is released and reaches sensitive wetlands, seagrass beds, and oyster reefs is greater.

6.3.4 Alternative Project Decommissioning Impacts

6.3.4.1 Onshore/Inshore

The decommissioning procedures and impacts associated with the Alternative Onshore and Inshore Pipelines would be consistent with those impacts described for the Proposed Project.

6.3.4.2 Offshore

The decommissioning procedures and impacts associated with the Alternative Offshore Pipelines would be consistent with those impacts described for the Proposed Project, with offshore removal of the pipelines beginning about 4,806 ft (1,465 m) from the shore.

6.3.5 Summary of Alternative Project Impacts

Impacts on aquatic resources from the Alternative Onshore Pipelines would predominantly occur from open-cut construction methods, which would cause downstream sedimentation and turbidity, as well as alteration or removal of in-stream and stream bank cover. However, these impacts would be minor and temporary given the limited area of disturbance and the restoration of stream areas after completion of construction. Impacts on aquatic habitat and organisms within waterbodies that would be crossed by trenchless construction methods (conventional bore and HDD) would generally be avoided.

The Alternative Inshore Pipelines would cross Corpus Christi Bay using a combination of HDD and open trench construction methods. As described above, HDD construction methods would generally avoid impacts on aquatic habitat (including seagrasses near the landfall location on Mustang Island). However, where open trench construction would be completed across Corpus Christi Bay for about 5.8 mi (9.3 km), trenching and jetting would result in increased turbidity and sedimentation. Active trenching would significantly increase TSS concentrations along the trenched portions of the Alternative Inshore Pipelines as the distance at which these concentrations return to ambient would likely be greater than the 2.1 mi (3.5 km) estimated for the Alternative Project Offshore Pipelines; this distance was also based on a 3 ft (1 m) depth of cover as opposed to the 5 ft (1.5 m) depth of cover required in Corpus Christi Bay. Increased turbidity and sedimentation, although temporary, can affect seagrasses around the edges of Corpus Christi Bay, which would take approximately 3 to 5 years to recover, if buried by no more than 3-inches of sediment. Further, trenching would require additional vessels to transit and be present in Corpus Christi Bay, causing further increase in turbidity, sedimentation, and the potential for inadvertent spills; however, given the existing vessel traffic in Corpus Christi Bay, these impacts are anticipated to be negligible. Overall, installation of the Alternative Inshore Pipelines would have the potential to impact seagrasses and would cause increased sediment and turbidity, but those impacts would be minor and temporary with implementation of BMPs and any requirements of the USACE permit.

The Alternative Offshore Pipelines would be installed by HDD to a point about 4,950.0 ft (1,580.3 m) offshore of the shoreline at which point they would be installed by jetting for 16.2 mi (26.1 km), until reaching the Alternative SPM buoy systems. Based on a construction workspace width of 75 ft (22.9 m) and the 16.2 mi (26.1 km) of the Alternative Offshore Pipelines that would be installed by jetting, approximately 147.3 ac (59.6 ha) off soft-bottom habitat would be directly disturbed during construction, and a greater area of soft bottom and the water column would be indirectly affected by turbidity and sedimentation. Where the Alternative Offshore Pipelines would be within 0.2 mile (0.3 km) of an artificial reef (the Lonestar Reef), TSS concentrations would be temporarily elevated similar to levels along the trenchline. The Alternative Offshore Pipelines would be buried a minimum of 3 ft (0.9 m) below the sediment surface, but would be buried to a depth of 10 ft (3 m) where beneath existing safety fairways (about 3.1 mi [5.0 km]). TSS concentrations would decrease with distance from the trench, and, along the trench, TSS levels would generally return to pre-construction levels within an estimated 1-2 days. Therefore, impacts would be temporary and minor. Sedimentation impacts would be localized and negligible, since sedimentation exceeding 0.04 inch thick would be limited to within 250 ft (76.2 m) of the Alternative Offshore Pipelines, and the layer of sediment deposited on the seafloor would decrease with distance. An additional 700 sq ft (0.02 ac [<0.01 ha]) of soft-bottom habitat would be lost by placement of the Alternative SPM buoy systems, which would be fabricated on land and delivered to the offshore site by barge; the presence of these hard structures would potentially result in beneficial impacts on the marine community by providing a surface area for epifaunal colonization. Sedimentation from construction may smother smaller benthic organisms; however, the benthic community would recolonize the area after construction and no long-term effects are anticipated. Mobile nekton species would be temporarily displaced from impacted habitat but would return to the area almost immediately following construction.

Underwater noise may be generated by installation of the Alternative Project in nearshore and offshore areas, by transiting vessels, and during pile-driving at the Alternative SPM buoy systems. Underwater pipeline installation and transiting vessels are transient and would result in temporary and negligible increases in ambient noise. Although increases in noise would make the aquatic environment less habitable to those species, the effect would be temporary, and no lasting habitat impact would occur. In addition, some offshore construction activities would continue 24 hours a day, requiring continuous lighting that may attract fishes, and their predators, to the construction area; these impacts are expected to be temporary and negligible.

The potential for inadvertent releases of drilling fluid (from HDD crossings) or hazardous materials (from refueling activities or onsite fluid storage) during construction would be minimized by BWTT's implementation of Project-specific HDD Inadvertent Return Contingency Plan and Spill Prevention, Control, and Countermeasure Plan. Water withdrawals from surface waters for hydrostatic testing could result in temporary impacts on water flow and entrainment or impingement of fish or other aquatic organisms; however, these impacts are anticipated to be negligible. Hydrostatic test water discharges would be in accordance applicable permits and water quality would not be impacted.

Impacts on the aquatic environment during operation of the Alternative Project would generally be limited to presence of the Alternative SPM buoy systems, port calls by the VLCCs (estimated at 16 per month for the two buoys combined), the sporadic transit of support vessels to and from the offshore port, and the presence of the restricted zones. The habitats disturbed during construction of the Alternative Onshore, Inshore, and Offshore Pipelines would take various amounts of time to recover to pre-construction levels, but no additional impacts would be incurred during operations except where rip rap would be installed along 3.1 mi (5.0 km) of the Alternative Offshore Pipelines in the shipping fairway. Because of the hard structure provided for marine species in an area of otherwise ubiquitous soft-bottom habitat, the presence of the rip rap would be considered a permanent, beneficial impact. Although not anticipated to occur, a release of petroleum products from the Alternative SPM buoy systems or pipelines would also impact the aquatic environment; the degree of impact on each habitat would depend on the volume of oil that reaches the affected habitat and the state of the oil (fresh or lightly or highly weathered). Given the greater length of the Alternative Inshore Pipelines, and their relatively shallow placement within Corpus Christi Bay, the potential for an inshore incident in which oil is released and reaches sensitive wetlands, seagrass beds, and oyster reefs is greater than for the Proposed Project.

The hard structures of the Alternative SPM buoy systems and rip rap in the shipping fairway along the Alternative Offshore Pipelines would act as artificial hard structures, allowing sessile invertebrates with a substrate on which to attach. In addition, the Alternative SPM buoy systems and components attaching it to the seafloor would likely cause fishes to congregate, creating a locally diverse fish assemblage; these impacts would be permanent and beneficial. Further, establishment of the 939-ac (380-ha) safety zone around the Alternative SPM buoy systems would preclude fishing activities, and the new habitat and faunal community would be protected from fishing pressures. Operational lighting at the Alternative SPM buoy systems and navigational beacons would be continuous and may attract predator and prey species, but would have no measurable effect on the quality of the aquatic environment. The anchor chains for the Alternative SPM buoy systems would cause minor scour of the soft-bottom habitat, as well as localized turbidity, but the area of impact would be limited and these impacts are considered negligible.

During facility operations, VLCCs would intake a total of 1.04 billion gallons of seawater per year for the various vessel systems. The offshore water column would be disturbed via the intake and discharge of water, as could any *Sargassum* present in the immediate area of these activities. Although these intakes and discharges would occur throughout operations, dilution and dispersion would limit the impacts such that they would be minor and localized. Intakes and discharges aren't expected to reach seafloor habitats. The presence and transit of support vessels would also be persistent, but would be consistent with area traffic and would result in negligible impacts on aquatic environments.

Decommissioning of the Alternative Onshore and Inshore Pipelines would consist of purging the pipe of crude oil liquids and filling them with water, but no in-water activities would occur. Habitat affected by the installation of the Alternative Offshore Pipelines (through jetting) and Alternative SPM buoy systems would be similarly disturbed for decommissioning, resulting in increased turbidity and sedimentation over the 6-month decommissioning period. Adverse impacts on the aquatic environment from removal of the Alternative Offshore Project Components are considered minor and temporary.

6.4 Summary of Impacts

A summary of impacts for the both the Proposed Project and Alternative Project is presented in Table 6-4 below. In general, the Proposed Project has significant advantages over the Alternative Project as it will avoid direct impacts on all inshore waters, and the aquatic environments that contain, for example, seagrasses and oyster beds. Although the Alternative Inshore Pipelines would likely avoid most direct seagrass impacts within Corpus Christi Bay, small areas of seagrasses may be directly affected by trenching/jetting and indirect impacts on area seagrasses may occur from the increase in turbidity and sedimentation. For these reasons, the Proposed Project is considered to be the Least Environmentally Damaging Practicable Alternative (LEDPA) and is considered to be environmentally preferable to the Alternative Project.

Table 6-4: Summary of Impacts

		Construction	Operation	Decommissioning
Proposed Project	**Onshore**	Temporary and minor Impacts associated with potential inadvertent releases; temporary and minor increases in downstream turbidity and sedimentation due to open-cut construction; and permanent but negligible loss of benthic organisms in directly affected streambeds.	No impacts on the aquatic environment during normal operations.	No decommissioning activities are proposed in onshore waterbodies.
	Inshore	Temporary and minor impacts associated with inadvertent releases. Temporary and negligible impacts to seagrasses from limited boat traffic. Direct impacts primarily avoided due to HDD construction.	No impacts on the aquatic environment during normal operations.	No decommissioning activities are proposed in inshore waterbodies, although the Inshore Pipelines may be flooded with seawater.
	Offshore	Temporary and minor impacts associated with inadvertent releases; temporary to permanent and negligible impacts to nekton and the benthic community from trenching and pipeline installation; temporary and negligible to minor impacts to the water column associated with sedimentation/turbidity and noise; temporary, negligible impacts on benthic habitat from sedimentation.	Risk of impacts associated with inadvertent releases; permanent and negligible impacts on the water column and offshore soft-bottom habitats from anchor chain sweep and VLCC discharge; permanent creation of hard-bottom habitat at the SPM buoy systems; permanent, localized, and minor impacts to *Sargassum* and the water column associated with intakes/discharges.	Temporary, minor increases in turbidity and sedimentation during facility removal.
Alt. Project	**Onshore**	Temporary and minor Impacts associated with potential inadvertent releases; temporary and minor increases in downstream turbidity and sedimentation due to open-cut construction; and permanent but negligible loss of benthic organisms in directly affected streambeds.	No impacts on the aquatic environment during normal operations.	No decommissioning activities are proposed in onshore waterbodies.
	Inshore	Impacts would be temporary and minor; Increased potential for inadvertent releases; *direct impacts on the water column, soft-bottom habitats, and seagrasses from trenching/ jetting and boat traffic across 5.8 mi (9.3 km) of Corpus Christi Bay.	No impacts on the aquatic environment during normal operations.	No decommissioning activities are proposed in inshore waterbodies, although the Alternative Inshore Pipelines may be flooded with seawater.

	Offshore	Temporary and minor impacts associated with inadvertent releases; temporary to permanent and negligible impacts to nekton and the benthic community from trenching and pipeline installation; temporary and negligible to minor impacts to the water column associated with sedimentation/turbidity and noise; *temporary and minor impacts on the Lonestar Reef due to trenching within 0.2 mi (0.3 km); temporary, negligible impacts on benthic habitat from sedimentation.	Risk of impacts associated with inadvertent releases; permanent and negligible impacts on the water column and offshore soft-bottom habitats from anchor chain sweep and VLCC discharge; permanent creation of hard-bottom habitat at the SPM buoy systems and where rip rap is installed; permanent, localized, and minor impacts to *Sargassum* and the water column associated with intakes/discharges. Temporary and minor impacts on a nearby artificial reef from turbidity and sedimentation.	Temporary, minor increases in turbidity and sedimentation during facility removal.
*indicates an environmental consequence that is significantly more impactful as compared to the other Project alternative.				

6.5 Mitigation of Proposed Project Impacts

The Proposed Project is the LEDPA choice in regard to impacts on the aquatic environment. Therefore, mitigation measures for the anticipated water quality impact from the only the Proposed Project are discussed in this section.

The Onshore Pipelines will not cross any sensitive or high value aquatic environments, resulting in minimal impacts during pipeline construction. BWTT will adhere to the USACE permit conditions, as applicable for the crossing of all jurisdictional waterbodies, including the maintenance of flow during construction (where present) for the movement of aquatic species and the appropriate use of soil erosion and sediment controls. Further, BWTT is planning to cross all waterbodies via conventional bore and HDD construction methods; these methods will avoid waterbody disturbance and therefore minimize water quality impacts (see Section 4: Water Quality for additional detail).

Although the Inshore Pipelines will cross areas of seagrass and oyster beds, all inshore waters will be crossed using HDD methods, thereby avoiding the direct impacts on these resources that would be caused by open water trenching. Further, BWTT will comply with TPWD recommendations, where possible, to use airboats, johnboats, shallow water boats, or trolling motors when traversing shallow waters through the RBSSA to avoid impacts on seagrasses from propeller scars and will use deeper water channels when practicable.

The offshore design and location of the SPM buoy systems inherently minimizes impacts on aquatic habitats through a number of factors, including avoiding nearshore transit of the VLCCs and sensitive habitats that provide high-quality habitat for aquatic species. Other mitigation that will be implemented during Project construction and operation includes:

- Utilizing existing channels to navigate to workspaces where appropriate;
- Land-based fabrication of the offshore SPM buoy systems, to minimize the timing and disturbance associated with offshore installation; and,
- HDD pipeline installation techniques under all crossed shorelines to avoid sensitive coastal habitats.

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