Annova LNG
Brownsville Project

Incidental Harassment Authorization Application for In-water Construction of Annova LNG Brownsville Project Facilities

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ACRONYMS AND ABBREVIATIONS

Annova LNG	Annova LNG Common Infrastructure, LLC
BND	Brownsville Navigation District
BSC	Brownsville Ship Channel
Caltrans	California Department of Transportation
CFR	Code of Federal Regulations
CTJV	Chesapeake Tunnel Joint Venture
CV	coefficient of variation
dB	decibel
DMPA	Dredged Material Placement Area
EEZ	(U.S.) Exclusive Economic Zone
ESA	Endangered Species Act
Hz	hertz
IHA	Incidental Harassment Authorization
kHz	kilohertz
km	kilometer
km^2	square kilometer
L_{pk}	peak sound pressure level
LNG	liquefied natural gas
μPa	micropascal
m	meter
m^3	cubic meter
m/s	meters per second
mi	statue miles
MARPOL	International Convention for the Prevention of Pollution from Ships
MMPA	Marine Mammal Protection Act
MOF	material offloading facility
NOAA Fisheries	National Oceanic and Atmospheric Administration National Marine Fisheries Service
OSP	optimum sustainable population
Project	Annova LNG Brownsville Project
PSO	Protected Species Observer

RMS	root mean square
SEL_{cum}	cumulative sound exposure level
SPL	sound pressure level
TSS	total suspended solid
TPWD	Texas Parks and Wildlife Department
UME	Unusual Mortality Event
USACE	U.S. Army Corp of Engineers
USFWS	U.S. Fish and Wildlife Service
WSDOT	Washington State Department of Transportation
yd^3	cubic yard
ZOI	zone of Influence

1 DESCRIPTION OF SPECIFIED ACTIVITY

A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals.

1.1 INTRODUCTION OF THE PROPOSED ACTIVITY

Annova LNG Common Infrastructure, LLC (Annova LNG) is proposing to site, construct, and operate facilities necessary to liquefy and export natural gas at a proposed site, the Annova LNG Brownsville Project (Project) along the Brownsville Ship Channel (BSC) in Cameron County, Texas. The Project will include a new liquefied natural gas (LNG) export facility with a nameplate capacity of 6.0 million metric tons per annum (6.6 million U.S. tons) and a maximum output at optimal operating conditions of 6.95 million metric tons (7.66 million U.S. tons) per year of LNG for export.

The Project will consist of two principal parts: the LNG facilities and the associated marine facilities. The in-water construction activities of the Project will occur in an area that supports several marine mammal species. The Marine Mammal Protection Act (MMPA) of 1972 prohibits the taking of marine mammals, which is defined as to "harass, hunt, capture, kill, or attempt to harass, hunt capture or kill," except under certain situations. Section 101(a)(5)(D) allows the issuance of an Incidental Harassment Authorization (IHA) provided that an activity results in small numbers of takes, negligible impacts on marine mammals, and would not adversely affect subsistence use of these animals. The MMPA defines "harassment" as "any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A injury harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B behavioral harassment]" (50 Code of Federal Regulations [CFR], Part 216, Subpart A, Section 216.3 - Definitions). The in-water construction activities associated with the Project (e.g., pile installation and removal) may result in Level B acoustical harassment, or the incidental taking of marine mammals protected under the MMPA. Annova LNG is submitting an IHA application requesting takes for three marine mammal species that may occur in the vicinity of the Project area during in-water construction activities.

1.2 PROJECT PURPOSE AND NEED

Annova LNG's stated purpose of the Project is to operate a mid-scale natural gas liquefaction facility along the South Texas Gulf Coast for exporting LNG to international markets via LNG carriers through United States and international waters. The facility will be located on the south bank of the BSC, approximately 13.2 kilometers (km) (8.2 statute miles [mi]) upstream from the channel mouth at Brazos Santiago Pass (see Figure 1). Annova LNG will have long-term use of approximately 2.96 square kilometers (km^2) (731 acres) to construct and operate the LNG facility.

Natural gas will be delivered to the facility via a third-party intrastate pipeline. The natural gas delivered to the site via the feed gas pipeline will be treated, liquefied, and stored on-site in two single-containment LNG storage tanks, each with a net capacity of approximately 160,000 cubic meters (m^3) (42.3 million gallons). The LNG will be pumped from the storage tanks to the marine facilities, where it will be loaded onto LNG carriers at the berthing dock using cryogenic piping.

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SCALE

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Project Site

Figure 1

Project Location

Annova LNG Brownsville Project

Cameron County, Texas

SOURCE: Annova LNG 2015; ESRI 2015; TX DOT 2014

1.3 CONSTRUCTION METHODS AND DESCRIPTIONS

The Project consists of LNG facilities and associated marine facilities located in south Texas. For this IHA application, descriptions of the marine facilities and marine berth are provided below.

LNG Facilities

The Project will be located on a 2.96 km^2 (731-acre) property adjacent to the BSC on land owned by the Brownsville Navigation District (BND). The property, located at approximate mile marker 8.2 on the south bank of the BSC, has direct access to the Gulf of Mexico via the Brazos Santiago Pass. Annova LNG signed a real estate lease option agreement with the BND for the Project site. Subject to compliance with the terms of the real estate lease option agreement, Annova LNG may exercise the option and enter into the ground lease at any time.

The facilities for the Project include the following major components:

- Gas pretreatment facilities;
- Liquefaction facilities (six liquefaction trains and six approximately 72,000-horsepower electric motor-driven compressors);
- Two LNG storage tanks;
- Boil-off gas handling system;
- Flare system;
- Marine facilities;
- Control, administration, and support buildings;
- Access road;
- Fencing and barrier wall; and
- Utilities (power, water, and communication).

Marine Facilities

The marine facilities will include a 457-meter (m) (1,500-foot)-diameter turning basin and widened channel approach areas to the turning basin (see Figure 2). LNG carriers will dock on the loading platform at the south side of the turning basin. The marine facilities include the following components:

- Loading platform and berth for one LNG carrier, including turning basin and access areas along the BSC;
- Cryogenic pipelines and vapor return lines;

- Aids to navigation;
- Material offloading facility (MOF);
- Mooring dolphins;
- Breasting dolphins;
- Fire protection equipment; and
- Tug berth area.

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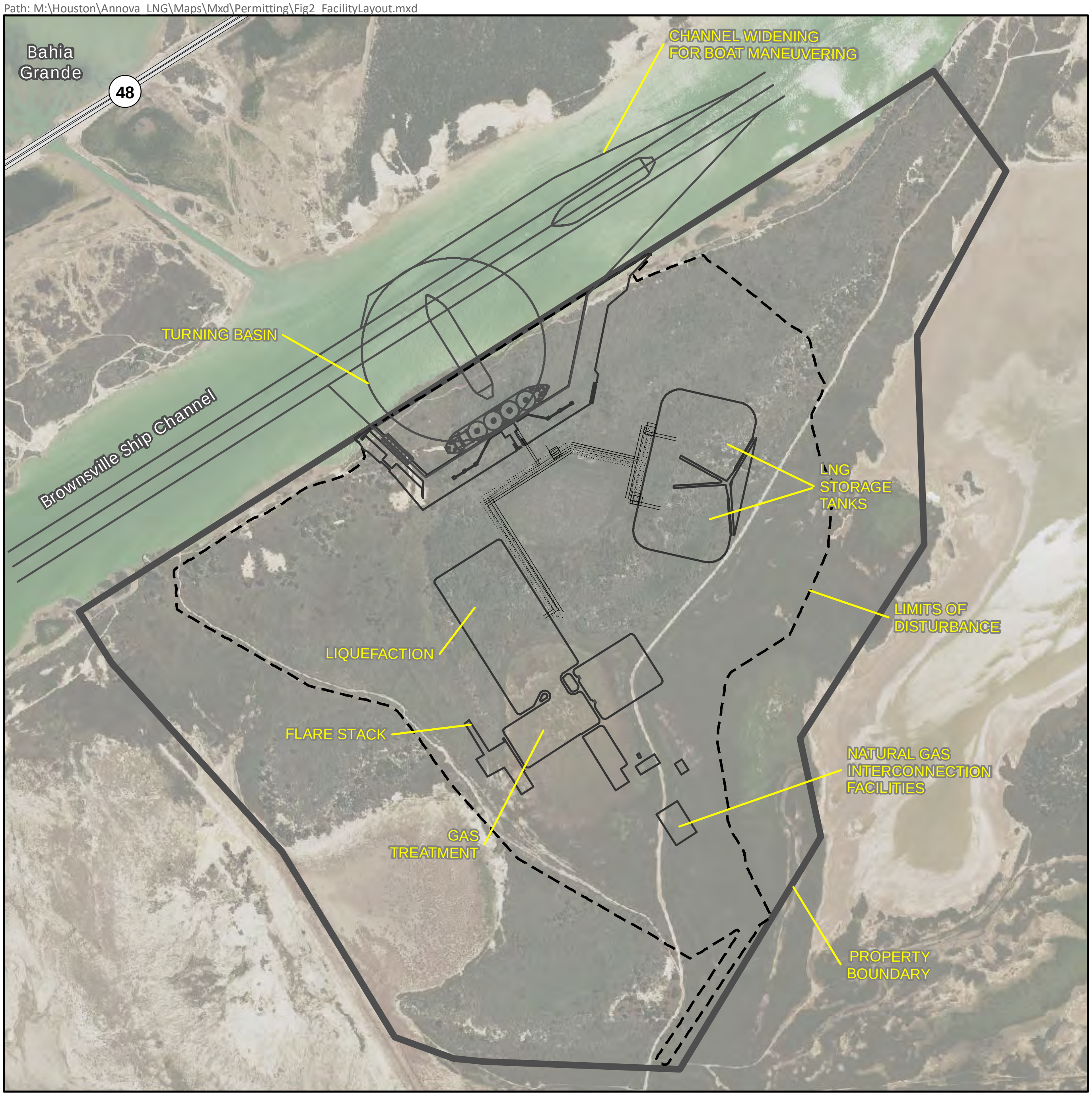

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- Facility Outlines
- Limits of Disturbance
- Project Site
- State Highway

SOURCE: Annova LNG 2015; ESRI 2014; USDA NAIP 2014; CBI 2010; Cameron County 2014

Figure 2

General Site Plan for Proposed Facilities

Annova LNG Brownsville Project

Cameron County, Texas

Marine Berth

The marine berth will be constructed using both land-based excavation and dredging. Land-based excavation will occur in land areas, and the excavated material will be stored for later use on the Project site. A portion of the shoreline will be retained as excavation begins and serve as an earthen berm to isolate the excavated area of the berth from the BSC; however, it is expected that once excavation reaches a depth below +0.6 m (+2 feet), the excavation will require dewatering. Land-based excavation will remove the material to a depth of about -6.4 m (-21 feet), at which point the earthen berm will be removed and the remainder of the berth will be dredged using a hydraulic cutter dredge. The berth will be dredged to the final design depth of -13.7 m (-45 feet) mean lower low water (MLLW), plus 0.9 m (3 feet) for advance maintenance and over depth, with side slopes at a ratio of 3:1 where sheet piling is not used.

The marine berth will also require installation of both land and in-water pilings. Pilings for the mooring dolphins and access trestle will be installed from land following land-based excavation but prior to removal of the earthen berm. Pilings for the breasting dolphins will be installed in-water after removal of the earthen berm. Prior to construction of the breasting dolphins, a number of temporary pilings will be installed to facilitate installation of the breasting dolphin piles and will be removed once complete (see Table 1 and Section 1.3.1).

Material Offloading Facility

Annova LNG will construct an MOF along the west side of the marine berth. The MOF will accommodate barge delivery of major equipment and modular plant components during construction and will be maintained for use during operation as needed. The initial excavation and dredging of the marine berth will create a berth of sufficient size to accommodate the MOF and will include a retaining wall consisting of a combination of piles and steel sheet bulkhead. The MOF deck will consist of a series of driven piles on land. The number, type, and installation methods for pilings required for the MOF are included in Table 1.

In-water Noise-generating Construction Activities

Construction of the marine berth and turning basins includes the following in-water noise-generating activities, which are described in the following sections:

- Pile-driving activities;
- Vessel operations; and
- Dredging.

1.3.1 PILE-DRIVING ACTIVITIES

Construction of the marine facilities will require pile driving using land-based and in-water equipment. Both in-water and on-land pile-driving activities are presented in Table 1 for reference; however, the discussion and analysis presented in this application will focus on in-water pile driving activities.

Table 1
Pile-driving Activities Associated with Construction of the Annova LNG Project

Project Component	Pile Type	Pile Diameter (meters [inches])	Number of Piles	Driving Location	Method	Estimated Duration (days of in-water pile driving)
Temporary piles for breasting dolphins[1]	Steel piles	0.6 (24)	16	In water	Vibratory and impact hammer	8[1]
Breasting dolphins	Monopile	2.4 (96)	4	In water	Vibratory and impact hammer	8[2]
Dolphin walkway support	Steel piles	1.1 (42)	3	On land	Impact hammer	2
Mooring dolphins	Steel piles	1.1 (42)	24	On land	Impact hammer	6
Trestle	Steel piles	0.9 (36)	12	On land	Impact hammer	3
MOF	Steel piles	0.8 (30)	241	On land	Impact or vibratory hammer[3]	60
MOF	Steel sheet piles	0.7 (27.6)	923 linear feet	On land	Impact or vibratory hammer[3]	20
LNG Carrier Loading Platform	Steel piles	1.1 (42)	28	On land	Impact hammer	7

Key:
LNG = liquefied natural gas
MOF = material offloading facility

[1] The 0.6-m (24-inch)-diameter steel piles will be installed to provide support during installation of the 2.4 m (96-inch) breasting dolphins. Once the breasting dolphins are installed, the temporary piles will be removed. The estimated installation duration is four days, and the estimated removal duration is four days.
[2] Each breasting dolphin pile could consist of up to two sections. The first section is set using a vibratory hammer. After fixity occurs, the rest of the section is driven using an impact hammer. The second section is installed using an impact hammer. It is estimated that one section could be installed per day, requiring up to two days to install one complete pile.
[3] The type of hammer used will be determined during final engineering design.

The proposed Project involves installation and removal of 16 temporary 0.6 m (24-inch)-diameter steel piles and installation of four 2.4 m (96-inch)-diameter steel breasting dolphin piles (see Table 2). The 16 temporary steel piles will provide support during installation of the breasting dolphins (four temporary piles for each breasting dolphin). Each temporary pile will be installed using a vibratory and impact hammer. Installation of the temporary piles will occur in stages, initially with a vibratory hammer followed by an impact hammer. Once installation of the breasting dolphin piles is complete, all temporary piles will be removed using a vibratory hammer.

Each breasting dolphin pile could consist of up to two sections, with time elapsing between the pile-driving periods for pile handling, positioning, and welding. The first section of each breasting dolphin pile is set using a vibratory hammer. After fixity occurs, the rest of the section is driven using an impact hammer. The second section is installed using an impact hammer.

1.3.2 VESSEL OPERATIONS

Various types of vessels will operate in the vicinity of the Project and transit between the Project and other areas along the BSC. Barges and support vessels will deliver construction materials and equipment to the MOF and Port of Brownsville during Project construction. During operations, Annova LNG anticipates that it will load approximately two to four LNG carriers per month when operating at full plant capacity; though the actual number of port calls will depend on future offtake agreements and the capacity of the specific vessels. At maximum output, Annova LNG will load up to a maximum of 125 LNG carriers per year based on 138,000 m^3 vessels. The LNG carriers will navigate through the Gulf of Mexico and the U.S. Exclusive Economic Zone (EEZ) using designated fairways and typical vessel routes to avoid obstructions and to maximize efficiency, considering distance and currents.

Cargo and LNG vessels can produce underwater noise levels up to 192 decibel (dB) re 1 micropascal (μPa) at maximum engine output, traveling at 8.2 meters per second (m/s) (16.0 knots), with noise levels reduced below this level during idling periods (Hildebrand 2009). Various vessel types to produce different frequencies; as vessel size increases, frequencies generally become lower. The predominant sound frequencies associated with large vessels are below several hundred hertz (Hz). The predominantly low-frequency noise from vessels in the Project area has the potential to affect the ambient (background) noise over a much larger area than the higher frequencies that may exist near individual sources (e.g., smaller vessels or various industrial activities within the BSC). Noise from LNG carriers is not expected to cause behavioral responses in marine species. Disturbances from vessel noise will be short term and similar to the existing baseline noise levels in the marine environment (see Section 2.3.2 for additional details).

1.3.3 DREDGING

Annova LNG will dredge the marine berth using a hydraulic cutter dredge. The berth will be dredged to the final design depth of -13.7 m (-45 feet) mean lower low water, plus 0.9 m (3 feet) for advance maintenance and over depth, with side slopes at a ratio of 3:1 where sheet piling is not used. Material removed by land-based excavation will be used for on-site fill where possible or placed on the Project site to support landscaping and final grading. Annova LNG proposes to use the existing Dredged Material Placement Area (DMPA) 5A or 5B, located just west of the Project site, to dispose of dredged material not used as fill on-site. Dredged material will be moved to the DMPA through an approximately 2.6 km (1.6-mile)-long, floating dredged material pipeline that will be temporarily anchored along the south shore of the BSC. The dredged material pipeline will be marked with navigation lights and reflective signs and monitored to ensure the safety of area traffic. Dredging for the marine berth is estimated to occur in two, 10-hour shifts, six days per week.

The U.S. Army Corps of Engineers (USACE) is responsible for maintenance dredging of the BSC, and during Project operation, Annova LNG will be responsible for maintenance dredging of its marine berth and associated turning basin. During operation of the Project, periodic maintenance dredging will be required to maintain depth in the turning basin. Maintenance dredging will occur only in areas that have been previously dredged during the initial construction of the Project. Annova LNG estimates that shoaling rates in the marine berth will be greater than those in the main channel. Based on estimated current annual shoaling rates within the BSC of approximately 7.6 m^3/0.3 m (10 cubic yards [yd^3] per linear foot), Annova LNG estimates that maintenance dredging will generate up to 76,455 m^3 (100,000 yd^3) of material annually. Annova LNG proposes to use the existing DMPA 5A or 5B located along the BSC just west of the Project site for placement of dredged material not used as fill on-site. Sound associated with dredging is not expected to affect marine mammals because the noise produced by the dredge will not reach levels that will disturb marine mammals.

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2 DATES, DURATION, AND SPECIFIED GEOGRAPHIC REGION

The date(s) and duration of such activity and the specified geographical region where it will occur.

2.1 DATES OF CONSTRUCTION

Annova LNG anticipates that construction will start at the beginning of 2021. Annova LNG estimates the total construction period will be about 48 months, from the start of site groundwork for the first stage, to completion of structural, mechanical, and electrical installations for the last stage. Pile-driving activity is currently planned to be completed by the end of 2021 (lasting no more than one year). Annova LNG is requesting an IHA with an effective start date of January 1, 2021.

2.2 DURATION OF ACTIVITIES

The proposed Project design involves installation and removal of 16 temporary 0.6 m (24-inch)-diameter steel piles and installation of four 2.4 m (96-inch)-diameter steel breasting dolphin piles (see Table 2). The 16 temporary steel piles will provide support during installation of the breasting dolphins (four temporary piles for each breasting dolphin).

Each 0.6 m (24-inch)-diameter temporary pile will be installed using a vibratory and impact hammer requiring up to 10 minutes of driving time per pile using the vibratory hammer and up to 15 minutes of driving time per pile using the impact hammer, for a total of 25 minutes of pile driving per pile installation. Installation of the temporary piles will occur in stages, initially with a vibratory hammer followed by an impact hammer.

Installation of all 16 temporary piles is anticipated to occur over a four-day period. Up to four temporary piles will be installed per day, with time elapsing between the pile-driving periods for pile handling and positioning. For the purposes of the analysis in this IHA application, the acoustic modeling used a maximum duration of 40 minutes per day of vibratory pile driving and 675 strikes per pile (total maximum strikes per day is 2,700) for impact pile driving. Once installation of the breasting dolphin piles is complete, all temporary piles will be removed using a vibratory hammer. Removal of a single pile could take up to 1 hour, and it is anticipated that four piles can be removed per day, for a maximum duration of 4 hours per day. Complete removal of all temporary piles could require up to 4 days. For the purposes of the analysis in this IHA application, the acoustic modeling for removal of the 24-inch temporary piles used a maximum duration of 60 minutes per day of vibratory pile driving.

Each of the four 2.4 m (96-inch)-diameter piles each could consist of up to two sections (total of eight sections installed), with time elapsing between the pile-driving periods for pile handling, positioning, and welding. Annova LNG anticipates installing up to one section per day. The first section of each breasting dolphin pile is set using a vibratory hammer, which typically takes up to 20 minutes per pile. After fixity occurs, the rest of the sections would be driven using an impact hammer, which could take up to 30 minutes.

Installation of the four complete piles is anticipated to occur over approximately two weeks, accounting for pile handling, positioning, and welding; however, the active pile installation time will occur over eight days with one section installed each day (i.e., half a pile). Vibratory pile driving will occur on only four of the eight days, while impact pile driving will occur on all eight days. For the purposes of the analysis in this IHA application, the acoustic modeling for 2.4 m (96-inch)-diameter piles used the following inputs: a maximum duration of 20 minutes of vibratory installation per day over a four-day period and a maximum of 1,350 strikes per half pile/day over an eight-day period.

Table 2 details the pile driving parameters used in the acoustic modeling for the described pile driving activities.

Table 2
Piles Required for the Marine Facilities

Facility	Pile Type	Pile Diameter (meters [inches])	Method	Total Piles	Duration (days)	Average Time per Pile (minutes)	Average Strikes per Pile
Temporary piles for breasting dolphins	Steel piles	0.6 (24)	Installation: vibratory hammer, in water	16	4	10	N/A
			Installation: impact hammer, in water			15	675 (2,700 strikes per day)
Temporary piles for breasting dolphins	Steel piles	0.6 (24)	Removal: vibratory hammer, in water	16	4	60	N/A
Breasting dolphins[1]	Monopiles	2.4 (96)	Installation: vibratory hammer, in water	4	8 (4 days overlap with both vibratory and impact; 4 days impact only)	20	N/A
			Installation: impact hammer, in water			60 (30 minutes per section)	2,700 (1,350 strikes per day)

[1] The 2.4-m (96-inch)-diameter piles will be installed in stages, initially with a vibratory hammer followed by an impact hammer. Each pile consists of up to two sections.

2.3 PROJECT AREA DESCRIPTION

2.3.1 SPECIFIED GEOGRAPHICAL REGION

The Project site is on the south bank of the BSC, approximately 13.2 km (8.2 miles) upstream from the channel mouth at Brazos Santiago Pass. The BSC is a man-made marine navigation channel that connects to the Gulf of Mexico and forms the western terminus of the Gulf Intracoastal Waterway system. It is a deep-draft navigation channel connecting the deepwater Port of Brownsville to the Gulf of Mexico via the Brazos Santiago Pass and is an established shipping corridor. The BSC is the only waterbody that occurs within the Project site. Bahia Grande and South Bay are connected to the BSC and are the other waterbodies nearest to the Project site. The BSC is approximately 12.8 m (42 feet) deep and 27.4 km (17 miles) long. A turning basin located at the western terminus of the BSC is approximately 11 m (36 feet) deep and 365.8 m (1,200 feet) wide (Port of Brownsville 2019a). Field surveys indicate that open water within the Project site is non-vegetated; the channel is a poor habitat for seagrass due to disturbance from drawdowns and return surges associated with normal tidal movement and human-induced actions such as vessel traffic.

The Bahia Grande is located approximately 1.1 km (0.7 miles) north of the Project site on the north side of the BSC. This waterbody is a large saline lagoon connected to the BSC via a pilot channel constructed in 2005. Between the 1930s and the 1950s, the accumulation of material along the BSC from maintenance dredging decreased the tidal flow into the small connection between Bahia Grande and the BSC. The pilot channel allowed the area to refill (U.S. Fish and Wildlife Service [USFWS] 2015). The Port has plans to widen the pilot channel to increase tidal flow into the Bahia Grande basin for water exchange on a daily basis (USFWS 2015).

South Bay is located within the South Laguna Madre watershed and consists of approximately 14.2 km^2 (3,500 surface acres) of water (Texas Parks and Wildlife Department [TPWD] 2019). The South Bay Coastal Preserve is bounded on the south by the Rio Grande riparian edge, on the north by the BSC, and on the east by Brazos Island (TPWD 2019). South Bay is a shallow waterbody with unique ecological features such as seagrass beds, black mangroves (*Avicennia germinans*), and oyster reefs (TPWD 2019). South Bay and the lower Laguna Madre, located approximately 3.2 and 6.4 km (2 and 4 miles) from the Project site, respectively, contain seagrass beds that function as nursery habitat for commercially important fishes and crustaceans.

Currents in the BSC are primarily wind driven. The USACE estimates that current velocities average 0.3 m/s (0.6 knots) at the Gulf of Mexico and about 0.05 m/s (0.1 knots) near the Project site (USACE 2012).

2.3.2 EXISTING VESSEL TRAFFIC AND AMBIENT UNDERWATER SOUNDSCAPE

Ambient noise is sound that already exists in the environment prior to the introduction of another noise. Ambient noise is produced by both natural and man-made sources. Natural sources of ambient noise include biological sources (i.e., various marine species), wind, waves, rain, or naturally occurring seismic activity (i.e., earthquakes) (Richardson et al. 1995). Human-generated sources can include vessel noise (e.g., commercial shipping/container vessels), seismic air guns, and marine construction. Various factors contribute to the ambient noise in the BSC. One of the major contributors to ambient noise is the commercial shipping traffic near the Project site. In 2017, 1,317 vessels called on the Port of Brownsville, with vessel traffic increasing overall (Port of Brownsville 2018). The channel also experiences frequent use by fishing vessels, with the Port of Brownsville fishing harbor housing up to 500 boats (Port of Brownsville 2019b). Water-based tourism in the channel is also popular and is supported by recreational vessels such as tour boats for whale watching. Based on the location of the Project site within a shipping channel, Annova LNG expects that ambient noise sources will include large vessels (i.e., container ships) that produce source levels of 180 to 190 dB re 1 μPa root mean square (RMS) at frequencies between 0.2 and 0.5 kilohertz (kHz) (Thomsen et al. 2009; Jasny et al. 2005). Noise from smaller vessels varies in terms of frequencies and source levels produced, with larger vessels typically producing greater source levels. Large outboard motors can produce noise up to 175 dB re 1 μPa-m (measured at 1 m) (Richardson et al. 1995). Annova

LNG expects that noise associated with Project vessels will be comparable to that generated by existing vessel traffic in the BSC.

3 SPECIES AND NUMBERS OF MARINE MAMMALS

The species and numbers of marine mammals likely to be found within the activity area.

3.1 SPECIES DESCRIPTIONS AND ABUNDANCES

Three species (four separate stocks) of marine mammals are found along the southern coast of Texas: the Atlantic spotted dolphin (*Stenella frontalis*), the common bottlenose dolphin (*Tursiops truncatus truncatus*), and the rough-toothed dolphin (*Steno bredanensis*) (see Table 3) (Waring et al. 2016; Hayes et al. 2019). While none of these species are protected under the Endangered Species Act (ESA), they are all protected under the MMPA. More information regarding detailed population status, distribution, and numbers of each species is discussed in Section 4. Given the Project location, and after initial consideration, species that occur in deeper and/or more offshore waters, such as sperm whales (*Physeter macrocephalus*), Risso's dolphins (*Grampus griseus*), and pantropical spotted dolphins (*Stenella attenuata*), were deemed unlikely to occur in the portions of the Project site that overlap the BSC. These species will not be further discussed in this application.

Atlantic-spotted and rough-toothed dolphins, though unlikely to occur in the Project area, are included in this application to ensure coverage if these species are observed. Both species have higher predicted abundance in deeper waters but do have predicted occurrence in nearshore waters (Roberts et al. 2016). The predicted densities of these species differ from species such as Risso's dolphin and sperm whales, which have sharp bathymetric delineations between regions of high predicted density in deeper waters and regions of no predicted density in near-shore waters (Roberts et al. 2016). In contrast, the predicted densities of Atlantic spotted and rough-toothed dolphins exhibit a gradual decline as waters become shallower, with some predicted occurrence in nearshore waters. The two stocks of bottlenose dolphins found in this estuarine area are the Laguna Madre Estuarine stock and the Gulf of Mexico Western Coastal stock.

Table 3
Marine Mammal Species Potentially in the Region of the BSC

Common Name	Scientific Name	Endangered Species Act Status	Marine Mammal Protection Act Status	Best Population Estimate	Presence in Project Area
Cetaceans					
Dolphins					
Atlantic Spotted Dolphin (Northern Gulf of Mexico Stock)[1]	*Stenella frontalis*	None	Not strategic	37,611 (coefficient of variation [CV]=0.28)[1]	Possible
Common Bottlenose Dolphin (Gulf of Mexico Western Coastal Stock)	*Tursiops truncatus*	None	Not strategic	20,161 (CV=0.17)[2]	Common
Common Bottlenose Dolphin (Laguna	*Tursiops truncatus*	None	Strategic	80 (CV=1.57)[3]	Common

Table 3
Marine Mammal Species Potentially in the Region of the BSC

Common Name	Scientific Name	Endangered Species Act Status	Marine Mammal Protection Act Status	Best Population Estimate	Presence in Project Area
Madre Estuarine Stock)					
Rough-toothed dolphin (Northern Gulf of Mexico Stock)	*Steno bredanensis*	None	Not strategic	624 (CV=0.99)[4]	Possible

[1] This abundance estimate is reported in latest stock assessment report for Atlantic spotted dolphin Northern Gulf of Mexico Stock (Hayes et al. 2017). This estimate is considered outdated (more than 8 years old) by the National Oceanic and Atmospheric Administration (NOAA) and is based on surveys from 2000–2004 (Fulling et al. 2003; Mullin 2007). Data combined from 1992–2009 resulted in an estimate of 47,488 (CV = 0.13) (Roberts et al. 2016).

[2] This abundance estimate is reported in the latest stock assessment report for common bottlenose dolphin Gulf of Mexico Western Coastal Stock (Hayes et al. 2017) based on surveys from 2011–2012 (no report citation provided). This estimate will be considered outdated (more than 8 years old) in 2020.

[3] This abundance estimate is reported in the latest stock assessment report for common bottlenose dolphin Gulf of Mexico Bay, Sound, and Estuary stocks (Hayes et al. 2019). This estimated is considered outdated (more than 8 years old) by NOAA and is based on surveys from 1992–1993 (Blaylock and Hoggard 1994). Recent photo-identification surveys by Piwetz and Whitehead (2019) in Lower Laguna Madre identified 109 individuals, raising the minimum number of bottlenose dolphins to 109. Neither Blaylock and Hoggard (1994) nor Piwetz and Whitehead (2019) distinguished between estuarine and coastal bottlenose dolphins, though mixing of estuarine and coastal stocks has been documented in other bays (e.g., Balmer et al. 2008).

[4] This abundance estimate is reported in the latest stock assessment report for rough-toothed dolphins in the Northern Gulf of Mexico stock (Hayes et al. 2018). This estimate is considered outdated (more than 8 years old) and is based on surveys from 2009 (Garrison 2016). It does not include continental shelf waters and does not correct for unobserved animals. Data combined from 1992–2009 resulted in an estimate of 4,853 (CV=0.19) (Roberts et al. 2016).

4 AFFECTED SPECIES STATUS AND DISTRIBUTION

A description of the status and distribution, including seasonal distribution (when applicable), of the affected species or stocks of marine mammals likely to be affected by such activities.

As described in Section 3, three species of marine mammals (four separate stocks) occur along the southern coast of Texas: Atlantic spotted dolphins, common bottlenose dolphins (Laguna Madre and Gulf of Mexico Western Coastal stocks), and rough-toothed dolphins. Each species may be present in the area throughout the year.

4.1 ATLANTIC SPOTTED DOLPHIN

The Atlantic spotted dolphin belongs to the Delphinidae family of toothed whales. There are three stocks of Atlantic spotted dolphins, but only the Northern Gulf of Mexico stock occurs in Texas waters (Waring et al. 2016).

Atlantic spotted dolphins rely on echolocation for foraging and navigation, much like many other cetaceans. Their hearing capabilities are critical to their survival. These, like all dolphins, are considered mid-frequency cetaceans. Mid-frequency cetaceans have an estimated functional hearing range of 150 Hz to 160 kHz (NOAA Fisheries 2018a). The following subsections provide additional information about the status, distribution, and population numbers of this species as it relates to the region of the BSC.

4.1.1 POPULATION STATUS

The northern Gulf of Mexico stock of Atlantic spotted dolphins is not considered strategic under the MMPA. The status of these dolphins relative to the optimum sustainable population (OSP) is unknown. Atlantic spotted dolphins are not listed as threatened or endangered under the ESA (Waring et al. 2016).

4.1.2 DISTRIBUTION

In the Gulf of Mexico, Atlantic spotted dolphins occur primarily from continental shelf waters (20 to 200 m [66 to 656 feet] deep) to slope waters up to 500 m (1,640 feet) deep (Waring et al. 2016). This distribution was gathered from Southeast Fisheries Science Center spring and fall vessel surveys conducted from 1996 to 2001 and from summer 2003 and spring 2004 surveys. Additionally, Atlantic spotted dolphins were observed in all seasons during aerial surveys of the northern Gulf of Mexico from 1992 to 1998. It has been suggested that this species may move inshore seasonally during spring, but data supporting this hypothesis are limited (Waring et al. 2016). While this species is more likely to occur along the outer continental shelf, it is possible that individuals or small groups could be present in the vicinity of the Project site.

4.1.3 NUMBERS

The total number of Atlantic spotted dolphins in the northern Gulf of Mexico stock is based on abundance estimates, which have been generated from survey efforts beginning in 1991 (Waring et al. 2016). The most recent and best available population estimate for this stock is 37,611 individuals (coefficient of variation

[CV] = 0.28), which is based on fall surveys conducted in 2000 and 2001 between the 20 m (66 feet) to 200 m (656 feet) isobaths (Fulling et al. 2003; Mullin 2007). Data combined from 1992 through 2009 resulted in an estimate of 47,488 (CV = 0.13) (Roberts et al. 2016).

4.2 COMMON BOTTLENOSE DOLPHIN

Common bottlenose dolphins are toothed whales that belong to the Delphinidae family. The Gulf of Mexico hosts many stocks of common bottlenose dolphins, including an Oceanic stock, a Continental Shelf stock, three Coastal stocks, and 31 Northern Gulf of Mexico Bay, Sound, and Estuary stocks (including the estuarine Laguna Madre stock) (Waring et al. 2016; Hayes et al. 2019). Distinguishing between individuals of each stock is difficult as members of these stocks have nearly identical physical characteristics and often have overlapping range boundaries. Coastal and estuarine stocks overlap in their ranges, with estuarine dolphins observed in coastal waters and coastal dolphins observed in estuarine waters (e.g., Bassos-Hull et al. 2013; Laska et al. 2011; Maze and Würsig 1999). For example, two bottlenose dolphins tagged in St. Joseph Bay travelled more than 40 km from the bay (Balmer et al. 2008). The two stocks that are likely to be present in the Project area are the Laguna Madre Estuarine and Gulf of Mexico Western Coastal stocks.

Common bottlenose dolphins rely on echolocation for foraging and navigation, much like many other cetaceans. Their hearing capabilities are critical to their survival. These, like all dolphins, are considered mid-frequency cetaceans. Mid-frequency cetaceans have an estimated functional hearing range of 150 Hz to 160 kHz (NOAA Fisheries 2018a). The following subsections provide additional information about the status, distribution, and population numbers of this species as it relates to the region of the BSC.

4.2.1 WESTERN GULF OF MEXICO COASTAL STOCK

The coastal waters of the Gulf of Mexico contain three separately managed stocks of common bottlenose dolphins (Waring et al. 2016). The Gulf of Mexico Western Coastal stock represents one of these three stocks and occurs in the vicinity of the Project site (Waring et al. 2016).

4.2.1.1 Population Status

The Gulf of Mexico Western Coastal stock of common bottlenose dolphins is not considered strategic under the MMPA, and the status of the stock relative to OSP in the Gulf of Mexico is unknown. Additionally, the common bottlenose dolphin is not listed as threatened or endangered under the ESA (Waring et al. 2016).

In May of 2012, the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) declared an Unusual Mortality Event (UME) for common bottlenose dolphins occurring in Texas State waters. The UME lasted from November of 2011 to March of 2012 and consisted of 126 dolphin mortalities. The majority of these dolphins were stranded in five Texas counties: Aransas, Brazoria, Calhoun, Kleburg, and Galveston, none of which contain the Project site. The cause of the common bottlenose strandings is undetermined, and NOAA Fisheries still lists the UME status as active (NOAA Fisheries 2018b). In 2019, NOAA Fisheries issued a UME for bottlenose dolphins occurring in the Northern Gulf of Mexico along Louisiana, Mississippi, Alabama, and the panhandle of Florida. As of June 27, 2019, 285 dolphins have been stranded (NOAA Fisheries 2019). Again, the region of the UME does not overlap with the Project site. Both UMEs did not identify the affected bottlenose dolphin stock.

4.2.1.2 Distribution

NOAA Fisheries defines the range of the Western Coastal stock of common bottlenose dolphins as beginning at the shore and extending out to the 20 m (66-foot) isobath from the Texas/Mexico border to the Mississippi River Delta (Waring et al. 2016). The Western Coastal stock overlaps boundaries with other common bottlenose dolphin stocks—namely, the estuarine stocks. The Gulf of Mexico Western Coastal stock may occur in the vicinity of the Project site and may enter the estuarine area of the BSC. Individual bottlenose dolphins have been observed during photo-identification surveys both inside and outside of the Brazos Santiago Pass, which is an inlet between the coastal waters of the Gulf of Mexico and the estuarine waters of the Laguna Madre adjacent to the BSC (Ronje and Whitehead 2016; Piewitz and Whitehead 2019). As noted in Section 4.2, studies of other bays have clearly indicated that bottlenose dolphins that are not part of local resident populations transiently use bays (Bassos-Hull et al. 2013; Laska et al. 2011; Maze and Würsig 1999; Balmer et al. 2008).

4.2.1.3 Numbers

The population estimate of the Gulf of Mexico Western Coastal stock of common bottlenose dolphins is 20,161 individuals (CV = 0.17) (Waring et al. 2016). This estimate was determined using an inverse-variance weighted average of seasonal abundance estimates derived from aerial surveys conducted during spring 2011, summer 2011, fall 2011, and winter 2012 (Waring et al. 2016).

4.2.2 NORTHERN GULF OF MEXICO BAY, SOUND, AND ESTUARY STOCKS: LAGUNA MADRE ESTUARINE STOCK

Bay, sound, and estuarine populations of common bottlenose dolphins are currently split into 31 distinct blocks within the northern Gulf of Mexico and adjacent areas. NOAA Fisheries is in the process of writing individual stock assessment reports for 31 common bottlenose dolphin estuarine stocks in the northern Gulf of Mexico, including the Laguna Madre Estuarine stock.

4.2.2.1 Population Status

The population status of the Laguna Madre Estuarine stock of common bottlenose dolphins relative to OSP is unknown because the stock size is currently unknown (Hayes et al. 2019); however, NOAA Fisheries does consider this stock to be strategic under the MMPA. Common bottlenose dolphins are not listed as threatened or endangered under the ESA (Hayes et al. 2019).

As described in Section 4.2.1.1, mass strandings of Texas common bottlenose dolphins occurred from November 2011 to March 2012. These strandings led NOAA Fisheries to declare a UME in May 2012. The UME is still active today (NOAA Fisheries 2018b). The UME did not identify the bottlenose dolphin stock affected.

4.2.2.2 Distribution

The Laguna Madre stock of common bottlenose dolphins is likely a year-round resident stock of lower Texas estuarine waters. The boundary associated with this stock (Rosel et al. 2011), which is also the survey area for abundance estimates from 1992/1993 (Blaylock and Hoggard 1994) and 1984/1985 (Scott et al. 1989), is the Laguna Madre estuary, which spans from Port Isabel to Corpus Christi Bay, including Baffin

Bay (see Figure 3). Piwetz and Whitehead (2019) conducted photo-identification surveys in Lower Laguna Madre in December 2018 and August 2019. During the five-day survey, they covered 365.4 km over 26.72 hours and consistently observed bottlenose dolphins along the length of the BSC and reported average group sizes of up to 14 individuals. Researchers also conducted a four-day opportunistic survey within the BSC in July of 2016 (Ronje and Whitehead 2016). Although the primary goal of the effort was to locate, track, and disentangle a reported bottlenose dolphin severely entangled in recreational fishing gear, opportunistic photographs and data were collected for sightings of other dolphin groups. During the four-day effort, approximately 287 km (178 miles) were surveyed and common bottlenose dolphins were sighted within the BSC as far into the channel as the shrimp docks and often travelling behind the boats of shrimp trawlers. Dolphins were observed foraging throughout the day at the mouth of the Brazos Santiago Pass and inside the BSC slowly traveling in the direction of tidal movement or behind shrimp trawlers. In addition, mixing of resident and non-resident bottlenose dolphins has been observed for other stocks, especially in passes and at the mouths of estuaries, and is therefore likely to occur in the Laguna Madre (Hayes et al. 2019). While older research yielded rarer sightings of common bottlenose dolphins in the area (Scott et al. 1989; Blaylock and Hoggard 1994; Phillips and Rosel 2014), newer research efforts suggest that these dolphins are residents of the estuarine waters of the Project site and commonly occur in the channel (Piwiez and Whitehead 2019).

4.2.2.3 Numbers

Population abundance for the Laguna Madre estuarine stock of common bottlenose dolphins has not been assessed since 1992/1993. The stock assessment report provides an abundance estimate of 80 dolphins (CV = 1.57) (Blaylock and Hoggard 1994). Recent photo-identification surveys of the lower Laguna Madre and BSC have identified 109 individuals (Piwetz and Whitehead 2019). Of these, 42% were sighted on more than one survey day, and 6% were observed during both seasons of the survey (winter and summer), suggesting some degree of residency. Hence, 109 can be considered a minimum population size. The survey area represents less than 25% of the area of the boundary of the Laguna Madre Estuarine stock of bottlenose dolphins, which suggests that the population size is likely much larger.

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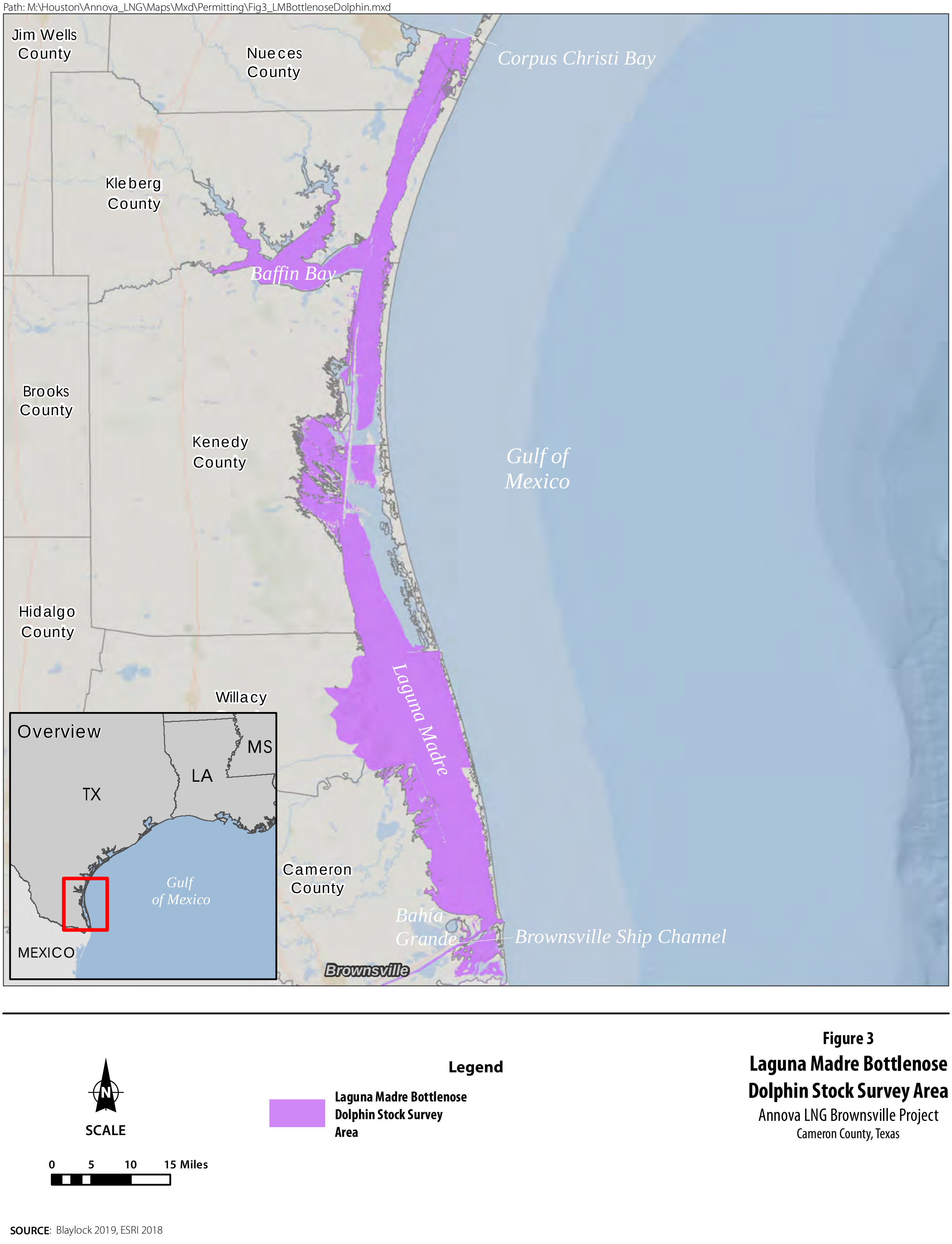

Legend

Laguna Madre Bottlenose Dolphin Stock Survey Area

Figure 3

Laguna Madre Bottlenose Dolphin Stock Survey Area

Annova LNG Brownsville Project

Cameron County, Texas

SOURCE: Blaylock 2019, ESRI 2018

4.3 ROUGH-TOOTHED DOLPHIN

Rough-toothed dolphins belong to the Delphinidae family of toothed whales. There are three stocks of rough-toothed dolphins in U.S. waters, but only one occurs off the coast of Texas: the northern Gulf of Mexico stock (Hayes et al. 2017).

Rough-toothed dolphins rely on echolocation for foraging and navigation, much like many other cetaceans. Their hearing capabilities are critical to their survival. These, like all dolphins, are considered mid-frequency cetaceans. Mid-frequency cetaceans have an estimated functional hearing range of 150 Hz to 160 kHz (NOAA Fisheries 2018a). The following subsections provide additional information about the status, distribution, and population numbers of this species as it relates to the region of the BSC.

4.3.1 POPULATION STATUS

The northern Gulf of Mexico stock of rough-toothed dolphins is not considered strategic under the MMPA. The status of these dolphins relative to the OSP is unknown. Additionally, rough-toothed dolphins are not listed as threatened or endangered under the ESA (Hayes et al. 2017).

4.3.2 DISTRIBUTION

Rough-toothed dolphins typically occur in oceanic and offshore waters, though they are also present, to a lesser extent, in continental shelf waters in the northern Gulf of Mexico. In 2000 and 2001, the Southeast Fisheries Science Center conducted ship-based line transect surveys and recorded two sightings of rough-toothed dolphins approximately 40 km (25 miles) offshore of Corpus Christi, Texas, in approximately 35 m (115 feet) of water (SEFSC 2000, 2001). The group size of the two encounters ranged from eight to 20 animals. During aerial surveys of the northern Gulf of Mexico from 1992 to 1998, rough-toothed dolphins were observed during all seasons of the calendar year (Hayes et al. 2017). While the presence of rough-toothed dolphins in the nearshore waters of the Project site is unlikely, they do have the potential to occur within the Project site.

4.3.3 NUMBERS

The current population size of the northern Gulf of Mexico stock of rough-toothed dolphins is estimated in the stock assessment report to be 624 individuals (CV=0.99) (Hayes et al. 2017). This estimate is based on a summer line-transect shipboard survey conducted in 2009 that covered waters from the 200 m (656-foot) isobath out to the outer boundary of the EEZ (Garrison 2016). This may be an underestimate because it does not include continental shelf waters and is not corrected for missed animals during surveys (Hayes et al. 2018). Data combined from 1992 to 2009 resulted in an estimate of 4,853 individuals (CV=0.19) (Roberts et al. 2016).

5 TYPE OF INCIDENTAL TAKING AUTHORIZATION REQUESTED

The type of incidental taking authorization that is being requested (i.e., takes by harassment only; takes by harassment, injury, and/or death) and the method of incidental taking.

The MMPA defines "harassment" as "any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A injury harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B behavioral harassment]" (50 CFR, Part 216, Subpart A, Section 216.3 - Definitions).

Level A harassment may result in injury, and Level B harassment results in behavioral disturbance without the potential for injury. After analysis of potential Level A and B exposures, this IHA application is requesting estimated takes resulting only from Level B behavioral harassment for the Atlantic spotted dolphin, common bottlenose dolphin, and rough-toothed dolphin. Clearance and a shut-down zone would be implemented to avoid Level A take. As per the proposed mitigation and monitoring protocols discussed in Section 11, visual monitoring would begin 30 minutes prior to the start of construction to clear the Level A exclusion zone of any marine mammals that may be present. If an animal is sighted within the Level A exclusion zone during pre-construction, operations would be delayed until the animal is sighted outside the zone or disappears from view for 15 minutes.

5.1 TAKE AUTHORIZATION REQUEST

Annova LNG is requesting issuance of an IHA pursuant to Section 101(a)(5) of the MMPA for the incidental Level B take (disturbance due to Level B behavioral harassment) of small numbers of three marine mammal species by impact and vibratory pile-driving activities, as described in this application. These activities are associated with construction of the Project in the BSC and nearshore coastal regions of southern Texas.

5.2 METHOD OF INCIDENTAL TAKING

The activities outlined in Section 1 have the potential to take marine mammals by behavioral harassment during impact and vibratory pile-driving activities. More specifically, the requested authorization is for the incidental harassment of four stocks of marine mammals that might either be within the Level B ensonified areas at start-up or enter the Level B ensonified areas during the described construction activities. Level B isopleths (straight-line distances to the thresholds) were estimated using proxies for sound source levels and a practical spreading loss model. Level A isopleths were estimated using the NOAA Fisheries (2018a) acoustic guidance; however, as the implementation of the planned mitigation measures described in Section 11 would avoid Level A take of marine mammals, no Level A takes are requested.

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6 TAKE ESTIMATES FOR MARINE MAMMALS

By age, sex, and reproductive condition (if possible), the number of marine mammals (by species) that may be taken by each type of taking identified in Section 5, and the number of times such takings by each type of taking are likely to occur.

6.1 INTRODUCTION

The NOAA Fisheries application for an IHA requires applicants to analyze the number of marine mammals with the potential to be exposed to incidental harassment (Level A or Level B). The in-water pile-driving activities that will occur at the Project site (outlined in Sections 1 and 2) have the potential to take marine mammals only by behavioral harassment (Level B). Other activities, such as dredging, are not expected to result in take since the BSC is an active waterway that already experiences ongoing and regular maintenance dredging activities. The additional construction dredging activities associated with the Project area are expected to be similar to the existing maintenance dredging and are not expected to have a significant underwater noise impact in the BSC. Airborne noise associated with pile-driving activities will not result in take of marine mammals because no pinnipeds reside within the Project area.

In-water pile driving will temporarily increase the sound levels in the BSC within and near the Project area and may result in Level B behavioral harassment of small numbers of Atlantic spotted dolphin, common bottlenose dolphins (including members of both coastal and estuarine stocks), and rough-toothed dolphins. The following sections provide a characterization of the underwater sound analyzed for this application, the sound exposure criteria thresholds and calculated isopleths, and methods and calculations used to determine take by Level B behavioral harassment. Level A injury harassment of cetaceans would be avoided through the implementation of mitigation measures (described in Sections 11 and 13). However, propagation modeling to the Level A criteria thresholds is included for reference.

6.2 DESCRIPTION OF NOISE SOURCES

The Project includes installation and removal of 0.6 m (24-inch)-diameter steel pipe temporary piles and installation of 2.4 m (96-inch)-diameter steel pipe piles using vibratory and impact hammers. See Table 1 and Sections 1 and 2 for full descriptions of installation and removal methods and durations. To estimate the sound levels for pile-driving activities of these piles, Annova LNG identified source levels for each pile type and size using the compendium compiled by the California Department of Transportation [Caltrans] (2015). The information presented in the compendium is a compilation of sound pressure levels (SPLs) recorded during various projects involving in-water pile driving. The compendium is a commonly used reference document for pile-driving source levels when analyzing potential impacts on protected species, including marine mammals, from pile-driving activities. Reference source levels for the Project were determined using data for piles of similar sizes, the same pile-driving method as that proposed for the Project, and at similar water depths.

While the pile sizes and water depths chosen as proxies do not exactly match those for the Project, they are similar enough to the proposed pile driving parameters that the source levels shown in Table 4 are representative for each pile type and associated pile-driving method. There are no reference source levels associated with removal of the 0.6 m (24-inch)-diameter steel pipe temporary piles in Caltrans (2015); therefore, the reference source level used for pile installation was also used for modeling removal.

Note that use of a bubble curtain would result in noise reductions from the source levels for impact installation of piles listed in Table 4. Typical noise reduction from a bubble curtain ranges from 5 to 15 dB (Caltrans 2015; Hannay 2008; Matthews and Zykov 2012). Based on the environment and pile-driving activity similarities, for the current Project, proxy unattenuated sound source levels were obtained from Caltrans (2015) and a conservative 7 dB reduction was applied to account for the use of bubble curtains (see Section 6.3.2). This value is consistent with NOAA Fisheries-approved applications for IHAs for in-water construction projects that modeled an 8- to 10-dB noise reduction from bubble curtains and assumed an average reduction of 12 dB (Chesapeake Tunnel Joint Venture [CTJV] 2018; Washington State Department of Transportation [WSDOT] 2018). The amount of noise reduction depends on several environmental factors—particularly, the flow rate of currents. As the currents in the BSC are relatively slow (see Section 2.3.1), higher noise reduction levels should be achievable. The bubble curtains for the Project would be specifically designed for the Project to account for the pile parameters as described in this application. The curtains would be designed with effectiveness in mind (e.g., curtains would not start mid-water-column and instead would begin near the benthos and surround the piles rather than offer partial coverage). The curtains would be designed and operated by experienced bubble curtain designers and operators with a proven record of successful deployment. Hence, while greater sound attenuation is achievable based on sound source verification studies using similar technology, Annova LNG proposes to apply a 7 dB reduction to all impact pile-driving activities. The sound source levels reported in Table 4 are the median source levels measured during unattenuated pile driving from Caltrans (2015) as well as with a 7 dB reduction applied (for impact pile-driving only).

Table 4
Source Levels

Pile Type[1]	Hammer Type	Proxy[1]	Source Levels		
			SEL (re 1 µPa)	RMS (re 1µPa)	Peak (re 1 µPa)
0.6-m (24-inch)-diameter steel pile	Vibratory	24-inch steel pipe pile with no sound attenuation	ND	165 @ 10 meters	ND
0.6-m (24-inch)-diameter steel pile	Impact	24-inch steel pipe pile with no sound attenuation	178 @ 10 meters	194 @ 10 meters	207 @ 10 meters
0.6-m (24-inch)-diameter steel pile	Impact	24-inch steel pipe pile with 7 dB bubble curtain attenuation	171 @ 10 meters	187 @ 10 meters	200 @ 10 meters
2.4-m (96-inch)-diameter steel pile	Vibratory	72-inch steel pipe pile with no sound attenuation	170 @ 10 meters	170 @ 10 meters	183 @ 10 meters

Table 4
Source Levels

Pile Type[1]	Hammer Type	Proxy[1]	Source Levels		
			SEL (re 1 µPa)	RMS (re 1µPa)	Peak (re 1 µPa)
2.4-m (96-inch)-diameter steel pile	Impact	96-inch steel pipe pile with no sound attenuation	195 @ 10 meters	205 @ 10 meters	220 @ 10 meters
2.4-m (96-inch)-diameter steel pile	Impact	96-inch steel pipe pile with 7 dB bubble curtain attenuation	188 @ 10 meters	198 @ 10 meters	213 @ 10 meters

[1]Proxies were obtained from Caltrans (2015). Only source levels considered the best proxies for the proposed pile driving and bubble curtain mitigation are shown above, as these were the levels used in calculating harassment thresholds.

Key:
µPa = micropascal
dB = decibels
ND = no data
re = relative to
RMS = root mean square
SEL = sound exposure level

6.3 DISTANCE TO SOUND THRESHOLDS

6.3.1 SOUND EXPOSURE CRITERIA AND THRESHOLDS

NOAA Fisheries recognizes two levels of incidental harassment. Level A injury harassment has the potential to injure a marine mammal or marine mammal stock in the wild. Level B behavioral harassment has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering, but which does not have the potential to injure a marine mammal or marine mammal stock in the wild.

Level A Criteria: NOAA Fisheries issued new acoustic guidance in 2016 (updated in 2018) for determining potential impacts on marine mammals and established new injury thresholds for Level A injury harassment (NOAA Fisheries 2016, 2018a). The technical guidance for determining potential impacts on marine mammals differentiates between marine mammal functional hearing groups. In addition to differentiating among functional hearing groups, the guidance uses metrics that address the impacts of noise on hearing sensitivity. The guidance criteria use dual metric acoustic thresholds for impulsive sounds, peak sound pressure (L_{pk}) re 1 µPa, and cumulative sound exposure level (SEL_{cum}) re 1 µPa^{2}s. For a non-impulsive source, such as vibratory pile driving, the guidance criteria specify a single SEL_{cum} re 1 µPa^{2}s for each hearing group. Importantly, the SEL_{cum} thresholds account for duration of the activity and associated accumulation of noise over time. The designated thresholds for mid-frequency cetaceans are 185 dB SEL_{cum} or 219 dB L_{pk} for impulsive sound sources, or 198 dB SEL_{cum} for non-impulsive (i.e., continuous) sound sources. For the analyses herein, Annova LNG applied thresholds for the mid-frequency cetacean group, which includes dolphins, toothed whales, beaked whales, and bottlenose whales, to determine isopleths, as all dolphin species analyzed belong to the mid-frequency hearing group.

Level B Criteria: To determine potential behavioral impacts on marine mammals from underwater acoustic sources, NOAA Fisheries has established a harassment threshold of 160 dB re 1 μPa RMS for impulsive sounds and 120 dB re 1 μPa RMS for non-impulsive sounds.

6.3.2 UNDERWATER SOUND PROPAGATION MODELLING

Annova LNG applied the proxy sound source levels to the practical spreading loss model for simple geometric propagation to obtain sound propagation for each pile type and hammer type (see Table 4 and Section 6.2).

Practical Spreading Loss Model:

TL = 15 log (R1/R0)

where:

TL = Source Level – Noise Threshold Level

R1 = Range distance the noise criterion extends away from the source (in meters)

R0 = Reference range (i.e., at 1 meter, at 10 meters, etc.)

6.3.3 UNDERWATER NOISE FROM PILE-DRIVING ACTIVITIES

Level A Analysis: Annova LNG used the Companion User Spreadsheet provided by NOAA Fisheries to develop noise propagation modelling for assessment of potential impacts on marine mammals. The Companion User Spreadsheet, issued in 2016 and updated in 2018 in conjunction with NOAA Fisheries' *Technical Guidance for Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing* and its subsequent revision, is a tool that allows project proponents to estimate distances to injury thresholds for various pile-driving activities (NOAA Fisheries 2018a).

The Companion User Spreadsheet provides a variety of different models for specific in-water construction situations. Annova LNG used the "Stationary Source: Non-Impulsive, Continuous" model to calculate underwater noise thresholds for vibratory pile-driving activities and the "Impact Pile Driving Stationary Source: Impulsive, Intermittent" model for impact pile-driving activities. For vibratory hammer pile driving, the suggested default weighting factor adjustment of 2.5 was used to calculate isopleths. For impact hammer pile driving, the suggested default weighting factor adjustment of 2 was used to calculate isopleths. Source levels used in the calculations are listed in Table 4. Calculations were also run for source levels with noise reductions of 7 dB to capture noise attenuation resulting from the use of bubble curtains during impact pile driving. All calculated isopleths are presented in Table 5.

For calculations using the new NOAA Fisheries injury thresholds, all calculations proceeded even if the source level was less than the threshold, as the User Spreadsheets account for accumulation of noise over time so the threshold may be crossed if an activity persists long enough for the accumulated noise to surpass the threshold.

Level B Analysis: Using proxies for sound source levels based on Caltrans (2015), the Practical Spreading Loss model was used to calculate distances to the mid-frequency cetacean behavioral thresholds for all pile-driving types. Note that for calculations made with the Practical Spreading Loss model, if the source level was less than the threshold, no calculation was performed since this model treats noise as instantaneous. The practical spreading loss model generally overestimates distances to thresholds compared to models that account for environmental metrics (e.g., Farcas et al. 2016) and the results are therefore likely to be conservative. All calculated isopleths are presented in Table 5.

Table 5
Isopleths for Level A and B Harassment Exposure[1]

Pile Type	Hammer Type	Model Inputs				Calculated Results	
		Source Levels	Number of Piles per Day	Activity Duration per Day	Strikes per Pile	Level B Radius (meters)[2]	Level A Radius (meters)[3]
0.6 m (24-inch)-diameter steel tube piles	Vibratory Installation; no sound attenuation	RMS = 165	4	10 minutes	N/A	10,000	0.9
0.6 m (24-inch)-diameter steel tube piles	Impact Installation; 7 dB sound attenuation	RMS = 187 SEL = 171 Peak = 200	4	15 minutes	675	631	10.9
0.6 m (24-inch)-diameter steel tube piles	Vibratory Removal; no sound attenuation	RMS = 165	4	60 minutes	N/A	10,000	2.8
2.4 m (96-inch)-diameter steel tube piles	Vibratory Installation; no sound attenuation	RMS = 170 SEL = 170 Peak = 183	0.5	20 minutes	N/A	21,544	1.2
2.4 m (96-inch)-diameter steel tube piles	Impact Installation; 7 dB sound attenuation	RMS = 198 SEL = 188 Peak = 213	0.5	30 minutes	2,700	3,415	93.5

Key:
SEL = sound exposure level
[1] Isopleth based on modeled output; actual distance truncated due to constriction of the channel (see Table 6).
[2] After truncation due to land in the Project area, the total Level B area for vibratory and impact pile-driving activities is the same. The Project area is located in a constricted channel, 300 meters wide.
[3] Isopleth distances were calculated using both peak and cumulative SEL. The cumulative SEL was the largest of the two isopleths and therefore carried forward throughout the analysis.

Note that as pile driving activities would take place in the BSC and within the marine berth with land on three sides (see Figure 4), the actual noise propagation would be restricted by the presence of land. Therefore, the area of possible exposure to noise, referred to as the zone of influence (ZOI) or ensonified area, would be reduced compared to an open-water construction scenario. The pile-driving activities will be located within the dredged marine berth area on the south side of an approximately 300 m-wide channel. To determine the ZOI for each pile-driving activity and level of potential impact, the isopleths from Table 5 were mapped using geospatial analysis to determine the area (km^2) of possible exposure (see Table 6), which is presented and used in Section 6.5 to calculate the potential take for bottlenose dolphins (see Figures 4 through 6; Table 7). Even though the calculated Level B isopleths (see Table 5) showed a significant difference in the straight-line distance between vibratory and impact pile-driving activities, the geospatial analysis showed that the total calculated area of exposure for Level B during vibratory and impact pile-driving of the 96-inch piles would be the same because sound propagation is truncated by land. Given the narrow constriction of the channel and the location of pile installation within the marine berth, the presence of land restricts the propagation of sound significantly.

Table 6
Zones of Influence for Level A and B Harassment Exposure

Pile Type	Hammer Type	Level B Behavioral Zone of Influence (km^2)	Level A Zone of Influence (km^2)
24-inch-diameter steel tube pile; Installation; no sound attenuation	Vibratory	1.0	<0.01
24-inch-diameter steel tube; Installation; 7 dB attenuation	Impact	0.56	<0.01
24-inch-diameter steel tube pile; Removal; no sound attenuation	Vibratory	1.0	<0.01
96-inch-diameter steel tube pile; Installation; no sound attenuation	Vibratory	1.0	<0.01
96-inch-diameter steel tube; Installation; 7 dB attenuation	Impact	1.0	0.04

Key:
km^2 = square kilometers

6.3.4 AIRBORNE SOUND FROM PILE-DRIVING

No pinniped species are known to occur in the Gulf of Mexico; therefore, airborne effects associated with the Project were not analyzed and will not be discussed further.

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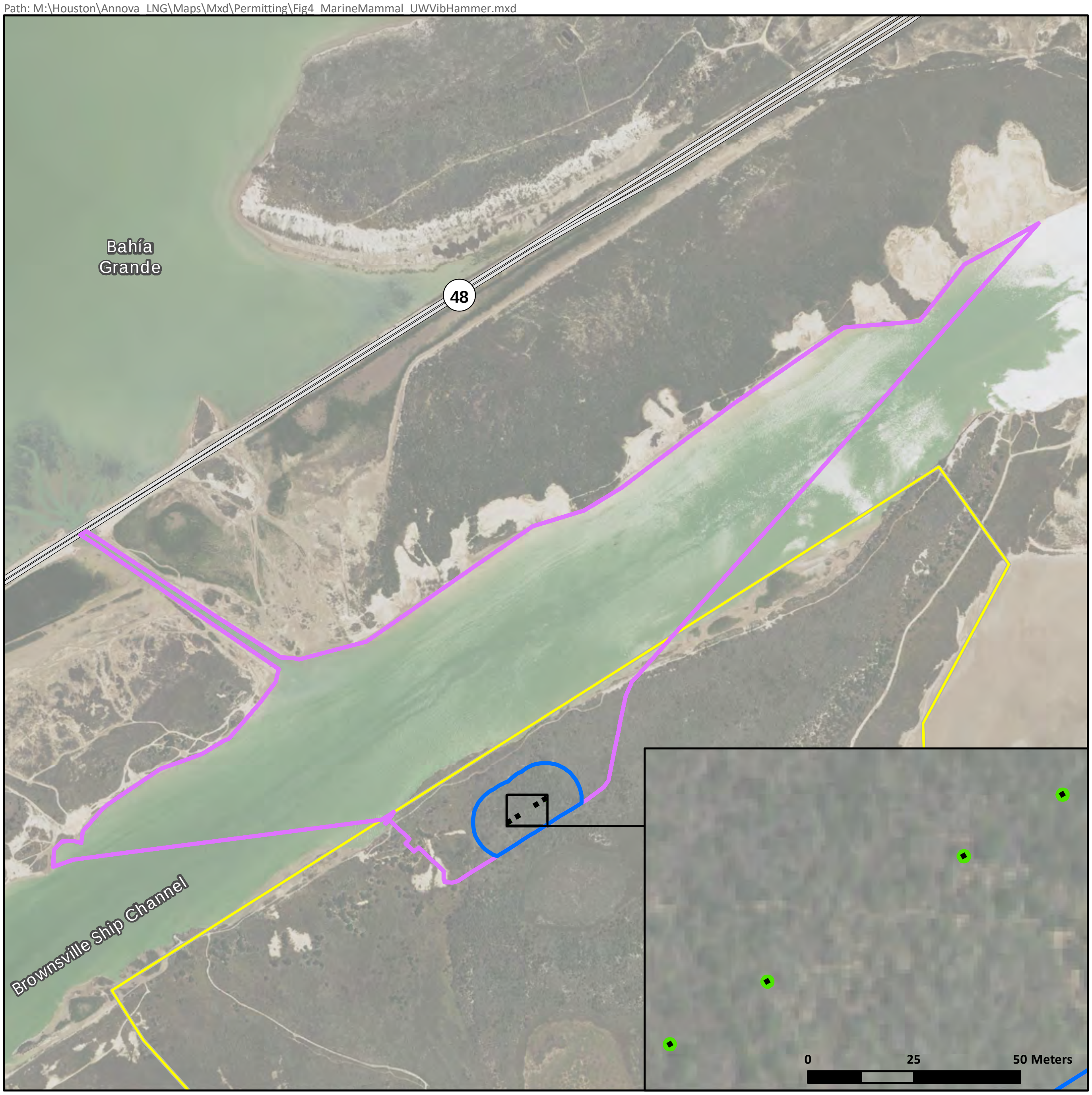


SCALE

0 0.25 0.5 Kilometers

SOURCE: Annova LNG 2015; ESRI 2014; USDA NAIP 2014; CBI 2010; Cameron County 2014

Legend

- Breasting Dolphins
- Vibratory Level A Injury
- Impact – 7dB Level A Injury
- Impact -7dB Level B Behavioral & Vibratory Level B Behavioral
- State Highway
- Project Site

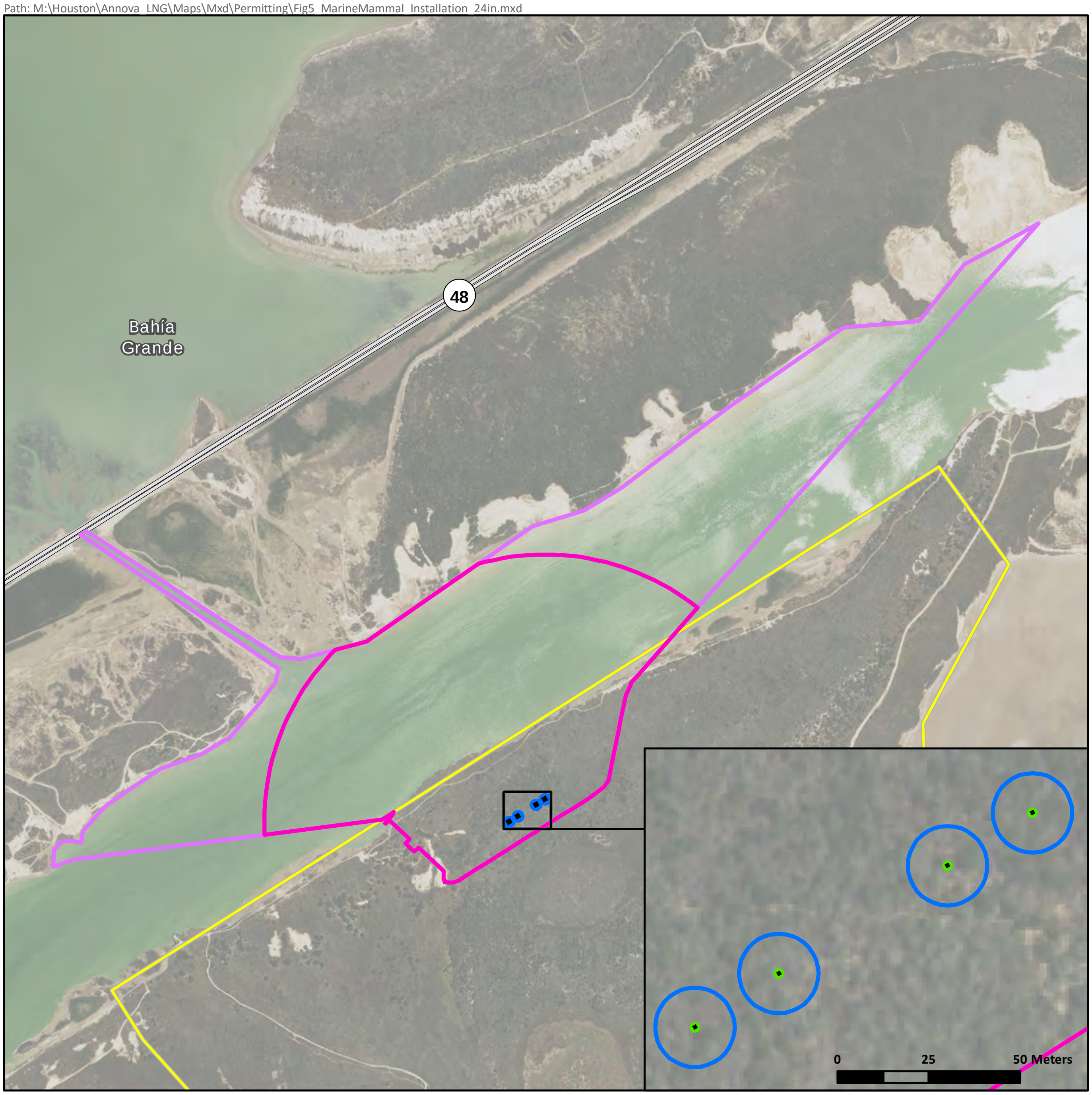
Figure 4

Marine Mammal Underwater Ensonification Installation of 96-inch Steel Pipe Pile Levels A and B

Annova LNG Brownsville Project

Cameron County, Texas

Path: M:\Houston\Annova_LNG\Maps\Mxd\Permitting\Fig5_MarineMammal_Installation_24in.mxd



SCALE

0 0.25 0.5 Kilometers

SOURCE: Annova LNG 2015; ESRI 2014; USDA NAIP 2014; CBI 2010; Cameron County 2014

Legend

- Breasting Dolphins
- Vibratory Level A Injury
- Impact -7dB Level A Injury
- Impact -7B Level B Behavioral
- Vibratory Level B Behavioral
- State Highway
- Project Site

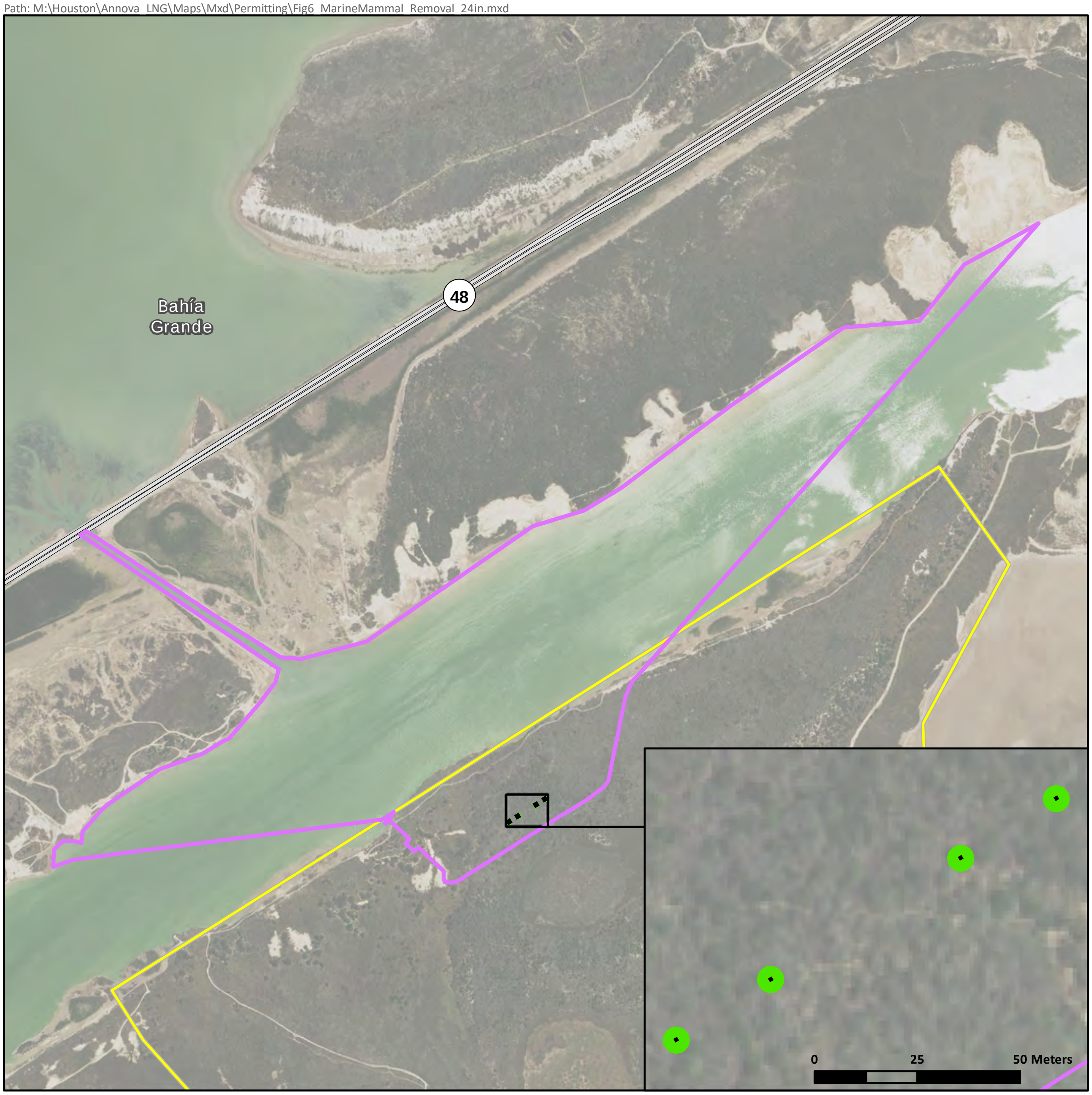
Figure 5

Marine Mammal Underwater Ensonification Installation of 24-inch Steel Pipe Pile Levels A and B

Annova LNG Brownsville Project

Cameron County, Texas

Path: M:\Houston\Annova_LNG\Maps\Mxd\Permitting\Fig6_MarineMammal_Removal_24in.mxd



SCALE

0 0.25 0.5 Kilometers

Legend

- Breasting Dolphins
- Vibratory Level A Injury
- Vibratory Level B Behavioral
- State Highway
- Project Site

Figure 6

Marine Mammal Underwater Ensonification Removal of 24-inch Steel Pipe Pile Levels A and B

Annova LNG Brownsville Project

Cameron County, Texas

SOURCE: Annova LNG 2015; ESRI 2014; USDA NAIP 2014; CBI 2010; Cameron County 2014

6.4 SPECIES DENSITY

It is unlikely that rough-toothed dolphins or Atlantic spotted dolphins will occur in the Project area, and none were observed during opportunistic and planned surveys in 2016 through 2019 (Ronje and Whitehead 2016; Piwetz and Whitehead 2019); however, because there is a small risk that these animals may be exposed to Project-related sound were they enter the BSC, Annova LNG is requesting one mean group size of these species based on the most recent analysis of group size (Maze-Foley and Mullin 2006). These mean group sizes are 14 rough-toothed dolphins and 26 Atlantic spotted dolphins. The maximum group sizes of these species observed in Maze-Foley and Mullin (2006) were 28 and 68, respectively; note that estuarine areas were not included in the surveys upon which these group sizes are based. Because Annova LNG is requesting a mean group size of each of these species, no density values were estimated. For bottlenose dolphins, density in the Laguna Madre area was estimated using the minimum abundance of identified individuals by Piwetz and Whitehead (2019), which was 109 dolphins. The area of the region defined as "Laguna Madre" is the area known as Block B-51 in Rosel et al. (2011), Blaylock and Hoggard (1994), and Scott et al. (1989) (see Figure 3).

Annova LNG used habitat data layers from Finkbeiner et al. (2009) to estimate the area of the Laguna Madre and Baffin Bay, removing the layers that were not dolphin habitat (e.g., land, emergent marsh, and mangroves), which resulted in a 1,938 km^2 area. Separately, Annova LNG estimated the area of the BSC at 27 km^2, for a total area of 1,965 km^2 for the Laguna Madre Estuarine stock area (i.e., Block B-51). An abundance of 109 dolphins for this stock would equate to a density of 0.055 dolphins/km^2 (109/1,965=0.055). The mean group size of bottlenose dolphins observed by Piwetz and Whitehead (2019) was 4.5, with sizes ranging from 1 to 14.

Although not directly studied in Laguna Madre, studies in other Gulf of Mexico estuaries suggest that mixing of coastal and estuarine bottlenose dolphins occurs and some individuals may not show a clear preference for estuarine or coastal waters (e.g., Laska et al. 2011). Based on studies indicating that estuarine residents and coastal bottlenose dolphins both occur in estuaries (e.g., Maze and Würsig 1999), the coastal and estuarine stocks of bottlenose dolphins would both be expected to occur in Block B-51, so it would be expected that some proportion of bottlenose dolphins in the estuary at any given time would be from the coastal stock. There is no estimate of the number of coastal stock individuals that may be in the Laguna Madre area at any given time. In areas such as the Galveston Ship Channel, Maze and Würsig (1999) reported that out of 71 identified individuals, 31 were considered resident (estuarine) and 34 were transient (coastal). In Sarasota Bay, 14 to 17% of the resident bottlenose dolphin groups observed included transients and most of the mixed groups were adjacent to coastal waters (Rosel et al. 2011). Studies conducted along Charleston, South Carolina, from 2003 to 2006 identified 1,221 dolphins, of which 68% were classified as coastal and 22% as estuarine bottlenose dolphins (Laska et al. 2011). This demonstrates mixing of the stocks occurs regularly in other coastal regions. Thus, Annova LNG has not defined a density of coastal stock animals but identifies the chance of coastal animals mixing with individuals from the Laguna Madre stock. Annova LNG is requesting a conservative percentage based on the upper limit of the lowest percentage of observed coastal bottlenose dolphins in an estuary in the studies cited above, 17%, of Western Coastal bottlenose dolphin stock be applied to the total number of requested take of the Laguna Madre stock to address potential harassment of this coastal stock. This percentage is conservative given values of as much as 50 to 70% overlap in some estuaries. Therefore, Annova LNG assumes that 17% of individuals exposed would belong to the Western Coastal bottlenose dolphin stock.

Additionally, commercial fishing trawlers may also play a role in the occurrence of coastal bottlenose dolphins within the BSC, with coastal dolphins following trawlers into the estuary. During the summer, Piwetz and Whitehead (2019) observed five of the 33 groups of dolphins following shrimp trawlers and foraging on discarded bycatch either behind the trawler or directly off the stern. It was unknown whether these dolphins belonged to the coastal or estuary stock. The same behavior was documented during the winter; however, fewer commercial fishing trawlers were observed in the area. This behavior is also consistent with Ronje and Whitehead (2016) in which dolphins were observed foraging behind commercial shrimp trawlers as far as the Brownsville Fishing Harbor.

6.5 DESCRIPTION OF TAKE CALCULATION

Take calculations presented in this IHA application relied on the best available data on marine mammal populations and distributions within or near the region of the BSC. Level A injury harassment and Level B take estimates were calculated, representing a conservative number of potential marine mammal exposures to sound above NOAA Fisheries' designated thresholds during in-water activities to construct the Project. Annova LNG estimated exposures for the pile-driving scenarios are detailed in Section 1.3.1. All impact pile installation activities would be conducted while implementing a bubble curtain, resulting in an estimated 7 dB reduction in sound level emissions.

The calculations for marine mammal Level A injury harassment and Level B takes are estimated by the following formulas:

Level A take estimate = (n * ZOI) * X days of total activity

Level B take estimate = (n * ZOI) * X days of total activity

where:

n	=	density estimate used for the particular species
ZOI	=	zone of influence representing the noise threshold impact area
X	=	number of days of pile-driving activity, estimated based on the total number of piles and the average amount of pile that the contractor can install in one day.

Level A injury and Level B behavioral harassment exposures were determined using the largest of the two cumulative isopleths calculated for vibratory or impact pile-driving activities (presented in Table 5) if the activities occurred on the same day. In addition to the cumulative isopleth, isopleths were calculated using the peak sound pressure levels and the larger of the two was used. In this case, the cumulative values were larger and carried forward throughout the analysis. Annova LNG took the larger of the two cumulative ZOIs and multiplied by the number of days associated with the particular combination of vibratory and/or impact pile driving to determine the number of total exposures for the Project (Table 7). As noted above, 17% of estimated exposures were assumed to be of the coastal stock of bottlenose dolphins. There were insufficient data to evaluate individuals exposed versus total exposures. Based on initial exposure estimation calculations, <0.01 (rounded to 0) Level A injury harassment exposures were calculated for all species.

Table 7
Level B Harassment Exposure Estimates for Laguna Madre Stock

Pile Type	Hammer Type	Days of Pile Driving	Level B Behavioral ZOI	Estimated Exposures Per Day (ZOI X density)	Estimated Total Exposures (Estimated Exposures Per Day X Days of Pile Driving)[1]
24-inch-diameter steel tube piles; Installation	Vibratory	4	1.00	0.055	0.22
24-inch-diameter steel tube piles; Installation	Impact	4 (4 days overlap with vibratory)[1]	0.56	0.031	-
24-inch-diameter steel tube piles; Removal	Vibratory	4	1.00	0.055	0.22
96-inch-diameter steel tube piles; Installation	Vibratory	4	1.00	0.055	0.22
96-inch-diameter steel tube piles; Installation	Impact	8 (4 days overlap with vibratory)[2]	1.00	0.055	0.22
Total Exposures	-	16	-		**0.88**

[1] Installation of the 24-inch-diameter steel tube piles requires four days of both vibratory and impact pile driving. During the four days of overlap between vibratory and impact, the vibratory ZOI was used for estimating take.

[2] Installation of the 96-inch-diameter steel tube piles requires four days of both vibratory and impact pile driving and four days of impact only pile driving. During the four days of overlap between vibratory and impact, the vibratory ZOI was used for estimating take. During the four days of impact only pile driving, the impact ZOI was used for estimating take.

Key:
ZOI = zone of influence
Density = 0.055 dolphins/km^2

6.6 REQUESTED TAKE

Although total exposures of bottlenose dolphins are estimated to be 0.88 (0.15 coastal, 0.73 estuarine), this estimate does not account for group size nor for the fact that abundance, based on minimum number of individually identified dolphins, is underestimated for this stock (Piwetz and Whitehead 2019). Observations in the BSC suggest relatively frequent use by bottlenose dolphins, which could include dolphins from both the estuarine and coastal stocks (Ronje and Whitehead 2016; Piwetz and Whitehead 2019). Requesting a larger number of takes to accommodate a more realistic population size of these animals makes it difficult to compare the requested take to an appropriate abundance for “small numbers” considerations; however, requesting one mean group size may underestimate exposures because the estimates of population size, upon which the density is based, are inaccurate.

The pile-driving activities would take place for 2 hours for each of four days of installation of the 24-inch piles, 4 hours for each of four days during removal of the 24-inch piles, and 1.5 hours for each of eight days of installation of the 96-inch piles. That is a conservative total of 36 hours of pile driving over 16 days. It is difficult to predict how many groups of bottlenose dolphins would pass through the channel during that activity. Piwetz and Whithead (2019) reported one sighting during summer and one sighting during winter of bottlenose dolphins within the Project area that includes the largest predicted Level B ZOI, but the level of effort in that specific location cannot be extrapolated from the survey line information and surveys are mobile rather than stationary (like pile driving).

NOAA has identified one-third of the abundance as a "small number" of takes. Noting that the minimum estimate of 109 estuarine bottlenose dolphins is an underestimate of abundance and that number of exposures has not been distinguished from individuals taken, a minimum "small number" of Laguna Madre Estuarine stock bottlenose dolphins would be 36 (109/3). Adding 17%, or seven additional dolphins, for the coastal stock, results in a total of 43 takes within this interpretation of abundance relative to small numbers. Mean group size is 4.5 (Piwetz and Whitehead 2019), so 43 dolphins would be approximately nine groups of dolphins. Although it is possible that less than 43 dolphins would be in the Level B harassment zone during pile-driving activities (which are relatively short in duration as noted above), Annova LNG is requesting 36 Laguna Madre Estuarine stock and seven Western Coastal stock takes to ensure the most conservative possible situation has been addressed within the confines of ensuring a small number of takes. This request for 43 takes conservatively assumes that all dolphins that would occur in the Level B zones over the 16 days of activity would be different individuals with respect to consideration of small numbers. To ensure no more than 43 takes will occur, additional shutdown mitigation that includes the Level B zone will be implemented in the event that a threshold of 21 (50% of 43) observed Level B exposures of bottlenose dolphins occur (see Section 11 for additional mitigation to prevent Level B take).

To minimize the likelihood of reaching requested take numbers, Annova LNG will consider actions in situ as appropriate, such as potential shutdown or delayed start if shrimp trawlers are approaching the Level B ZOI (given dolphins can follow shrimp trawlers) or implementing a shutdown if a large group of dolphins (greater than approximately 10) are nearing the Level B ZOI. Such actions will be considered on a case-by-case basis to avoid impracticable actions for the Project while decreasing likelihood of reaching issued take before completing the Project. Requested takes are presented in Table 8.

Table 8
Total Number of Requested Level B Takes by Species

Species	Total Estimated Level B Exposures	Total Requested Level B Takes
Atlantic Spotted Dolphin	0[1]	26
Common Bottlenose Dolphin Laguna Madre Estuarine Stock	0.88	43[2]
Common Bottlenose Dolphin Western Coastal Stock	Not estimated	
Rough-toothed Dolphin	0[1]	14

1 No Atlantic spotted or rough-toothed dolphin exposures are anticipated but because it is possible these species could enter the channel, a requested take of one mean group size of each is included in this request.
2 Total requested take for common bottlenose dolphins includes 36 exposures to the Laguna Madre Estuarine Stock and seven exposures to the Western Coastal Stock for a total of 43 Level B takes for reasons explained in Sections 6.5 and 6.6.

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7 ANTICIPATED IMPACT OF THE ACTIVITY

The anticipated impact of the activity to the species or stock of marine mammal.

7.1 POTENTIAL EFFECTS OF PILE DRIVING AND DRILLING ON MARINE MAMMALS

Annova LNG is proposing to install and remove piles using impact and vibratory devices. The sound generated by in-water vibratory and impact pile-driving activities during construction of the Project would exceed the NOAA Fisheries in-water acoustic thresholds for Level A injury and Level B behavioral harassment for marine mammals. However, mitigation measures would avoid Level A injury take of marine mammals (see Section 11).

Annova LNG is requesting incidental taking by Level B behavioral harassment for small numbers of three marine mammal species: Atlantic spotted dolphin, common bottlenose dolphin, and rough-toothed dolphin. For the purpose of calculating the percentage of each species' stock potentially affected by the Project, Annova LNG assumed all exposures are of different individuals and provide comparison to the stock sizes reported in the stock assessment reports and more current or comprehensive abundances if available. The number of takes in relation to the overall stock size of each of the three species are presented in Table 9.

Table 9
Requested Number of Takes and Percentage of Marine Mammal Stock Potentially Affected by Level B Behavioral Harassment during Pile-driving Activities

Species	Stock	Stock Abundance Report Abundance	Other Available Abundance	Level B Takes Requested	Percentage of Stock Potentially Affected by Level B Take[1]
Atlantic Spotted Dolphin	Northern Gulf of Mexico Stock	37,611	47,488 [2]	26	0.07%/0.05%
Common Bottlenose Dolphin	Laguna Madre Estuarine Stock	80	109[3]	36	45.00%/33.03%
Common Bottlenose Dolphin	Western Coastal Stock	20,161	N/A	7	0.04%/N/A
Rough-toothed Dolphin	Northern Gulf of Mexico Stock	624	4,853[2]	14	2.24%/0.29%

[1] Percentage of exposures relative to the reported abundance in the Stock Assessment Report/Percentage of exposures relative to the other (more current or comprehensive) abundance provided in the table. This percentage assumes all exposures are of different individuals.
[2] Roberts et al. (2016)
[3] Piwetz and Whitehead (2019) number of individually identified dolphins in lower Laguna Madre and BSC.
Key:
N/A = not applicable

7.1.1 UNDERWATER NOISE EFFECTS

Impacts on marine mammals are expected to result primarily from underwater sound propagation during pile-driving activities associated with construction of the Project. The effects of pile driving are highly dependent on a number of factors, including the physical characteristics of each affected species (e.g., size, type, hearing thresholds); intensity and duration of the pile-driving sound; bottom substrate composition; water depth; existing ambient sound levels; and distance of the animal from the sound source. The degree of effect is related to the received level and duration of the sound exposure, which is influenced by the distance of the animal from the sound source. Sound propagation in shallow water environments is generally more complex than in deep water. The shallower the water depth, the more repeated sound reflections off the surface and the bottom can occur, causing sound to travel farther distances. In addition to water depth, soft bottom substrate composition (e.g., mud) would likely absorb the sound more readily than hard substrates (e.g., rock), which can cause more repeated sound reflections. The softer the bottom, the less time required for a single pile to be driven into the substrate, which would decrease the intensity of the sound source.

For all cetaceans, sound serves three main functions: (1) provide information about their environment, (2) facilitate communication, and (3) enable the detection of prey (David 2006). When the level of noise in the environment increases (e.g., impulsive sound sources), marine mammals are likely to experience behavioral and physiological changes. Behavioral changes or reactions can include changes in call rates and frequencies, sudden changes in traveling speed, changes in breathing and diving patterns, and avoidance of important habitat or migration areas, while physiological changes can include physical discomfort, temporary and/or permanent hearing loss, injury of internal organs, and death of the animal (Southall et al. 2007; Richardson et al. 1995; Nowacek et al. 2007).

Physiological Responses

Increased sound levels can lead to physiological damage in the hearing systems of marine mammals through the temporary or permanent alteration of the sensory hair cells. The hearing system includes organs most susceptible to high-intensity, impulsive (i.e., impact), and continuous (i.e., vibratory) sounds. Damage of these hair cells can affect the neurosensory system, which causes dizziness and vertigo in humans; however, little is known of the effects in marine mammals (Southall et al. 2007). Sound-related trauma can be lethal, resulting in death, or sub-lethal, resulting in hearing loss. Hearing loss can occur after a single, very loud event that damages the hair cells of the inner ear. The degree of damage in marine mammals exposed to pile-driving activities is poorly understood. No physiological responses are expected from in-water pile-driving activities associated with construction of the Project due to preventive mitigation.

Behavioral Responses

Behavioral responses of marine mammals to sound are not fully understood, are highly variable, and are context specific. Several factors can influence an animal's response to a specific sound source, including its existing habitat condition, its auditory sensitivity, its biological structure (e.g., age, sex, existing hearing loss), and its behavior at the time of exposure. Animals can become habituated to certain sound stimuli with repeated exposure. An animal's behavioral response depends critically on the exposure history of the animal to the sound source. For example, the majority of coastal marine mammals are habituated to noise above background, naturally occurring levels because they already inhabit a noisy environment with fishing vessels, trawling, dredging, and cargo shipping lanes (Southall et al. 2007). As noted in Section 2.3.2, the BSC experiences frequent vessel traffic, and thus the dolphins in the area are likely accustomed to some noise. Noise associated with the construction of the Project could temporarily alter behaviors such as foraging or calving.

While no marine mammal foraging areas are known to be in or near the BSC due to limited available data, during opportunistic surveys conducted by Ronje and Whitehead (2016), dolphins were observed foraging throughout the day at the mouth of the Brazos Santiago Pass. Dolphins have also been observed following shrimp boats into the BSC (Ronje and Whitehead 2016) (additional discussion of potential impacts on foraging habitat is presented in Section 9.1). Mixing of resident and non-resident bottlenose dolphins has been observed for other stocks, especially in passes and at the mouths of estuaries, and is therefore likely to occur in the Laguna Madre as well (Hayes et al. 2019). No information on calving behavior is available for the BSC, and since there are known differences in reproductive seasonality from site to site for other better-studied estuarine stocks in the Gulf of Mexico, it is difficult to predict the potential patterns for this specific region (Hayes et al. 2019). Controlled experiments with captive and wild marine mammals show that avoidance behavior of loud sound sources is the primary reaction (Hastie et al. 2017; Bailey et al. 2010; Southall et al. 2007). Responses to continuous noise (e.g., vibratory pile driving) have not been documented as well as responses to pulsed sounds (e.g., impact pile driving). Behavioral responses in small numbers of marine mammals are expected from in-water pile-driving activities associated with construction of the Project.

7.1.3 CONCLUSIONS REGARDING IMPACTS ON SPECIES OR STOCKS

Annova LNG does not anticipate any physiological responses in marine mammals during in-water construction during the Project. Annova LNG proposes the use of a bubble curtain during impact pile-driving, which would reduce the peak SPL and SEL_{cum}. This would greatly reduce the potential for injury of a marine mammal exposed to pile-driving noise associated with in-water construction activities of the Project. Lastly, Annova LNG proposes a shutdown zone to ensure that no marine mammals are injured (see Section 11.1). With both types of in-water pile driving, it is likely that the onset of pile driving could result in temporary, short-term changes in an animal’s typical behavior (behavioral response) and/or avoidance of the Project area, resulting from Level B behavioral harassment. Any takes associated with Level B behavioral harassment would be expected to have only a minor effect on the individual and no effect on the population. Therefore, based on the best available information and the information provided in this authorization request (including density, status, and distribution), Project-related in-water pile-driving activities are expected to have a negligible impact on the marine mammal species and stocks that could occur in the vicinity of the Project during the in-water construction period.

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8 ANTICIPATED IMPACTS ON SUBSISTENCE USES

The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses.

This section is not applicable. The Project will take place in the Gulf of Mexico, specifically, the BSC. There are no traditional subsistence hunting areas in the Project region.

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9 ANTICIPATED IMPACTS ON HABITAT

The anticipated impact of the activity upon the habitat of the marine mammal populations and the likelihood of restoration of the affected habitat.

9.1 PILE-DRIVING AND DREDGING EFFECTS ON POTENTIAL PREY (FISH)

As described in Section 7, in-water pile-driving and dredging activities within the BSC waterway due to construction of the Project could result in short-term increases in underwater noise levels. Underwater sounds could have physiological and behavioral impacts on fish, which are a primary dietary component of the cetaceans discussed in this application. Additionally, dredging activities could cause temporary increases in turbidity and loss of bottom habitat, which could impact fish, in addition to the potential for direct injury or mortality to bottom-dwelling species within the limits of disturbance.

Pile-Driving Effects

Noise impacts on fish can cause physical damage, stress, and changes in typical behavior (ICF Jones and Stokes and Illingworth and Rodkin, Inc. 2009; Popper et. al 2014). Fish with swim bladders are particularly vulnerable to the changes in pressure that occur quickly during pile-driving activities, which can result in the inability to control buoyancy and/or the temporary loss of hearing (ICF Jones and Stokes and Illingworth and Rodkin, Inc. 2009; Popper and Hastings 2009; Popper et al. 2005; Popper et al. 2014). General stress responses such as a startle reaction or site avoidance during pile-driving activities are also likely, with fish moving laterally away from the sounds or moving into deeper water (Wysocki et al. 2006).

Direct injury or mortality of fish due to sound could also occur if SPL or SEL_{cum} criteria are exceeded. NOAA Fisheries' Greater Atlantic Regional Fisheries Office issued interim acoustic guidance in 2017 for determining the potential effects on ESA-listed fish, including sturgeon and salmon, and sea turtle species exposed to elevated levels of underwater sound produced during pile-driving activities. A cooperative effort between several federal and state transportation and resource agencies along the West Coast of the United States resulted in the establishment of interim criteria for the onset of physical injury to fish exposed to the underwater sounds generated by impact pile driving (NOAA Fisheries Greater Atlantic Regional Fisheries Office [GARFO] 2017). The onset of physical injury is determined using the dual criteria of the SPL and SEL_{cum}, with injury expected to occur if either of these criteria is exceeded. A potential onset of physical injury is determined if either the peak SPL exceeds 206 dB re 1 µPa or the SEL, accumulated over all pile strikes generally occurring within a single day, exceeds 187 dB re 1 $\mu Pa^2 s$ for fishes 2 grams or larger and 183 dB re 1 $\mu Pa^2 s$ for smaller fishes. Adverse behavioral effects occur at a threshold of 150 dB re 1 µPa (NOAA Fisheries GARFO 2017).

To determine reasonable source levels for pile-driving activities associated with the Project, studies of pile-driving operations with similar properties were evaluated. Refer to Section 6.2 for additional description of noise sources. Note that use of a bubble curtain would result in noise reductions from the source levels for impact piling (see Section 6.2). Typical noise reduction from a bubble curtain ranges from 5 to 15 dB (Caltrans 2015; Hannay 2008; Matthews and Zykov 2012). This range is consistent with NOAA Fisheries-approved applications for IHAs for in-water construction projects that modeled an 8 to 10 dB noise reduction from bubble curtains and assumed an average reduction of 12 dB (CTJV 2018; WSDOT 2018). The amount of noise reduction depends on several environmental factors, particularly the flow rate of currents. As the currents in the BSC are relatively slow (see Section 2.3.1), a good reduction should be achievable. To be conservative, a 7 dB reduction in sound source levels is used to account for the use of a bubble curtain. As the proxy underwater noise estimates indicate, in-water pile-driving activities would exceed the limit for adverse behavioral impacts and have the potential to exceed limits for the onset physical injury per the above-mentioned criteria.

As described in Section 2.2, in-water pile driving would be required for the installation and removal of 16 temporary 0.6 m (24-inch)-diameter steel piles using a vibratory and impact hammer, and four 2.4 m (96-inch)-diameter steel breasting dolphin piles will be installed in stages, first using a vibratory hammer then using an impact hammer. Given this temporal nature of the pile driving, permanent deterrence of fish from the area for foraging would not occur. In addition, noise impacts would be localized to the immediate vicinity of the marine berths. Ample similar habitat is found throughout the BSC, so it is anticipated that displaced fish species would find suitable nearby habitat.

Based on the short duration of pile-driving activities, the abundance of available fish habitat adjacent to the Project site, and implementation of mitigation and minimization measures, impacts on fish (and thereby cetacean foraging) from in-water pile-driving noise would be short term and minor.

Dredging Effects

Seafloor-disturbing activities such as dredging (described in Section 1.3.3) would suspend sediments in the water column for a period of time, depending on the size of the sediment particles. Coarser sediments are expected to fall out and resettle quickly (within hours), while finer sediments are likely to remain suspended for longer periods of time (days). Sediments suspended within the water column can cause an increase in turbidity and temporary siltation or sedimentation. These effects could result in a reduction in predation efficiency for local fish species, as extended periods of elevated turbidities have been shown to reduce feeding rates by up to 20% and to reduce the efficiency of the foraging process for visual predators (Gardner 1981).

Juvenile and adult fish are likely to temporarily relocate during periods of increased turbidity where forage efficiency would improve. Fish eggs and larvae may be impacted more than juveniles and adults due to the potential decrease in dissolved oxygen that corresponds to an increase in turbidity, as they are more sensitive to water quality stresses and unable to emigrate from the affected area. However, the effects from elevated turbidities are associated with long-term exposure, which would not occur as part of construction of the Project. The Environmental Assessment for the Brazos Island Harbor Channel Improvement Project determined that short-term elevated turbidity concentrations occurring from pile-driving, drilling, and dredging activities are not likely to cause chronic adverse effects (USACE 2014). Annova LNG performed turbidity plume modeling using the USACE's DREDGE model, plus a "far-field" distribution model of suspended sediment (Black and Veatch 2016). The results were predicted using a maximum current velocity in the BSC of 0.154 m/s (0.5 feet per second). To assess the impacts on the Bahia Grande, the lateral movement of particles predicted is more pertinent due to the location of the channel. The model predicted total suspended solid (TSS) concentrations of 4 to 6 milligrams per liter above ambient within the greatest lateral extent of the plume, 100 m (328 feet) either side of the plume centerline, at the surface of the BSC (Black and Veatch 2016). The outgoing tide will transport the suspended clay particles downstream of the shallow (0.99 m [-3.25 feet] to [proposed] -2.7 m [9 feet] mean sea level) Bahia Grande Pilot Channel entrance. This, combined with the tidal flow from the Bahia Grande during an outgoing tide, will prevent particle transport into the Bahia Grande. Particle transport will occur during an incoming tide, with clay particles moving upstream from the Bahia Grande. Actual effects on the Bahia Grande will likely be greater during an incoming tide, with elevated TSS concentrations of 4 to 6 mg/L at the periphery of the plume 100 m (328 feet) from the cutterhead and will result in a minor impact on water quality within proximal portions of the Bahia Grande. Similarly, although not directly modeled, particle transport during a slack tide will be limited due to the lack of water movement, which will restrict particle transport from the dredging area. As a result, a slack tide will also limit impacts within the Bahia Grande. Additionally, as an active navigation channel, the BSC is subject to maintenance dredging on a regular basis, and the aquatic communities within the BSC are regularly subjected to periodic disturbance and associated increases in turbidity. Regardless of the dredging methodology employed (mechanical or hydraulic), all work would be conducted in accordance with Texas State water quality standards, and any necessary mitigation measures would be employed on an as-needed basis in the event that water quality standards cannot be achieved without them. Annova LNG will continue to coordinate with federal and state agencies to develop mitigation measures for excavation and dredging activities.

In addition to water quality and/or sedimentation impacts, dredging activities could impact cetacean prey from the temporary removal of the seafloor habitat within the limits of the dredge area. Impacts of these activities would differ among species, depending on life history, habitat use, and distribution. Some bottom-dwelling species, such as mollusks, crustaceans, and demersal shrimp (if present), may be affected because they could be entrained during dredging activities. Larger, more mobile, demersal species (e.g., blue crab) would be temporarily displaced. These impacts could extend to higher trophic groups, from fish to cetaceans. However, habitat use would reestablish within days following dredging operations (USACE 2014). Relocation of prey could limit foraging in the localized area of dredging activities; however, prey would still be accessible in nearby unaffected areas. The dredging activities could also suspend floating debris or prey that could attract marine mammals to the area (Clement 2017). In addition, the area of impact would be small compared to the total available habitat present within the BSC. Therefore, although dredging activities would have an effect on species occupying the substrate, impacts on fish and the habitat supporting them, as well as cetaceans that predate them, would be short term and minor and not expected to have population-level impacts

Finally, within the limits of the dredge area, bottom-dwelling fish species and their prey could experience direct injury or mortality due to crushing, localized disruption, removal, turnover, and/or deposition of sediment in the immediate vicinity of dredging. These impacts could extend to higher trophic groups, from benthic communities to fish to cetaceans. As most benthic infauna live on or within the upper 6 inches of the sediment surface, it is expected that removal of sediment and burial from settling of sediments resulting from increased turbidity would result in some loss of these organisms. These patterns currently occur within the BSC as a result of ongoing maintenance dredging activities. However, benthic communities typically recover to pre-disturbance conditions within six months to two years after a physical disturbance (Germano et al. 1994; Murray and Saffert 1999; Rhoads et al. 1978). While recovery time varies depending on the site-specific environmental conditions, disturbance-related impacts on bottom dwelling species (and thereby higher trophic level effects) would be short term and minor, with species recolonizing the impacted area (USACE 2014).

9.2 PILE-DRIVING ACTIVITIES AND DREDGING EFFECTS ON POTENTIAL FORAGING HABITAT

Marine mammal foraging habitat could be impacted as a result of ground-disturbing activities during in-water pile-driving activities. In-water ground-disturbing activities are expected to impact water quality through the temporary increase in turbidity, associated noise, and increased potential for resuspension of contaminated sediments. However, in 2013, the USACE sampled sediments of the BSC as part of the Brazos Island Harbor Channel Improvement Project and concluded that there were no contaminants of concern within the BSC (USACE 2014); therefore, the potential release of contaminated sediments would not be a concern for impacts on marine mammal foraging habitat. In January 2019, Annova LNG conducted sediment sampling of the portion of the BSC that would support the LNG facilities and the berthing area during the first and second quarters of 2019 and found no contaminants of concern within the study area.

As pile-driving and drilling activities disturb the seafloor, resuspended disturbed sediments would result in turbid conditions in the immediate area of the Project site. Coarser sediments would fall and resettle quickly (within hours), while finer sediments could remain suspended for longer periods of time (days). Effects could include reduced dissolved oxygen concentrations and a corresponding reduction in primary production, as well as a reduction in predation efficiency for visual predators (Gardner 1981). However, based on the tidal fluctuation within the BSC and the channel's linear nature, localized turbidity plumes are expected to be dispersed quickly. Additionally, these effects are expected to be localized and not significantly different from impacts resulting from current and ongoing maintenance dredging activities conducted within the BSC. During periods of increased turbidity, marine mammals are likely to temporarily relocate to similar surrounding waters and return once turbidity reverts to pre-existing conditions.

The increased in-water noise from pile-driving activities may cause marine mammals to avoid potential available foraging habitat within the BSC in favor of quieter surrounding waters. However, no distinct marine mammal foraging habitat has been identified within the BSC. Disturbance from underwater noise associated with the Project would therefore be limited, as marine mammals can avoid noise disturbance by temporarily relocating to surrounding habitats for forage.

Based on the discrete duration and localized nature of the in-water pile-driving activities, permanent displacement from the area is not expected to occur. Given the low density of marine mammal populations in the BSC, the small area of impact, the abundance of suitable habitat adjacent to the Project site, and implementation of proposed mitigation measures, any habitat impacts that do occur would have no effect on populations and impacts would be short term and minor.

9.3 SUMMARY OF IMPACTS ON MARINE MAMMAL HABITAT

No direct loss of habitat available to marine mammals (or their primary diet, fish) is expected to occur as a result of any activities associated with the construction of the Project. No known marine mammal foraging areas are located in the vicinity of the Project site; however, during opportunistic surveys conducted by Ronje and Whitehead (2016), dolphins were observed foraging throughout the day at the mouth of the Brazos Santiago Pass. All marine mammals using the BSC for foraging habitat would have the ability to temporarily relocate to ample surrounding waters for forage. Any potential adverse impacts are expected to be temporary and localized, with the habitat reverting to pre-existing conditions after completion of construction activities.

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10 ANTICIPATED EFFECTS OF HABITAT IMPACTS ON MARINE MAMMALS

The anticipated impact of the loss or modification of the habitat on the marine mammal populations involved.

Existing benthic communities would be disturbed by construction of the Project due to ground-disturbing activities such as dredging, pile installation and removal, and vessel anchoring. However, benthic disturbances would not result in a significant permanent loss or modification of habitat for marine mammals or their prey. The greatest potential impact on marine mammal habitat resulting from construction of the Project would be the temporary loss of habitat and decrease in availability of prey due to elevated noise levels and increased turbidity associated with pile-driving activities. These temporary impacts are discussed in detail in Section 9.

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11 MITIGATION MEASURES TO PROTECT MARINE MAMMALS AND THEIR HABITAT

The availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

The in-water construction phase of the Project is anticipated to result in take by Level B behavioral harassment of small numbers of Atlantic spotted dolphins, common bottlenose dolphins, and rough-toothed dolphins. Annova LNG is proposing mitigation measures to avoid and minimize impacts on marine mammals protected under the MMPA. In addition to the mitigation measures described below, Annova LNG will comply with all federal and state requirements of the Clean Water Act.

11.1 PROPOSED MITIGATION FOR PILE-DRIVING ACTIVITIES

Based on the initial analysis of potential impacts on marine mammals discussed in Section 6, Annova LNG plans to employ mitigation measures to reduce exposure of marine mammals to pile-driving noise (i.e., vibratory and impact pile driving) and avoid Level A injury harassment. Anticipated mitigation measures include the following:

1. NOAA Fisheries-approved observers (i.e., Protected Species Observers [PSOs] or Marine Mammal Observers) would visually monitor 100 m (maximum SEL_{cum} Level A radius is 93.5 meters) around the pile-driving site within the in-water area of the ZOI from a vantage point that allows visibility of the complete Level A ZOI, beginning 30 minutes prior to the start of pile driving "pre-construction" to clear the 100 m zone of any marine mammals that may be present "pre-clearance". If animals are sighted within the 100 m zone during pre-construction, pile driving would be delayed until the animals are sighted outside the zone or disappear from view for 15 minutes. Observations would be conducted using high-quality binoculars throughout the entire pile-driving activity, and all observations would be documented based on an approved monitoring and reporting plan (described in Section 13). To adequately perform observations, a sufficient number of PSOs would be needed to ensure no PSO works more than 4 hours in succession. The longest pile driving efforts are 8 hours in a day, with no pile driving at night.

2. Visual monitoring of a 20 m instantaneous injury zone (maximum peak Level A radius is 2.2 meters) would be conducted during all phases of vibratory and impact pile-driving activities, and a shutdown would be implemented, if feasible, during impact pile driving if a dolphin is sighted approaching near the 20 m instantaneous injury exclusion zone. However, if a shutdown is called for before a pile has been driven to a sufficient depth to allow for pile stability, or "fixity", then for safety reasons the pile driving may continue until the pile reaches a sufficient depth to ensure stability prior to executing the shutdown. If a shutdown is executed, pile driving would remain shut down until the animal(s) is(are) re-sighted outside the 20 m zone traveling away from the pile-driving activity or disappears from view for 15 minutes.

3. Standard monitoring and documentation procedures would be conducted for the observable portion of the Level B behavioral harassment zone. This includes documenting species, numbers, locations, and behavior of the dolphins (see Section 13).

4. A “soft start” would be implemented at the start of impact pile driving and at any time following cessation of impact pile driving for a period of 30 minutes or longer. The soft start technique provides an initial set of strikes at reduced energy, followed by a 30-second waiting period, then two subsequent reduced energy strike sets.

5. In-water pile-driving operations may commence only if the 100 m exclusion zone is fully visible to observers for the time needed for clearance. Therefore, pile-driving operations would be limited to daylight hours and weather conditions suitable for monitoring. All in-water pile-driving activities would begin no earlier than 30 minutes after sufficient light is available for monitoring and the 30-minute pre-clearance monitoring is completed. All in-water pile-driving activities would finish no later than 30 minutes before sunset each day.

6. A 30-minute “post-construction” survey would be conducted at the completion of pile installation and/or removal on each day of pile driving.

7. A bubble curtain would be employed during in-water impact pile driving to achieve an increase in noise attenuation. These bubble curtains would be specifically designed for the Project to account for the pile parameters as described in this application. The curtains would be designed with effectiveness in mind (e.g., curtains would not start mid-water-column and would instead begin near the benthos and surround the piles rather than offer partial coverage). The curtains would be designed and operated by experienced bubble curtain designers and operators with a proven record of successful deployment.

8. Construction would adhere to all laws and regulations pertaining to discharges and prevention and control of spills.

9. In the case that PSOs observe 21 bottlenose dolphins (which would be approximately four groups based on mean group size) over any portion of pile driving activities within Level B ZOIs during pile-driving operations, Annova LNG would implement additional mitigation. This mitigation would consist of using additional PSOs to observe the Level B zone border area during remaining activities. If dolphins are observed approaching within 25 m of the Level B zone, pile driving operations will be shut down if feasible until dolphins are observed leaving the zone or disappear from view for 30 minutes. As stated above, if a shutdown is called for before a pile has been driven to a sufficient depth to allow for pile stability, or “fixity”, then for safety reasons the pile driving may continue until the pile reaches a sufficient depth to ensure stability prior to executing the shutdown. An individual PSO can observe the border area of one side of the ZOI at any given time because the channel is approximately 300 m across, allowing visibility across the full channel with the equipment for PSOs described above. Annova LNG will implement this mitigation if 21 dolphins have been observed (rather than 43) to allow for the unlikely potential that PSOs at the ZOI borders along the channel may miss dolphins and because vibratory pile driving cannot be shut down during the period in which fixity much be achieved for the pile to stay in place in the event of shutdown. Four groups of dolphins (on average) would result in 21 exposures, so four additional mean group sizes of bottlenose dolphins could be missed by PSOs and taken within the activity area within the limits of the requested takes. This is an extra measure to ensure that take stays within the take request of 43 exposures.

11.2 TRANSITING VESSELS

Vessel traffic in the vicinity of the Project site would increase during the pile-driving activities of Project construction. All vessels used during construction of the proposed Project would comply with all federal and state regulations in an effort to minimize pollution in the oceans, both accidental and resulting from routine operations. The BSC was specifically created to provide deep water access for maritime commerce and is maintained by regular dredging. Use of the waterways by LNG vessels, barges, and support vessels during construction of the Project would be consistent with the planned purpose. Vessels associated with the Project are not expected to cause harassment of marine mammals; however, vessel operators and crew will use the following protocols at all times and locations:

- Maintain a vigilant watch for marine mammals and slow down or stop the vessel as is safe to avoid striking the animal(s). Vessels will maintain course and avoid abrupt changes in direction.
- All transiting vessels will comply with speed regulations, reducing to 10 knots or less, if a marine mammal(s) is present.
- All vessels will avoid approaching marine mammals and will maintain a safe distance.

11.3 CONSTRUCTION ACTIVITIES

Construction and operation of the Project will affect water quality of the BSC in the vicinity of the site as a result of initial dredging and maintenance dredging, vessel traffic, site modification and stormwater runoff, and hydrostatic testing. To prevent contamination of waters within the Project site during construction, Annova LNG will develop and implement specific spill prevention and response procedures in accordance with the requirements of 40 CFR 112. These plans will outline potential sources of releases at the sites, measures to prevent a release to the environment, and initial responses in the event of a spill. All vessels associated with the Project are expected to comply with U.S. Coast Guard requirements for the prevention and control of oil and fuel spills (International Convention for the Prevention of Pollution from Ships [MARPOL], Annex V, Pub. L. 100−220 [101 Stat. 1458]). All activities associated with construction of the Project will be designed to avoid or minimize, to the extent practicable, any impacts on marine mammals and their habitat. Mitigation measures will include the following:

- There shall be no discharge of ballast and bilge waters, sanitary waste, trash and debris, oil, fuel, chemicals, or other contaminates into the surface water or onshore. All contaminants will be disposed of properly, adhering to all federal and state regulations;
- Fuel hoses, oil drums, transfer valves, fittings, etc., will be routinely checked for leaks and stored properly to prevent accidental spills;
- All chemicals and solvents used for cleaning and maintenance of tools or equipment shall be properly handled and stored to prevent discharge to ground or surface waters;
- No petroleum products or other toxic deleterious material shall be allowed to enter surface waters;

- Applicable spill response equipment outlined in the Spill Prevention and Countermeasure Control Plan shall be available and maintained at the site; and
- All activities associated with Project construction will comply with water quality restrictions imposed by the Texas Commission of Environmental Quality and the U.S. Environmental Protection Agency.

12 MITIGATION MEASURES TO PROTECT SUBSISTENCE USES

Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, you must submit either a plan of cooperation (POC) or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses.

This section is not applicable. The Project will take place in the Gulf of Mexico off the coast of Texas, specifically the BSC, and no activities will take place in or near a traditional Arctic subsistence hunting area. No subsistence uses of marine mammals will impacted by this action.

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13 MONITORING AND REPORTING

The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding.

13.1 MONITORING PLAN

Annova LNG developed monitoring and mitigation measures (described in Section 11.1) in order to reduce impacts on marine mammals to the lowest extent practicable. Well in advance of the start of construction, Annova LNG will finalize the monitoring plan, which will be reviewed by NOAA Fisheries for final approval and will include the following measures:

- PSOs will primarily be located on boats, barges, docks, and/or land at the best vantage point(s) to properly observe the entire shutdown zone and, to the extent possible, the behavioral zone(s) during both vibratory and impact pile driving activities.
- PSOs will monitor 360 degrees around the stationed location (or the angle appropriate to observe the area where water is present).
- Marine binoculars with a reticle rangefinder and/or the naked eye will be used to continuously search for marine mammals during all in-water pile-driving activities.
- Handheld range finders will be used to measure distances from the PSO to the sighting, if possible. Handheld range finders will also be used to measure and verify distance of the Level A shutdown zone(s) from the sound source.
- All data will be recorded using waterproof notebooks or entered into a digital database.
- Environmental conditions (i.e., weather conditions, wind speed/direction, wave height, cloud cover, visibility, and glare) will be documented throughout the day.
- The date and time of each in-water pile-driving activity start and end will be documented.
- In-water pile-driving activities will be curtailed under adverse weather conditions (i.e., heavy fog or poor visibility) that prevent the PSO from observing the entire Level A zone, and to the extent possible, the Level B zone(s).
- All marine mammal sightings will be fully documented to include the following when possible:

    i. Distance and bearing to animal(s) relative to the PSO position;

ii. Distance of animals(s) from the sound source (i.e., impact hammer location);

iii. Number of individuals present;

iv. If possible, sex and age class;

v. Current phase of construction activity (i.e., impact, vibratory [pre-clearance, active-, post-construction]); and

vi. Behavior of animal(s) (i.e., foraging, resting, social, traveling), making note of any possible reaction related to the in-water pile-driving activity.

13.2 REPORTING PLAN

Annova LNG will provide NOAA Fisheries a draft monitoring report within 90 days of the conclusion of monitoring. A final report will be prepared and submitted to NOAA Fisheries within 30 days following receipt of comments on the draft report. If no comments are received from NOAA Fisheries, the draft report submitted will be considered the final report.

In general, reporting will include the following details.

- Summary of completed pile-driving mitigation measures implemented to minimize impacts on marine mammals, including:

  i. Duration of activity,

  ii. Location(s) of activity,

  iii. Number of days of activities, and

  iv. Times and durations of all shutdown events due to the presence of marine mammals.

- Summary of water (e.g., Beaufort sea state, tidal state) and weather conditions (e.g., percent cloud cover, visibility).

- Summary of PSO monitoring and marine mammal sightings, including:

  i. Date, time, and location of sighting;

  ii. Locations of observation station(s);

  iii. Total number of animals sighted;

  iv. Species;

  v. Descriptions of observed behavior (both in the presence and absence of activities);

  vi. Weather conditions during each sighting; and

vii. Assessment of implementation and effectiveness of prescribed mitigation and monitoring measures.

If an injured, stranded, or deceased marine mammal is observed in which the cause of injury or death is unclear, and death is relatively recent (i.e., animal is in less than a moderate state of decomposition), the NOAA Fisheries Southeast Marine Mammal Stranding Hotline (877-942-5343) and the Texas Marine Mammal Stranding Network (1-800-962-6625) will be contacted immediately. If an injured or dead marine mammal is discovered in which cause of death is clear and unrelated to the Project, or if death is not recent (i.e., animal is in a moderate to advanced state of decomposition), the observation will be reported within 24 hours.

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14 SUGGESTED MEANS OF COORDINATION

Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects.

Any and all marine mammal data gathered during the in-water construction of the Project along the BSC will be provided to NOAA Fisheries, and to any other interested federal agencies, environmental groups, or educational institutions upon request. This practice is especially important for this Project, because of the lack of recent marine mammal research in the area. This knowledge will help reduce incidental taking of marine mammals and evaluate Project-related impacts to inform future construction projects with similar environmental conditions.

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