PUBLIC

Petition for Incidental Take Regulations for Construction of the Alaska LNG Project in Cook Inlet, Alaska

April 4, 2025

3061-REG-GRD-00001

Alaska Gasline Development Corporation
3201 C Street, Suite 505
Anchorage, Alaska 99503
T: 907-330-6300
www.alaska-lng.com

REVISION HISTORY

Rev	Date	Description	Originator	Reviewer	Approver
2020	2/17/2020	Agency Submittal	EXP	L. Haas	F. Richards
2024	12/5/2024	2024 Application	EXP	L. Haas	F. Richards
2025	4/4/2025	Revised 2025 Application	EXP	L. Haas	F. Richards
Approver Signature*	d. J. Miller				

*This signature approves the most recent version of this document.

MODIFICATION HISTORY

Rev	Section	Modification
2020	All	Application was submitted in 2020 as AKLNG-6010-REG-GRD-DOC-00001, Rev. 6
2024	All	Provides updated information for the 2024 application
2024	All	Update to pile size information
2025	All	Update sound sources and requested takes

TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

ACRONYMS AND ABBREVIATIONS

4MP .... Marine Mammal Mitigation and Monitoring Plan
8 Star .... 8 Star Alaska, LLC
µPa .... microPascal
ADEC.............................. Alaska Department of Conservation
ADF&G........................... Alaska Department of Fish and Game
AGDC .... Alaska Gasline Development Corporation
AHT................................ anchor handling tug
AOE................................ Area of Ensonification
AUD INJ .... auditory injury
BA .... Biological Assessment
BiOp.............................. Biological Opinion
CFR .... Code of Federal Regulations
CHA-1 .... Critical Habitat Area 1
CHA-2 .... Critical Habitat Area 2
CISS................................ cast-in-shell steel
dB .... decibel
dB re 1 µPa .... decibel referenced to one microPascal
DPS .... distinct population segment
EIS.................................. Environmental Impact Statement
ESA .... Endangered Species Act
E-W................................ east-west
FEIS................................ Final Environmental Impact Statement
FERC .... Federal Energy Regulatory Commission
FR .... Federal Register
ft .... foot
HF .... High-Frequency
Hz .... hertz
IHA................................. Incidental Harassment Authorization
ITR .... Incidental Take Regulation
kHz................................. kilohertz
km .... kilometer
km^2 .... square kilometers
LF .... Low-Frequency
LNG................................ liquefied natural gas
LNGC.............................. liquefied natural gas carrier
LoLo............................... lift-on/lift-off
LOA................................ Letter of Authorization
L_{pk} .... peak level
m .... meter

MHHW...........................mean higher high water
ML ....Mainline
MLLW ....mean lower low water
MMPA ....Marine Mammal Protection Act
MOF..............................Material Offloading Facility
MP ....Milepost
MTRP.............................Marine Terminal Redevelopment Project
NMFS.............................National Marine Fisheries Service
NMML ....National Marine Mammal Laboratory
NOAA.............................National Oceanic and Atmospheric Administration
North Slope ....Alaska North Slope
NRC...............................National Research Council
N-S................................north-south
NTU ....nephelometric turbidity units
OPR...............................Office of Protected Resources
PBU...............................Prudhoe Bay Unit
PCE ....Primary Constituent Element
PLF ....Product Loading Facility
ppm ....parts per million
Project ....Alaska LNG Project
PSO ....protected species observer
PTS................................permanent threshold shift
PTU ....Point Thomson Unit
R ....radius
RMS ....root mean square
ROD ....Record of Decision
RoRo ....roll-on/roll-off
SEL ....sound exposure level
SPL................................sound pressure level
SSV................................sound source verification
TL..................................transmission loss
TS..................................threshold shift
TTS................................temporary threshold shift
U.S. ....United States
USACE............................United States Army Corps of Engineers
USCG ....United States Coast Guard
USFWS...........................United States Fish and Wildlife Service
VHF ....Very High-Frequency

1. ACTIVITIES POTENTIALLY RESULTING IN MARINE MAMMAL EXPOSURES

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

The National Oceanic and Atmospheric Administration (NOAA), through regulations administered by the National Marine Fisheries Service (NMFS), governs the issuance of Incidental Harassment Authorizations (IHAs) and Letters of Authorization (LOAs) through promulgation of Incidental Take Regulations (ITRs) permitting the incidental, but not intentional, take of marine mammals under certain circumstances. The regulations are codified in 50 Code of Federal Regulations (CFR) Part 216, Subpart I (Sections 216.101-216.108). The Marine Mammal Protection Act (MMPA) defines “take” to mean “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal” (50 CFR 216.316).

The Alaska LNG Project (Project) is an integrated liquefied natural gas (LNG) project with interdependent facilities for liquefying supplies of natural gas, from the Point Thomson Unit (PTU) and Prudhoe Bay Unit (PBU) production fields on the Alaska North Slope (North Slope), for export in foreign commerce and for in-state deliveries of natural gas. The Project includes a Liquefaction Facility on the Kenai Peninsula. The location of the Project is depicted in Figure 1.

On April 18, 2017, NMFS received a request from the Alaska Gasline Development Corporation (AGDC) for a LOA to take marine mammals incidental to constructing LNG facilities in Cook Inlet. The application was deemed adequate and complete on March 14, 2018. On June 28, 2019, NMFS issued a proposed rulemaking notice in the Federal Register (FR), inviting public commentary on the Applicant’s application for a 30-day comment period (84 FR 30991). The final regulations were published on August 17, 2020 (85 FR 50720), detailing mitigation, monitoring, and reporting measures for incidental marine mammal take during the construction of LNG facilities in Cook Inlet, Alaska. The LOA granted to the Applicant, effective from January 1, 2021, to December 31, 2025, permitted the incidental take of marine mammals under specific conditions. Specified activities originally included in the 2021 LOA have not yet commenced due to unexpected delays in completing the final design and starting construction of the Project, and are not likely to be completed before the December 31, 2025 end date.

AGDC established 8 Star Alaska, LLC (8 Star, Applicant) to be the lead on the Alaska LNG Project, and to provide the opportunity to obtain funding to move the Project forward. On behalf of the Project, the Applicant is re-petitioning NMFS to promulgate ITRs pursuant to Section 101(a)(5)(D) of the MMPA to allow non-lethal takes of whales and seals, incidental to Project construction activities for another 5-year period from January 1, 2026 to December 31, 2030 in marine waters of Cook Inlet. This petition addresses and requests coverage for the same specified activities, duration, and geographic region detailed in the 2021 Rule Making that are associated with Project construction activities within Cook Inlet (see Figure 2) that could have direct or indirect effects on marine mammal species managed by NMFS. These Project activities are:

- Construction of the proposed Marine Terminal in Cook Inlet, including construction of a temporary Material Offloading Facility (MOF) and a permanent Product Loading Facility (PLF).
- Construction of the Mainline across Cook Inlet, including the potential construction of a Mainline MOF on the west side of Cook Inlet.

Components of proposed construction activities in Cook Inlet that have the potential to result in acoustical exposures that rise to the level of takes of marine mammals include:

- Vibratory and impact pile driving associated with MOF and PLF construction.
- Anchor handling associated with pipelay across Cook Inlet.

With implementation of the mitigation and monitoring measures described in Sections 11 and 13 of this petition, only a small number of takes by disturbance (Level B) are expected. While the Applicant does not believe the construction activities would result in serious injury or mortality of any marine mammal, it is taking precautionary measures and including Level A takes for humpback whales, harbor porpoises, and harbor seals over the 5-year period as part of this application based on analyses of the potential acoustic harassment.

Section 216.104 of the MMPA sets out 14 specific items that must be addressed in requests for ITRs pursuant to Section 101(a)(5) of the MMPA. The 14 items are addressed in Sections 1 through 14 of this petition.

The Federal Energy Regulatory Commission (FERC) issued an Order on May 21, 2020 granting the Project authorization under the authority of Section 3 of the Natural Gas Act. The Order references the 2020 FERC Final Environmental Impact Statement (FEIS),[1] and its Appendix O - Biological Assessment (BA), which found the Project's design and its measures for avoidance, minimization, and mitigation to be in compliance with the Endangered Species Act (ESA). FERC determined that these avoidance and mitigation measures will not likely jeopardize the existence of ESA-listed species or adversely modify their critical habitats. Furthermore, on June 3, 2020, NMFS adopted the FERC FEIS in their Biological Opinion (BiOp), affirming that the project's proposed actions are not expected to threaten the survival of listed species or negatively impact their critical habitats due to construction activities in Cook Inlet. NMFS also confirmed that the FEIS satisfies all criteria for an adequate Environmental Impact Statement (EIS), as outlined in 40 CFR 1500-1508. NMFS issued a Record of Decision (ROD) for the Project on February 16, 2021. The ROD documents NMFS's adoption of the FEIS to fulfill its independent National Environmental Policy Act requirements for the Project, which includes issuing regulations and a Final ITR to the Applicant for construction activities in Cook Inlet.

[1] FERC, 2020. Alaska LNG Project Final Environmental Impact Statement. FERC/EIS-0296F. FERC Docket No. CP17-178-000. March. https://www.ferc.gov/industries-data/natural-gas/environment/final-environmental-impact-statement-feis.

Figure 1: Project Overview

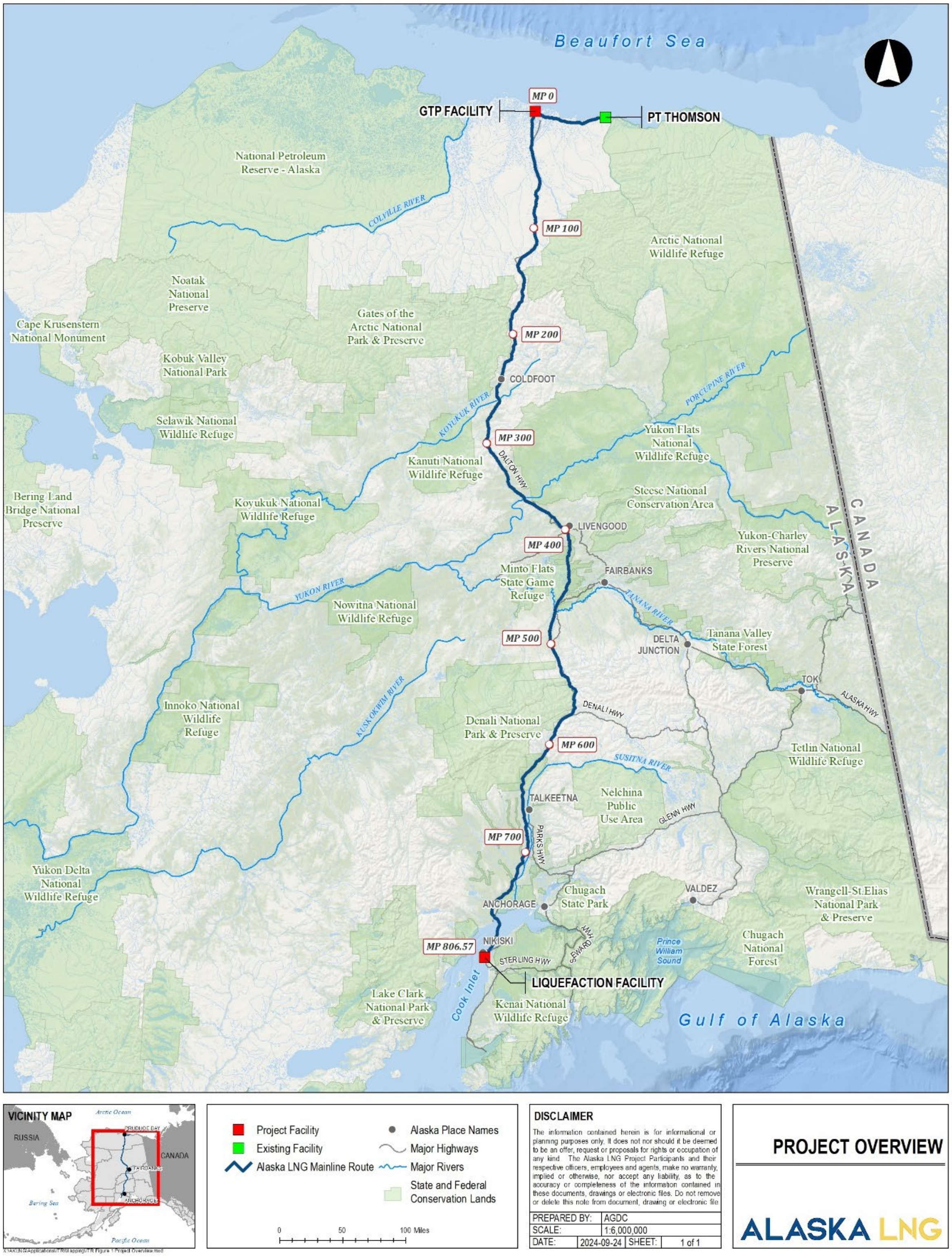


Figure 2: Petition Geographic Region

1.2. Description of Activities

In this document, the Applicant petitions NMFS for ITRs that would cover planned activities associated with construction of the Project's proposed facilities in Cook Inlet, which include a Marine Terminal and the Mainline crossing of Cook Inlet. The Marine Terminal consists of a permanent PLF and a temporary MOF. The Mainline crossing includes the installation of the 42-inch-diameter natural gas pipeline across the inlet, and construction of a Mainline MOF. Brief descriptions of these proposed facilities are provided below. This petition asks for coverage of activities associated with construction of these facilities that are expected to generate underwater sound energy at levels that NMFS has deemed sufficient to potentially result in Level B harassment of marine mammals. As detailed in Section 6 of this petition, those activities have been identified as pile driving associated with construction of the PLF, Temporary MOF, and Mainline MOF, and anchor handling associated with installation of the Mainline crossing of Cook Inlet. Descriptions of construction of the facilities is, therefore, focused on these specific activities. The Applicant will perform a sound source verification (SSV) study at the beginning of the pile driving to characterize the sound levels associated with different pile and hammer types, as well as to establish the marine mammal monitoring and mitigation zones. A description of the entire Project is provided in Volume 1 of the FEIS (FERC, 2020).

1.2.1. Marine Terminal

The proposed Marine Terminal would be constructed adjacent to the proposed onshore Liquefaction Facility near Nikiski, Alaska, (Figure 2) and would allow LNG carriers (LNGCs) to dock and be loaded with LNG for export (Figure 3). Primary components of the Marine Terminal include a PLF and the Temporary MOF (Figure 4).

Figure 3: Location of Proposed Project Marine Terminal

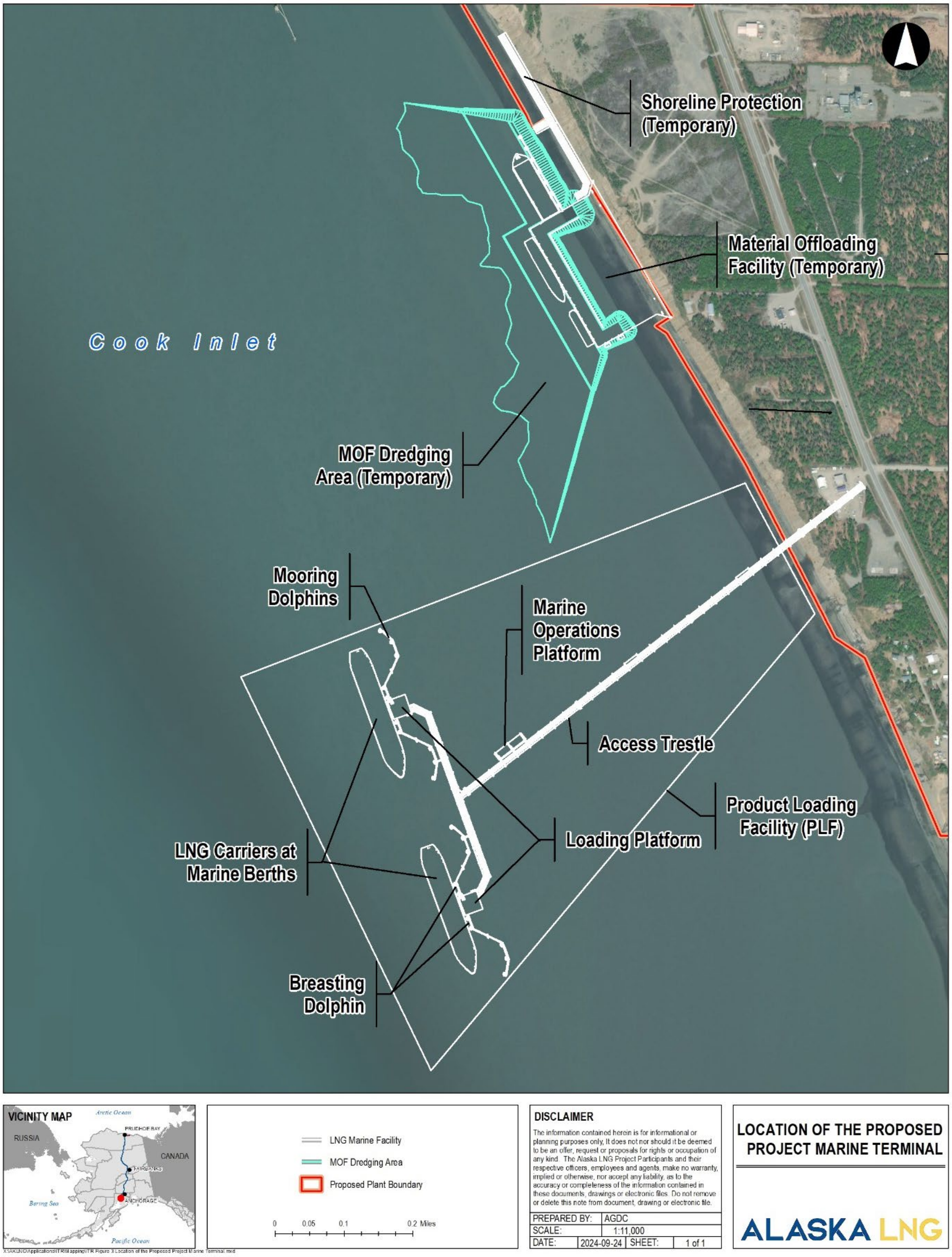
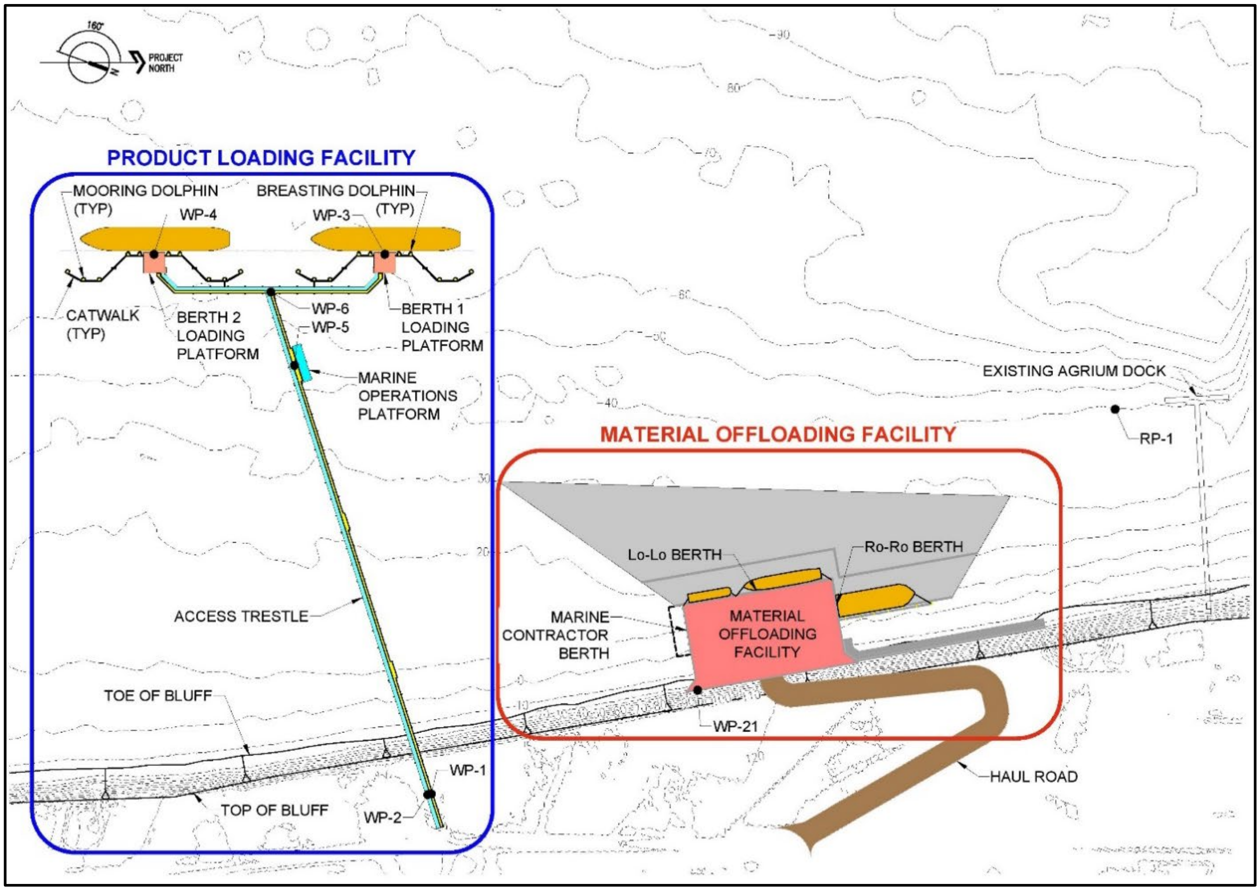


Figure 4: Product Loading Facility and Material Offloading Facility



1.2.1.1. Product Loading Facility

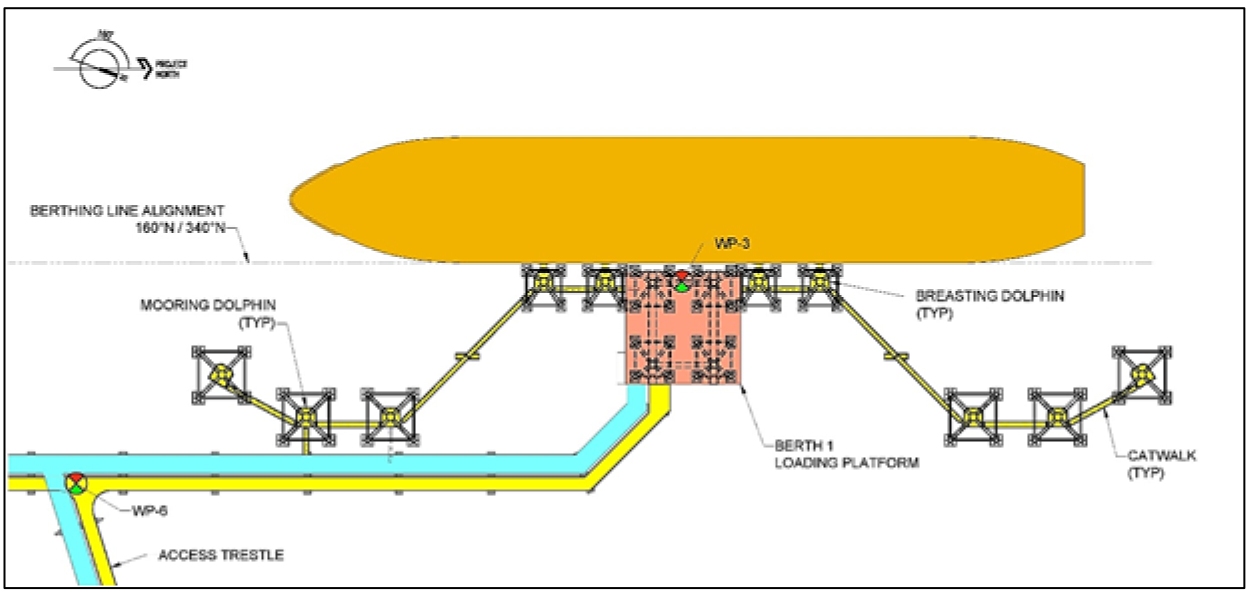
The proposed PLF would be a permanent facility used to load LNGCs for export. It consists of two loading platforms, two berths, a Marine Operations Platform, and an access trestle that supports the piping that delivers LNG from shore to LNGCs and includes the equipment to dock LNGCs. Analyzed elements of the PLF are shown in Figures 3 and 4 and are described as follows.

- **PLF Loading Platforms** – Two loading platforms, one located at either end of the north-south portion of the trestle (Figure 4), would support the loading arm package, a gangway, and supporting piping, cabling, and equipment. The platforms would be supported above the seafloor on steel-jacketed structures called quadropods.
- **PLF Berths** – Two berths would be located in natural water depths greater than -53 feet (-16 meters) mean lower low water (MLLW) and would be approximately 1,600 feet apart at opposite ends of the north-south portion of the trestle.

Each berth would have four concrete pre-cast breasting dolphins and six concrete pre-cast mooring dolphins (Figure 5). The mooring and breasting dolphins would be used to secure vessels alongside the berth for cargo loading operations. The mooring and breasting dolphins would be supported over the seabed on quadropods. A catwalk, supported on two-pile bents, would connect the mooring dolphins to the loading platforms.

- **Marine Operations Platform** – A Marine Operations Platform would be located along the east-west portion of the access trestle (Figure 4), and would support the proposed Marine Terminal Building; an electrical substation, and piping, cabling, and other equipment used to monitor the loading operations. The platform would be supported above the seafloor on four-pile bents.
- **Access Trestle** – This structure is T-shaped with a long east-west oriented section and a shorter north-south oriented section, and carries pipe rack, roadway, and walkway. The pipe rack contains LNG loading system pipelines, a fire water pipeline, utility lines, power and instrument cables, and lighting. The east-west portion of the trestle extends from shore, seaward, for approximately 3,650 feet, and would be supported on three-pile and four-pile bents at 120-foot intervals. The north-south oriented portion of the access trestle is approximately 1,560 feet long and is supported on five-pile quadropods.

Figure 5: Berth Layout – Plain View



1.2.1.2. Construction of the Product Loading Platforms and Berths

Construction methods would include both overhead construction (conducted with equipment located on a cantilever bridge extending from shore) and marine construction (conducted with equipment located on barges/vessel). The Project footprint of the PLF is approximately 18.67 acres; however, a much smaller footprint of seafloor within this area would be impacted by the bents and quadropods supporting the PLF.

The PLF would be constructed using both overhead and marine construction methods. As planned, the PLF would be constructed over the course of four ice-free seasons (Seasons 2–5); however, Season 2 activities associated with PLF construction include only installation of onshore portions of the PLF, and are therefore, not described or analyzed in this petition. Activities in Seasons 3 through 5 are described below.

Each season extends from April 1 through October 31, during which construction crews would be working 12 hours per day, 6 days per week.

In Season 3, the marine construction spread would be mobilized and the cantilever bridge would be commissioned. A total of 35 bents and quadropod structures would be installed for part of the east-west and north-south access trestles, and berth loading platforms (Table 1).

In Season 4, the remainder of the bents for the east-west access trestle would be installed. Additionally, bents supporting the Marine Operations Platform and north-south trestle would be installed. A total of 26 bent and quadropod structures would be installed (Table 2).

In Season 5, installation of the mooring quadropods would be completed, and the bents supporting the catwalk between the loadout platforms and the mooring dolphins would be installed. A total of 18 bent and quadropod structures would be installed (Table 3).

The approximate numbers and types of piles that would be installed in Seasons 3–5 are listed in Table 1, Table 2, and Table 3. PLF bents and quadropods are expected to be installed with impact hammers. The anticipated production rate for installation of the bents is one bent per 6 construction days, and for quadropods it is one quadropod per 8 workdays. Pile driving is expected to occur during only 2 of the 6 days for bents and 2 of the 8 days for quadropods. It is also assumed the impact hammer would only be operated approximately 25 percent of time during the 2 days of pile driving.

Table 1: Pile Structures to be Installed for the PLF in Season 3

PLF Element	Structure Type	Number of Structures	Number of Piles		Hammer	Method	Days[4]	Months
			48-inch Piles	60-inch Piles				
E-W Trestle	3-pile bent [1]	11	-	33	Impact [2]	Overhead	22	Apr–Jun
E-W Trestle	4-pile bent	10	-	40	Impact [3]	Overhead	20	Jun–Aug
Berth 1	quadropod	4	20	-	Impact [3]	Marine	8	Apr–May
Berth 2	quadropod	4	20	-	Impact [3]	Marine	8	Apr–May
N-S Trestle	quadropod	8	40	-	Impact [3]	Marine	16	May–Jun
Total	**--**	**37**	**80**	**73**	**--**	**--**	**74**	**Apr–Aug**

Notes: E-W = east-west; N-S = north-south

[1] Four 3-pile bents (12-piles) to be installed on land in Season 2; five additional three-pile bents for the E-W access trestle would be installed on land or in the dry area within the intertidal zone in Season 3.

[2] Two impact hammers are expected to be used from the barges.

[3] One impact hammer is expected to be used from the overhead cantilever bridge.

[4] Number of days on which pile-driving would occur, based on expected progress rate of 2 days per structure, pile driving would occur during only a portion of each day.

Table 2: Pile Structures to be Installed for the PLF in Season 4

PLF Element	Structure Type	Number of Structures	Number of Piles		Hammer	Method	Days[3]	Month(s)
			48-inch	60-inch				
E-W Trestle	4-pile bent	7	-	28	Impact [1]	Overhead	14	Apr–May
Operations Platform	4-pile bent	3	-	12	Impact [1]	Overhead	6	May–Jun
Breasting Dolphins	quadropod	8	8	32	Impact [2]	Marine	16	Apr–May
Mooring Dolphin	quadropod	2	2	8	Impact [2]	Marine	4	May
N-S Trestle	quadropod	6	30	-	Impact [2]	Marine	12	Apr–May
Total	**--**	**26**	**40**	**80**	**--**	**--**	**52**	**Apr–Jun**

Notes: E-W = east-west; N-S = north-south

[1] Three impact hammers are expected to be used from the barges.

[2] One impact hammer is expected to be used from the overhead cantilever bridge.

[3] Number of days on which pile-driving would occur, based on expected progress rate of 2 days per structure, pile driving would occur during only a portion of each day.

Table 3: Pile Structures to be Installed for the PLF in Season 5

PLF Element	Structure Type	Number of Structures	Number of Piles		Hammer	Method	Days[2]	Month(s)
			48-inch	60-inch				
Mooring Dolphin	quadropod	10	10	40	Impact [1]	Marine	20	Apr–Jun
Catwalk	2-pile bent	4	-	8	Impact [1]	Marine	16	Apr–May
Total	**--**	**14**	**10**	**48**	**--**	**--**	**36**	**Apr–Jun**

[1] Two impact hammers are expected to be used from the barges.

[2] Number of days on which pile-driving would occur, based on expected progress rate of 2 days per structure, pile driving would occur during only a portion of each day.

1.2.1.3. Temporary Material Offloading Facility

The proposed Temporary MOF, to be located near the PLF in Nikiski (Figures 2-4), would consist of two berths and a quay (Figure 6), which would be used during construction of the Liquefaction Facility to enable direct deliveries of equipment modules, bulk materials, construction equipment, and other cargo to minimize the transport of large and heavy loads over road infrastructure.

The MOF quay would be approximately 1,050 feet long and 600 feet wide, which would provide sufficient space for cargo discharge operations and accommodate 200,000 square feet of staging area. It would have a general dock elevation of +32 feet MLLW.

The quay would have an outer wall consisting of combi-wall (combination of sheet piles and king piles) tied back to a sheet pile anchor wall, and 11 sheet pile coffer cells, backfilled with granular materials.

Berths at the MOF would include:

- One lift-on/lift-off (Lo-Lo) berth with a maintained depth alongside of -32 feet (-10 meters) MLLW.
- One roll-on/roll-off (Ro-Ro) berth with a maintained depth alongside of -32 feet (-10 meters) MLLW.

The MOF has been designed as a temporary facility and would be removed early in operations when it is no longer needed to support construction of the Liquefaction Facility.

Seafloor areas directly affected by construction of the MOF, and the associated dredging are itemized in Table 4.

Table 4: Cook Inlet Seafloor Affected by Construction of the MOF

Facility/Activity	Affected during Construction (acres)
Temporary MOF & MOF Dredging Area[1]	62.01
Dredge Disposal Area	1,200.00
Shoreline Protection	1.54
Total	**1,263.55**

[1] The temporary MOF footprint and temporary MOF dredging area overlap by 16.98 acres. Approximately 50.7 acres will be dredged. The MOF will encompass approximately 28.30 acres.

1.2.1.3.1. Construction of the Temporary MOF

The Temporary MOF would be constructed over the course of two construction seasons (Seasons 1 and 2), with each season extending from approximately April 1 through October 31. The estimated number of sheet pile and king pile structures that would be installed in each season, along with the methods and durations of the installation activities, are provided in Table 5.

The combi-wall and the first six of 11 coffer cells would be installed in Season 1. An equal amount of sheet pile anchor wall (tie-back) would be associated with the combi-wall, but this is not considered in the analysis or requested takes, as the anchor wall would be driven into fill and would not generate substantial underwater sound. The construction of the sheet pile coffer cell wall will involve driving a set of 188 sheet piles per cell in a template to form a complete circle. Four, 24-inch bearing piles per template would be installed with a vibratory hammer before the sheet pile is installed for each coffer cell and then removed when coffer cell installation is complete. Once a cell is complete, it will be filled with granular material to provide mass before removing or relocating the template to the next cell. The remaining five coffer cells and fill would be installed in Season 2, along with the quadropods for the dolphins for the Ro-Ro berth.

The Temporary MOF would be constructed using both land-based (from shore and subsequently from constructed portions of the MOF) and marine construction methods. Crews are expected to work 12 hours per day, 6 days per week. The anticipated production rate for installation of combi-wall and coffer cells is 25 linear feet per day per crew, with two crews operating, and vibratory hammers operating 40 percent (4.8 hours) of each 12-hour construction day. The anticipated production rate for quadropod installation is the same, as described in Section 1.2.1.1.

Table 5: Sheet and Pile Structures to be Installed as Part of Temporary MOF Construction

Season	Structure Type	Number of Structures	Number of Piles / Sheets				Method	Hammer	Days[1]	Months
			24-inch	48-inch	66-inch	Sheet Pile				
1	Combi-wall[2]	1	-	-	70	144	Land	Vibratory	22	Jul
1	Coffer cell	6	48[3]	-	-	1,496	Land	Vibratory	56	Jul-Oct
2	Coffer cell	5	40[3]	-	-	1,491	Land	Vibratory	54	Apr-Jun
2	Quadropod[4]	7	7	28	-	-	Marine	Impact	14	Apr-Jun
All	**-**	**19**	**95**	**28**	**70**	**3,131**	**-**	**-**	**146**	**Apr-Oct**

[1] Number of days on which pile-driving would occur, based on expected progress rate of 2 days per structure for pile driving, 25 feet per day per crew for sheet pile and combi-wall. Pile driving would occur during only a portion of each of these days. One day is also required per structure for installation and removal of the templates for the coffer cell (see footnote 3).

[2] Combi-wall is a wall made of sheet piles with pipe piles at interval along the wall for support. These piles and sheet wall are installed from land but are located in water; therefore, these components were used in Level A and B evaluation. There would also be an equal length of anchor wall with no pipe piles installed in fill, on land and therefore no underwater sound is anticipated and was not used in Level A and B evaluation.

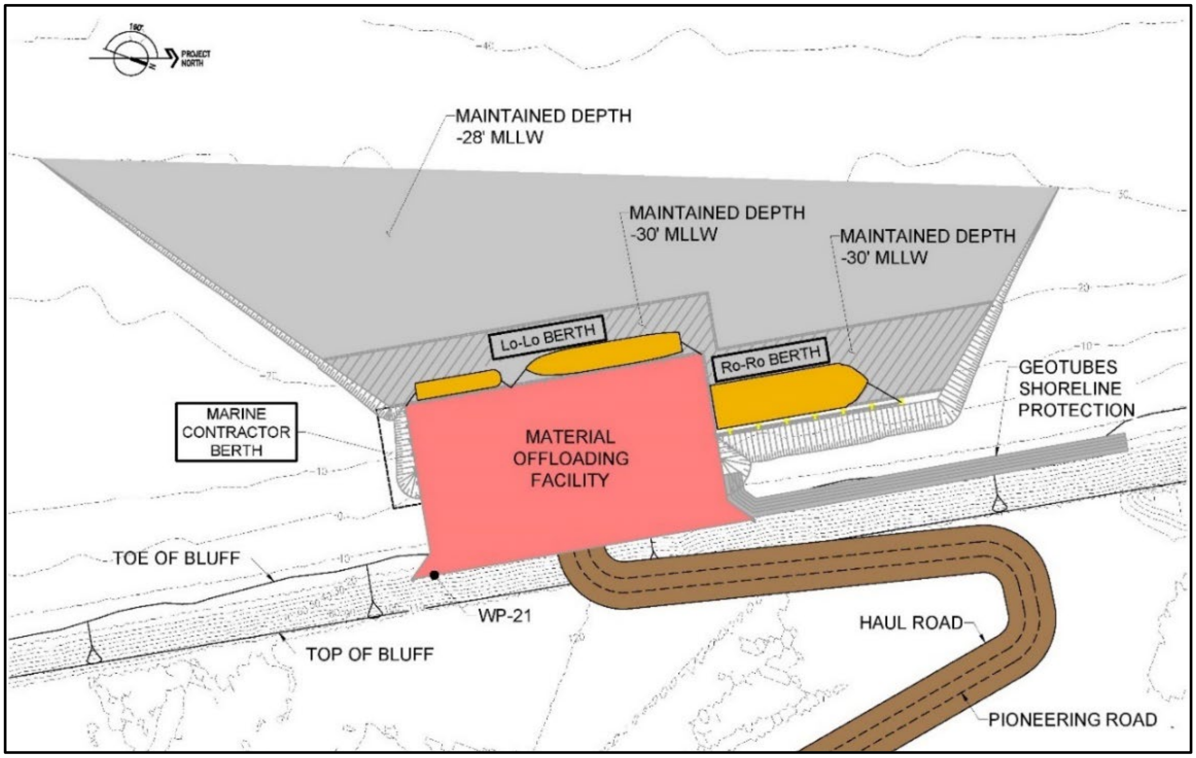
[3] These are 4 (temporary) 24-inch bearing piles or spuds driven in the seafloor to form templates for the circular sheet pile (coffer cell); one pile driving day is added for template installation and removal for each coffer cell.

[4] Each of these quadropods for the MOF Ro-Ro dolphins consists of five piles.

Dredging would be conducted over two ice free seasons. Dredging at the MOF during the first season of marine construction may be conducted with either an excavator or clamshell (both mechanical dredges). Various bucket sizes may be used. Sediment removed would be placed in split hull or scow/hopper barges tended by tugs that would transport the material to the location of dredge material placement.

Dredging at the MOF during the second season may be conducted with either a hydraulic (cutter head) dredger or a mechanical dredger. For a hydraulic dredger, the dredged material would be pumped from the dredge area to the disposal location or pumped into split-hull barges for transport to the placement location. If split-hull barges are used rather than direct piping of material, a manifold system may be set up to load multiple barges simultaneously. For a mechanical dredger, two or more sets of equipment would likely be required to achieve total dredging production to meet the Project schedule. Personnel transfer, support equipment, and supply would be similar to the first season. Maintenance dredging may be conducted in Season 4 and/or Season 5.

Figure 6: General Arrangement of the Temporary Material Offloading Facility



1.2.2. *Mainline Material Offloading Facility*

A MOF may be required on the west side of Cook Inlet to support installation of the Cook Inlet shoreline crossing, and onshore construction between the South of Beluga Landing shoreline crossing and the Yentna River. The Mainline MOF would be located near, but at a reasonable distance from, the existing Beluga Landing. Use of the existing landing is not considered to be feasible.

The Mainline MOF would consist of a quay, space for tugs, and berths including:

- Lo-Lo Berth for unloading pipes and construction materials.
- Ro-Ro Berth and ramp dedicated to Ro-Ro operations.

The quay would be 450 feet long (along the shoreline) and 310 feet wide (extending into Cook Inlet). A Ro-Ro ramp (approximately 80 feet by 120 feet) would be constructed adjacent to the quay. Both the quay and the Ro-Ro ramp would consist of anchored sheet pile walls backed by granular fill. The sources for the granular material would be onshore. Surfacing on the quay would be crushed rock. Some fill material for the quay and Ro-Ro ramp are expected to be generated by excavation of the access road. Any additional needed fill materials and crushed rock for surfacing would be barged in.

The quay and the Ro-Ro ramp are located within the 0-foot contour, so berths would be practically dry at low tide. No dredging is planned; vessels would access the berths and ground themselves during high tide cycles. The proposed top level of the Mainline MOF is +36 feet MLLW, which is about 11 feet above mean higher high water (MHHW).

1.2.2.1. Construction of the Mainline MOF

Approximately 1,270 feet of sheet pile would be installed for construction of the Quay and Ro-Ro ramp, and a corresponding length of sheet pile would be installed as anchor wall; however, only 670 feet of sheet pile would be installed in the waters of Cook Inlet (Table 6). The remainder would be installed as anchor wall in fill material, or in the intertidal area when the tide is out and would not result in underwater sound.

The Mainline MOF would be constructed in a single construction season (Season 2), which would extend from 1 April to 31 October. Crews are expected to work 12 hours per day, 6 days per week. The sheet pile would be installed using marine equipment, with the first 50 percent of embedment conducted using a vibratory hammer and the remaining 50 percent conducted using an impact hammer. Hammers would be expected to be operated either 25 percent (3 hours) of a 12-hour construction day (impact hammer) or 40 percent (4.8 hours) of a 12-hour construction day (vibratory hammer).

Table 6: Structures to be Installed in Cook Inlet as Part of Mainline MOF Construction

Season	Structure Type	Structures	Number of Sheet Pile (ft)	Hammer	Method	Days[1]	Months[2]
2	Quay [3]	1	205 (470)	Vibratory/Impact[5]	Marine	10	Apr-May
2	Ro-Ro ramp[3]	1	87 (200)	Vibratory/Impact[5]	Marine	4	Apr-May
All	**-**	**2[3]**	**292 (670)[4]**	**Vibratory/Impact[5]**	**Marine**	**14**	**Apr-May**

[1] Number of days on which pile-driving would occur based on expected progress rate of 25 linear feet per day per crew (2 crews) for sheet pile; however, pile driving would occur during only a portion of each of these days – approximately 40 percent (4.8 hours) of workday when operating vibratory hammer and 25 percent (3 hours) of workday with impact hammer.

[2] Months during which some of the pile driving is expected to occur.

[3] The quay and the Ro-Ro ramp are adjoining parts of the Mainline MOF.

[4] Itemized sheet pile is for only sheet pile installed in the water; additional sheet pile would be installed in the dry (600 feet, in intertidal area when tide is out) and additional sheet pile installed in fill as anchor wall. These piles are not included in the table or analyzed in the document as installation would not result in significant underwater sound.

[5] The first 50 feet of embedment would be conducted with a vibratory hammer, and the remainder with an impact hammer – assume half of the pile driving days with each hammer type.

1.2.3. Mainline Crossing of Cook Inlet

The proposed Mainline, a 42-inch-diameter, natural gas pipeline, would cross the Cook Inlet shoreline on the west side of the inlet (north landfall) south of Beluga Landing at pipeline milepost (MP) 766.3, traverse Cook Inlet in a generally southward direction for approximately 26.7 miles, and cross the east Cook Inlet shoreline near Suneva Lake at MP 793.1 (south landfall) (Figure 7). The pipe would be trenched into the seafloor and buried from the shoreline out to a water depth of approximately 35-45 feet MLLW on both sides of the inlet, approximately 8,800 feet from the north landfall and 6,600 feet from the south landfall. Burial depth (depth of top of pipe below the seafloor) in these areas would be 3–6 feet. Seaward of these sections, the concrete coated pipeline would be placed on the seafloor. Seafloor that would be directly affected by construction and operation of the Cook Inlet crossing of the Mainline is itemized in Table 7.

Additional footprint would be impacted by the use of anchors to hold the pipelay vessel in place while installing the pipeline on the seafloor.

Table 7: Cook Inlet Seafloor Directly Affected by the Cook Inlet Crossing

Facility/Activity	Affected during Construction [1]
Nearshore trenching	27 – 52 acres / 10.9 – 20.2 hectares
Offshore pipe installation	11 acres / 4.5 hectares
Total	**40 acres / 20 hectares**

[1] Additional seafloor impacts would occur from anchoring of the pull barge and pipelay vessel.

1.2.3.1. Pre-installation Surveys

Geophysical surveys would be conducted just prior to pipeline construction and a detailed bathymetric profile (longitudinal and cross) would be developed. Types of geophysical equipment expected to be used for the surveys would include (Table 8):

- Single-beam echosounder planned for use during this program operate at frequencies of 200 kilohertz (kHz).
- Multi-beam echo sounders planned for this program operate at frequencies of 200 and 400 kHz.
- Side-scan sonar system planned for use during this program operates at a frequencies of 400 kHz.
- Magnetometer, which is an instrument that does not emit underwater sound.

Acoustic characteristics of equipment expected to be used are provided in Table 8. Operation of geophysical equipment, such as echosounders and side-scan sonars at frequencies greater than 200 kHz, are generally not considered to result in acoustic harassment of marine mammals. Magnetometers do not emit underwater sound. The geophysical surveys are, therefore, not evaluated further in this petition.

Table 8: Acoustical Characteristics of Planned Geophysical and Geotechnical Equipment

Type	Model [1]	Operating Frequency (kHz)	SPL Source Level (dB re 1 µPa m)[3]
Single Beam Echosounder	Echotrac CV-100	200[4,5]	175[4,5]
Multibeam Echosounder	R2Sonic 2024	200-400[2]	196[4,5]
Side-scan Sonar	EdgeTech 4200	400[4,5]	205[4,5]

[1] A similar model may be used.

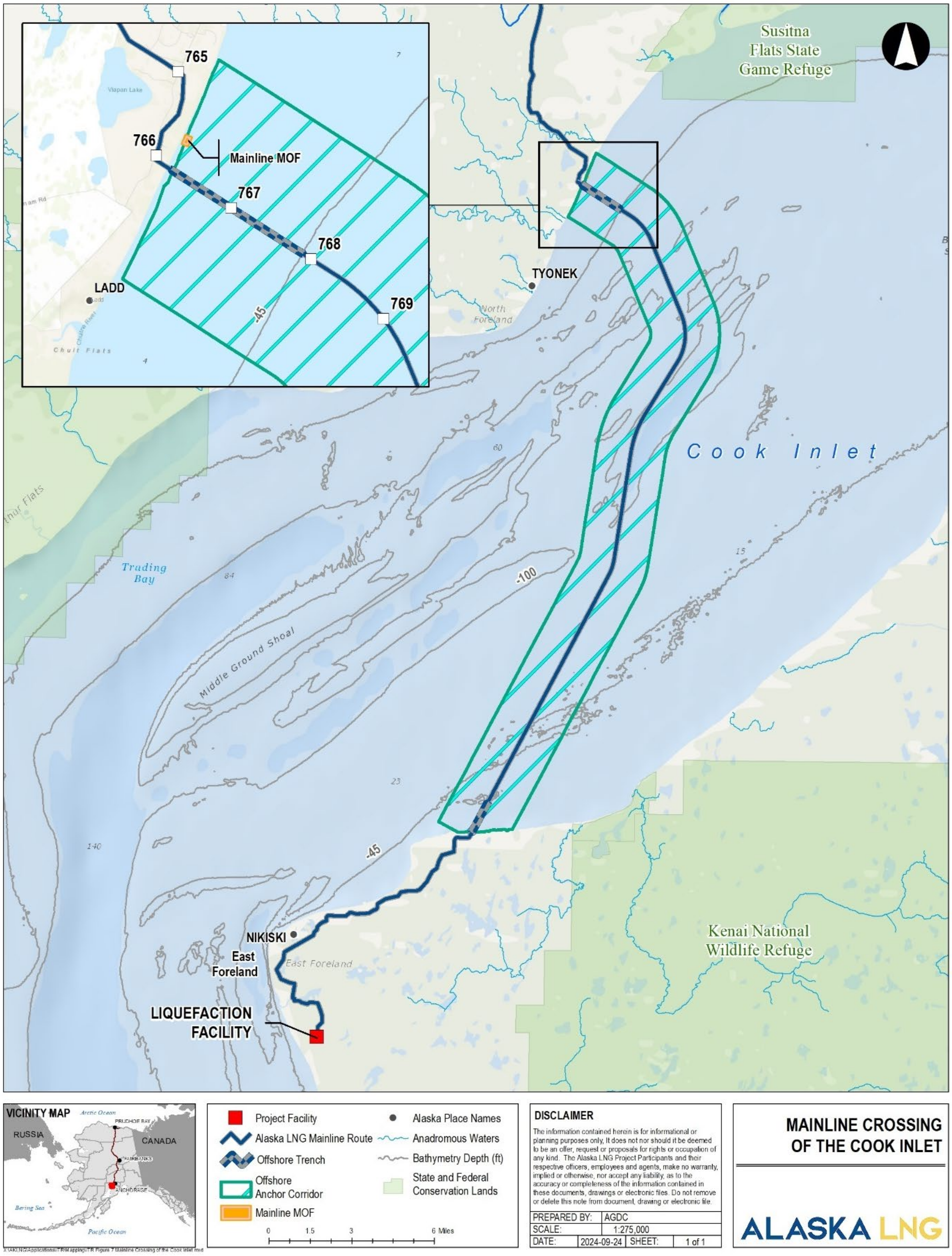
[2] Source: Sonic 2024-V Manual.

[3] SPL = Sound pressure level.

[4] Source: Crocker and Fratantonio, 2016.

[5] BOEM, 2023.

Figure 7: Mainline Crossing of Cook Inlet



1.2.3.2. Trenching, Pipelay, and Burial

The pipeline would be trenched and buried in the nearshore portions of the route across the Cook Inlet. Dimensions of the trenches are provided in Table 9 and Table 10.

Table 9: Expected Volumes to be Excavated from Subsea Pipe Trenches in Cook Inlet

Site	Subsea Trench Length		Overcut (feet)	Trench Slope (Depth: Width)	Subsea Trench Cross Sectional Area (square feet)	Seafloor Area Trenched	
	To -35 feet	To -45 feet				To -35 feet (cubic yards)	To -45 feet (cubic yards)
Beluga Landing	8,300	8,800	5	1:3	500	155,000	163,000
				1:6	900	274,000	289,000
Suneva Lake	6,400	6,600	5	1:3	500	118,000	123,000
				1:6	900	209,000	218,000

Table 10: Expected Seafloor Area Directly Affected by Trenching for Cook Inlet Crossing

Site	Subsea Trench Length		Trench Slope (Depth: Width)	Trench Width (feet)	Seafloor Area Trenched	
	To -35 feet	To -45 feet			To -35 feet (acres)	To -45 feet (acres)
Beluga Landing	8,300	8,800	1:3	76.5	15	15
			1:6	143.0	27	29
Suneva Lake	6,400	6,600	1:3	76.5	11	12
			1:6	143.0	21	22

The nearshore portion of the trench is expected to be constructed using amphibious or barge-based excavators and would extend from the shoreline out to a transition water depth where a dredge vessel can be employed. This nearshore portion of the trench is expected to be 655 feet long on the west side of the inlet (Beluga Landing) and 645 feet long on the east side (Suneva Lake). The trench design basis is to excavate a shallow slope trench that would not retain sediments (i.e., a self-cleaning trench). A backhoe dredge may also be required to work in this portion of the crossing.

From the transition water depth to water depths of the -35 feet or -45 feet MLLW, a trailing suction hopper dredger would be used to excavate a trench for the pipeline. Alternative burial techniques, such as plowing, backhoe dredging, or clamshell dredging, would be considered if conditions become problematic for the dredger. After installation of the nearshore pipelines, a jet sled or mechanical burial sled may be used to achieve post dredge burial depths.

Pipeline joints would be welded together onshore in 1,000-foot-long strings and laid on the ground surface in an orientation that approximates the offshore alignment. A pipe pull barge would be anchored offshore near the seaward end of the trench, and would be used to pull the pipe strings from their onshore position into the trench.

Following pipeline installation, the trench is expected to backfill naturally through the movement of seafloor sediments. If manual backfilling is required, the backfill would be placed by reversing the flow of the trailing suction hopper dredger used offshore (see below) or mechanically with the use of excavators.

1.2.3.3. Offshore Pipeline Installation

Seaward of the trenched sections, the pipeline would be laid on the seafloor across Cook Inlet using conventional pipelay vessel methods. The pipelay vessel would likely employ 12 anchors to keep it positioned during pipelay and provide resistance as it is winched ahead 80 feet each time an additional 80-foot section of pipe is added/welded on the pipe string. Dynamic positioning may be used in addition to the conventional mooring system. Mid-line buoys may be used on the anchor chains when crossing other subsea infrastructure (i.e., pipelines and cables). A pipelay rate of 2,000 to 2,500 feet per 24-hour period is expected. It is anticipated that three anchor handling attendant tugs would be used to repeatedly reposition the anchors, thereby maintaining proper position and permitting forward movement. The primary underwater sound sources would be from the anchor handling tugs (AHTs) during the anchor handling for the pipelay vessel.

1.2.3.4. Construction Schedule for the Mainline Crossing

The pipeline crossing of Cook Inlet would occur over two consecutive construction seasons (Seasons 3 and 4). The construction season extends from April 1 through October 31. Work from the pipelay vessel and pull barge would be conducted 24 hours per day, 7 days per week, until the work planned for that season is completed. Anchor handling durations were estimated differently for the two construction seasons. Anchor handling is expected to be conducted 25 percent of the time that the pull barge is on site in Season 3. The estimate for anchor handling duration in Season 4 was based on the proposed route length, the total numbers of individual anchors moves (Table 11), and the estimated time required to retrieve and reset each anchor (approximately 30 minutes per anchor to retrieve and reset). A break-down of activities per season is provided below.

Season 3

- Conduct onshore enabling works including establishing winch/laydown and welding area, and excavation of a trench through onshore sections of the shore approach (open cut the shoreline).
- Excavate trench in very nearshore waters using land and amphibious excavation equipment.
- Conduct pre-lay excavation of the pipe trench out to depths of -35 to -45 feet MLLW using various subsea excavation methods.
- Install the pipe in the nearshore trenches using a pull barge.
    - Anchor handling would occur for approximately six (5.75 days), 24-hour periods in Season 3.
- Cap installed nearshore sections and leave in place until the next year.

Season 4

- Lay unburied offshore section of Mainline across Cook Inlet using conventional pipelay vessel.
  - Anchor handling is estimated to occur over 13, 24-hour periods in Season 4.
- Tie-in the offshore section to the buried nearshore sections on both sides of the Cook Inlet.
- Flood, hydrotest, and dry the Mainline pipeline with Cook Inlet.

Table 11: Anchors to be Handled during Installation of the Offshore Portion of Mainline Crossing

Season	Offshore Route (feet)	Lay Rate (feet/day)	Anchors Set
4	132,440	2,500	636

2. DATES, DURATION, AND GEOGRAPHICAL REGION OF ACTIVITIES

The dates and duration of such activity and the specific geographical region where it will occur.

This petition geographic region for Project activities within Cook Inlet is provided in Figure 2. The activities would be conducted primarily at the site of the proposed Marine Terminal (Figure 3), the site of the Mainline MOF (Figures 3 and 4), and the construction right-of-way for the Mainline crossing of Cook Inlet waters (Figure 7). For the purposes of this application, "lower Cook Inlet" refers to waters south of Redoubt Point in the west and Calm Gulch in the east; "middle Cook Inlet" refers to waters north and east of Redoubt Point and north and west of Calm Gulch to north and south of Threemile River in the west and Point Possession in the east; and "upper Cook Inlet" refers to waters north and east of Beluga River in the west and Point Possession on the east. Figure 8 depicts the specific geographical area of lower, middle and upper Cook Inlet. Table 12 summarizes the planned Project schedule for the Project components and activities located in middle Cook Inlet.

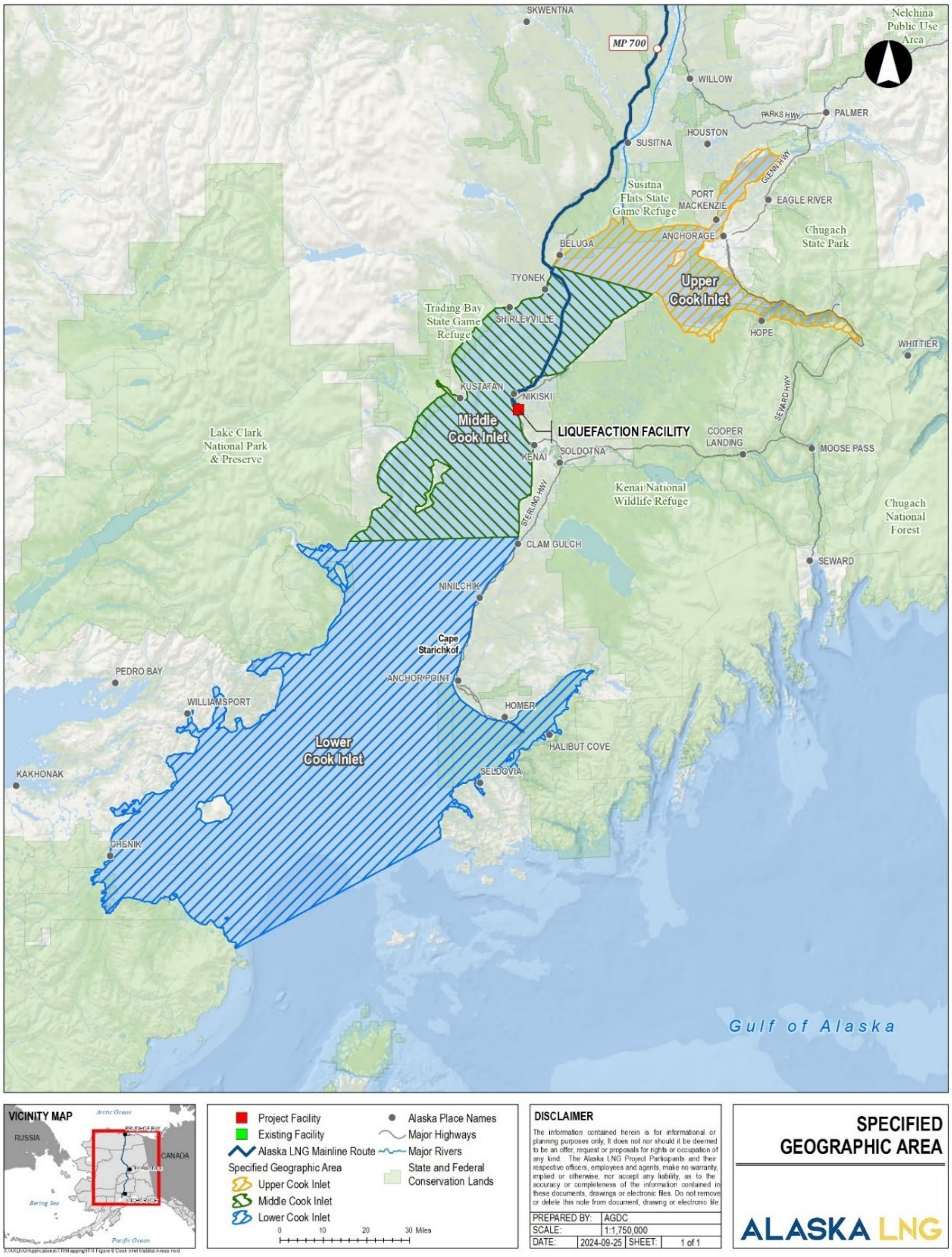
As discussed in Section 1, the Applicant requests that ITR under this petition start January 1, 2026, and extend through December 31, 2030, given the expiration of the current ITR on December 31, 2025. However, the actual starting year is dependent upon completing the final engineering and firm construction execution plans.

Table 12: Project Schedule

Project Component / Activities	Season 1	Season 2	Season 3	Season 4	Season 5
Marine Terminal					
Site Preparation Activities, Temporary MOF Construction	✓	✓			
Dredging, Complete Temporary MOF, Construct Mainline MOF	✓	✓			
Commence Installation of Trestle and Berths, Quadropod Installation		✓	✓	✓	
Complete Installation of Trestle, Continue Installation of Berths, Commence Installation of PLF Modules, Berths, and Mooring Dolphins			✓	✓	✓
Complete Installation of PLF					✓
MOF Reclamation/Demobilization					✓
Mainline Offshore Cook Inlet Spread					
Construct Shore Crossings and Nearshore Pipeline			✓	✓	
Complete Offshore Pipeline Construction, Hydrotest, and Final Tie-In				✓	✓

The above schedule includes onshore work to be conducted during construction of the MOF and PLF. The schedule for offshore construction activities is based on using the ice-free working windows (Season) in Cook Inlet, which extends approximately from April 1 through October 31.

Figure 8. Specified Geographic Area



3. TYPE AND ABUNDANCE OF MARINE MAMMALS IN PROJECT AREA

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

3.1. Species and Number in the Project Area

The marine mammals most likely to be in the mid-Cook Inlet project activity area (Mainline crossing and Marine Terminal) are the Cook Inlet stock of beluga whale (*Delphinapterus leucas*), harbor porpoise (*Phocoena phocoena*), harbor seal (*Phoca vitulina*), and killer whale (*Orcinus orca*). Populations of these species become concentrated in upper Cook Inlet area during the summer months when they feed on runs of salmon (*Oncorhynchus* spp.) and eulachon (*Thaleichthys pacificus*) (Nemeth et al., 2007; Boveng et al., 2012). These species tend to move to middle and/or lower Cook Inlet area during winter, as upper Cook Inlet largely freezes over.

Another species that has more recently been observed and stranded in Cook Inlet is the humpback whale (*Megaptera novaeangliae*) (personal communication with Greg Balogh at NMFS, 2016). There are rare occurrences of humpback whales in northern Cook Inlet where they have been sighted north of Nikiski (Lomac-MacNair et. al., 2014); however, they are not expected to occur in mid-Cook Inlet area as far north as the proposed Marine Terminal location near Nikiski or in upper Cook Inlet area near the Mainline crossing. The status and estimated stock size of marine mammals in Cook Inlet are shown in Table 13.

Table 13: Cetaceans and Pinniped in the Cook Inlet Project Area

Species	Stock Estimate	Stock	ESA Status
Humpback Whale	11,278[1]	Hawai'i[4]	Not Listed
Humpback Whale	918[1]	Mexico – North Pacific[4]	Threatened
Humpback Whale	1,084[1]	Western North Pacific[4]	Endangered
Beluga Whale	331[2]	Cook Inlet	Endangered
Killer Whale	1,920[1]	Alaska Resident	Not Listed
Killer Whale	587[3]	Alaska Transient	Not Listed
Harbor Porpoise	31,046[3]	Gulf of Alaska	Not Listed
Harbor Seal	28,411[2]	Cook Inlet/Shelikof	Not Listed

[1] Young et al., 2023
[2] Goetz et al., 2023
[3] Muto et al., 2021
[4] NMFS, 2022. New MMPA stock designation for DPS of North Pacific humpback whale stock structure changes.

4. DESCRIPTION OF MARINE MAMMALS IN COOK INLET PROJECT AREA

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

Descriptions of the status, distribution, and seasonal distribution of the affected species or stocks of marine mammals listed above in Table 13 are presented in the following subsections. Information provided in this section relates to the proposed activities in Cook Inlet. Additional information can be found in the Alaska LNG FEIS (FERC, 2020) and BiOp (NMFS, 2020b).

4.1. Humpback Whale

Humpback whales were listed as endangered in 1970 under the Endangered Species Conservation Act (predecessor act to the ESA of 1973) primarily due to overexploitation in commercial fisheries (35 FR 8491). On September 8, 2016, NMFS issued a final ruling that revised the ESA status of humpback whales, effective October 11, 2016 (81 FR 62259). This ruling identified 14 distinct population segments (DPSs) based on unique breeding grounds in tropical and temperate regions. Out of these, five DPSs were listed under the ESA (four as endangered and one as threatened), while the remaining nine were removed from the list. Subsequently, on April 21, 2021, NMFS established critical habitat for three of the endangered DPSs (86 FR 21082). The designation was based on prey within humpback whale feeding areas and the essential feature was defined as follows for each of the ESA-listed DPSs:

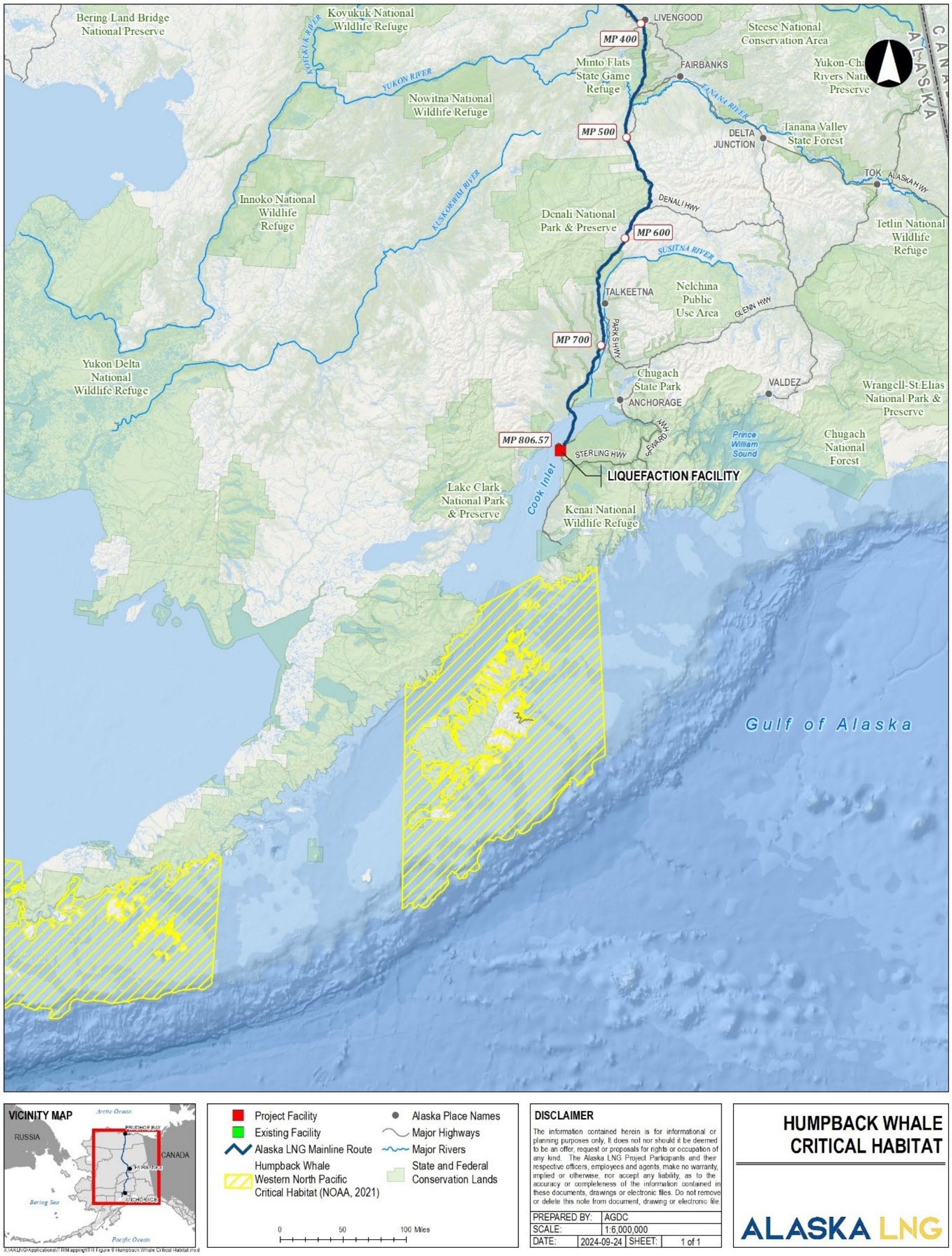
- <u>Western North Pacific DPS</u>*:* Prey species, primarily euphausiids (*Thysanoessa* and *Euphausia*) and small pelagic schooling fishes, such as Pacific herring (*Clupea pallasii*), capelin (*Mallotus villosus*), juvenile walleye pollock (*Gadus chalcogrammus*) and Pacific sand lance (*Ammodytes personatus*) of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.
- <u>Central America DPS</u>*:* Prey species, primarily euphausiids (*Thysanoessa, Euphausia, Nyctiphanes*, and *Nematoscelis*) and small pelagic schooling fishes, such as Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), and Pacific herring (*Clupea pallasii*), of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.
- <u>Mexico DPS</u>*:* Prey species, primarily euphausiids (*Thysanoessa, Euphausia, Nyctiphanes*, and *Nematoscelis*) and small pelagic schooling fishes, such as Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), Pacific herring (*Clupea pallasii*), capelin (*Mallotus villosus*), juvenile walleye pollock (*Gadus chalcogrammus*), and Pacific sand lance (*Ammodytes personatus*) of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.

Three DPSs of humpback whales are found in the waters off the coast of Alaska: the Western North Pacific DPS, which is listed as endangered; the Mexico DPS, which is listed as threatened; and the Hawaii DPS, which is not protected under the ESA. Whales from these three DPSs overlap to some extent on summer feeding grounds in the Gulf of Alaska.

The Western North Pacific DPS whales are found in the central Gulf of Alaska, particularly between Yakutat and the Alaska Peninsula, but they have low encounter rates (0.4 percent according to Wade, 2021). To conservatively protect this endangered DPS, the probability occurrence has been rounded to 1 percent (i.e., the estimates of abundance and probability of animals moving between winter/breeding and summer/feeding areas). This adjustment acknowledges both the presence of these whales in the Gulf of Alaska and the lack of precision in the recent population estimates revision by Wade (2021). It is also estimated that individual humpback whales in the Gulf of Alaska have an 11 percent probability of being members of the threatened Mexico DPS and an 89 percent probability of being members of the recovered Hawaii DPS.

Humpback whale use of Cook Inlet has been observed to be confined to lower Cook Inlet; the whales have been regularly seen near Kachemak Bay during the summer months (Rugh et al., 2005). There are anecdotal observations of humpback whales as far north as Anchor Point (which is well south of the planned Alaska LNG facilities, as shown on Figure 9), with recent summer observations extending to Cape Starichkof (Owl Ridge, 2014). There were two sightings of three humpback whales observed near Ladd Landing north of Tyonek during the Harvest Alaska Cook Inlet Pipeline project (Sitkiewicz et al., 2018). The Ladd Landing is south of the planned Mainline crossing offshore anchor corridor depicted in Figure 7. Humpback whales will move about their range and it is possible for a small number of humpback whales to be observed near the Marine Terminal construction area; however, they are unlikely to venture north into the proposed upper Cook Inlet pipeline crossings. No critical habitat was designated in or near the Project area or within middle/upper Cook Inlet, as depicted in Figure 9.

Figure 9: Critical Habitat for the Western North Pacific DPS of the Humpback Whale



4.2. Cook Inlet Beluga Whale

The Cook Inlet beluga whale population, which resides year-round in Cook Inlet, is the smallest and most geographically isolated from other beluga populations by the Alaska Peninsula. Studies have confirmed that these whales are genetically distinct from other groups in Alaska, suggesting that the Peninsula acts as a barrier to interbreeding (O'Corry-Crowe et al., 1997; Goetz et al., 2012; Young et al., 2023). The number of belugas in Cook Inlet has declined significantly from an estimated 1,300 individuals in the 1970s (Calkins, 1989) to a current estimate of 331 whales (Goetz et al., 2023). This decline, particularly noted in the mid-1990s, has been attributed to unregulated subsistence hunting (Mahoney and Shelden, 2000). Although, there has been no subsistence harvesting of Cook Inlet belugas since 2006 (Muto et al., 2021), the beluga population has continued to slowly decline in Cook Inlet.

In 2000, NMFS listed the population stock as depleted and as endangered under ESA in 2008 (65 FR 34590), and finalized the Conservation Plan for the Cook Inlet beluga in the same year (NMFS, 2008). On April 11, 2011, NMFS designated critical habitat (76 FR 20180) for Cook Inlet beluga whales that includes two areas (Area 1 and Area 2) and encompasses 7,800 square kilometers (km^2) or 3,012 square miles (mi^2) of marine and estuarine habitat in Cook Inlet (Figure 10).

- *Critical Habitat Area 1 (CHA-1):* consists of 1,909 km^2 (737 mi^2) of Cook Inlet, north of Three Mile Creek and Point Possession and includes nearshore areas with shallow tidal-mud-flats flats and mouths of rivers that provide important areas for foraging, calving, molting, and escape from predators. High concentrations of Cook Inlet beluga whales are often observed in these areas from spring through fall.
- *Critical Habitat Area 2 (CHA-2):* consists of 5,891 km^2 (2,275 mi^2) located south of CHA-1 and includes nearshore areas along western Cook Inlet and Kachemak Bay. CHA-2 is known fall and winter foraging and transit habitat for Cook Inlet beluga whales, as well as spring and summer habitat for smaller concentrations of beluga whales. Project activities would likely occur primarily in CHA-2.

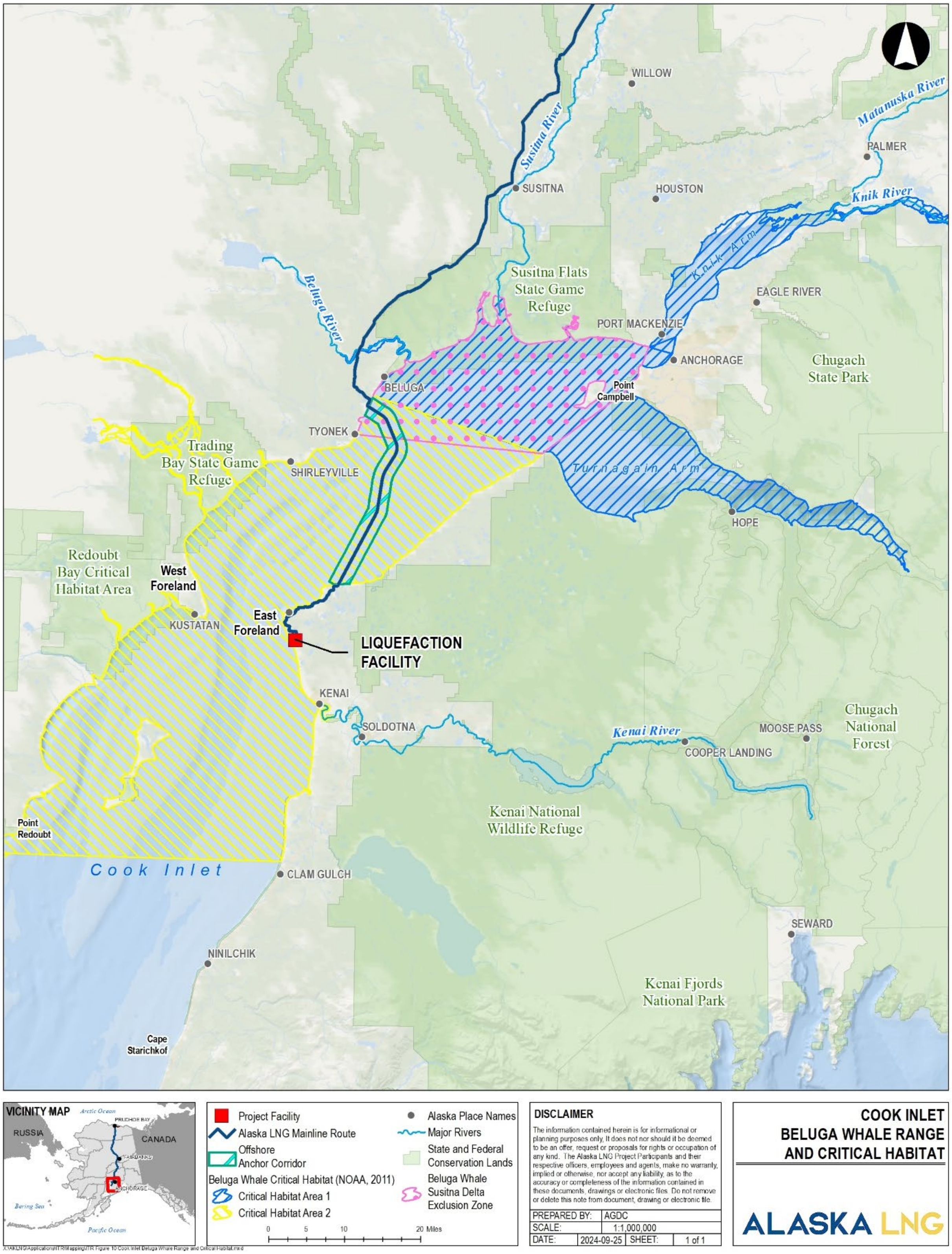
NMFS finalized the Cook Inlet Beluga Whale Recovery Plan in December 2016 (NMFS, 2016a).

Belugas can be found throughout Cook Inlet year-round, but they generally spend the ice-free months in upper Cook Inlet and expand their distribution southward and into more offshore waters of upper Cook Inlet during winter. These seasonal movements seem to be influenced by changes in the physical environment, such as sea ice and currents, and shifts in prey resources (NMFS, 2016a). Year-round, belugas primarily inhabit the coastal areas of Knik Arm, Turnagain Arm, Susitna Delta, Chickaloon Bay, and Trading Bay (Goetz et al., 2012). During the open-water months in upper Cook Inlet (north of the Forelands), beluga whales are typically concentrated near river mouths (Rugh et al., 2010). The winter distribution of this stock is not well known; however, some evidence suggests that certain whales may inhabit upper Cook Inlet year-round (Hansen and Hubbard, 1999; Rugh et al., 2004; Hobbs et al., 2005). Satellite tags from 10 whales tagged between 2000 and 2002 transmitted through the fall, with three tags on adult males transmitting through April and late May. None of the tagged belugas moved south of Chinitna Bay on the western side of Cook Inlet. A review of marine mammal surveys conducted in the Gulf of Alaska from 1936 to 2000 found only 31 beluga sightings among 23,000 marine mammal sightings, indicating that very few belugas occur in the Gulf of Alaska outside of Cook Inlet (Laidre et al., 2000 cited in Allen and Angliss, 2014).

Based on these studies, it is anticipated that beluga whales are most likely to occur near the Marine Terminal in moderate densities during the period when sea ice is typically present in Cook Inlet north of the Forelands (December through May; Goetz et al., 2012). Few belugas may occur near the Marine Terminal during the ice-free period (June through November). Belugas are not expected to focus their foraging efforts near the proposed Marine Terminal location. If belugas do forage near the Marine Terminal, their foraging dives are more likely to be long and deep during the sea-ice season (December through May; Goetz et al., 2012).

Beluga whales could be found near the Mainline crossing during summer and fall, and near the Marine Terminal construction area during winter. Previous marine mammal surveys conducted between the Beluga River and the West Forelands (Nemeth et al., 2007; Brueggeman et al., 2007a, 2007b; Lomac-MacNair et al., 2013, 2014; Kendall et al., 2015) suggest that beluga whale numbers near the proposed MOF on the west side of Cook Inlet and the pipeline landing peak in May and again in October, with few whales observed in the intervening months. Beluga whales may occur along the portion of the Mainline route within upper Cook Inlet year-round, but as previously discussed, beluga distribution is concentrated in shallow coastal waters near Knik Arm, Chickaloon Bay, and Trading Bay during the ice-free season (June through November), and in deeper waters of the Susitna Delta, offshore between East and West Forelands, and around Fire Island during the sea-ice season (December through May) (Goetz et al., 2012). Belugas may remain near the Mainline route during the winter (December through May).

Figure 10: Cook Inlet Beluga Whale Range and Critical Habitat



4.3. Killer Whale

Killer whales are widely distributed, although they occur in higher densities in colder and more productive waters (Allen and Angliss, 2015). Two different stocks of killer whales inhabit the Cook Inlet region: the Alaska Resident Stock and the Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock (Allen and Angliss, 2015).

Killer whales are occasionally observed in lower Cook Inlet, especially near Homer and Port Graham (Shelden et al., 2003, 2022; Rugh et al., 2005). A concentration of sightings near Homer and inside Kachemak Bay may represent high use, or high observer-effort given most records are from a whale-watching venture based in Homer. The few whales that have been photographically identified in lower Cook Inlet belong to resident groups more commonly found in nearby Kenai Fjords and Prince William Sound (Shelden et al., 2003). Prior to the 1980s, killer whale sightings in upper Cook Inlet were very rare (Rugh et al., 2005). During aerial surveys conducted between 1993 and 2004, killer whales were observed on only three flights, all in the Kachemak and English Bay area (Rugh et al., 2005). However, anecdotal reports of killer whales feeding on belugas in upper Cook Inlet began increasing in the 1990s, possibly in response to declines in sea lions and harbor seals elsewhere (Shelden et al., 2003). Observations of killer whales in beluga summering grounds have been implicated as a possible contributor to decline of Cook Inlet belugas in the 1990s, although the number of confirmed mortalities from killer whales is small (Shelden et al., 2003). Recent industry monitoring programs only reported a few killer whale sightings (Kendall et al., 2015). The sporadic movements and small numbers of this species suggest that there is a rare possibility of encountering this whale during Marine Terminal construction and Mainline pipelay. Vessels associated with the Project could encounter killer whales during transit through lower Cook Inlet.

4.4. Harbor Porpoise

The Gulf of Alaska harbor porpoise stock is distributed from Cape Suckling to Unimak Pass (Allen and Angliss, 2015). They are found primarily in coastal waters less than 328 feet (10 meters) deep (Hobbs and Waite, 2010) where they feed on Pacific herring (*Clupea pallasii*), other schooling fishes, and cephalopods.

Although harbor porpoises have been frequently observed during aerial surveys in Cook Inlet, most sightings are of single animals, and the sightings have been concentrated nearshore between Iliamna and Tuxedni bays on the lower west side of lower Cook Inlet (Rugh et al., 2005; Shelden et al., 2013). No harbor porpoises were recorded near Nikiski during NMFS aerial surveys conducted between 1993 and 2012 (Shelden et al., 2013). Dahlheim et al., (2000) estimated the 1991 Cook Inlet-wide population at 136 animals. However, they are one of the three marine mammals (besides belugas and harbor seals) regularly seen in upper Cook Inlet (Nemeth et al., 2007), especially during spring eulachon and summer salmon runs. Brueggeman et al. (2007a, b) also reported small numbers of harbor porpoise between Granite Point and the Beluga River. Industry monitoring programs in lower and middle Cook Inlet reported harbor porpoise sightings in all summer months (Lomac-MacNair et al., 2013, 2014; Kendall et al., 2015). Because harbor porpoise have been observed throughout Cook Inlet during the summer months, they represent a species that could be encountered during all phases and locations of construction.

4.5. Harbor Seal

Harbor seals inhabit coastal and estuarine waters along the West Coast, including southeast Alaska west through the Gulf of Alaska and Aleutian Islands, in the Bering Sea and Pribilof Islands (Allen and Angliss, 2015). At more than 150,000 animals state-wide, harbor seals are one of the more common marine mammal species in Alaskan waters (Allen and Angliss, 2015). Harbor seals haul out on rocks, reefs, beaches, and drifting glacial ice (Allen and Angliss, 2015).

Large numbers of harbor seals concentrate at the river mouths and embayments of lower Cook Inlet, including the Fox River mouth in Kachemak Bay (Rugh et al., 2005). Montgomery et al. (2007) recorded over 200 haul-out sites in lower Cook Inlet alone. However, only a few hundred seals seasonally occur in upper Cook Inlet (Rugh et al., 2005; Shelden et al., 2013), mostly at the mouth of the Susitna River where their numbers vary in concert with the spring eulachon and summer salmon runs (Nemeth et al., 2007; Boveng et al., 2012). In 2012, up to 83 harbor seals were observed hauled out at the mouths of the Theodore and Lewis rivers during April to May monitoring activity associated with a Cook Inlet seismic program (Brueggeman, 2007a). Montgomery et al. (2007) also found seals elsewhere in Cook Inlet to move in response to local steelhead (*Onchorhynchus mykiss*) and salmon runs. Industry monitoring programs in lower and middle Cook Inlet reported harbor seal sightings in all summer months, both in-water and on haul-outs (Lomac-MacNair et al., 2013, 2014; Kendall et al., 2015). During summer, small numbers of harbor seals are expected to occur near both the Marine Terminal construction area near Nikiski, and along the proposed Mainline pipeline crossing route.

5. REQUESTED TYPE OF INCIDENTAL TAKING AUTHORIZATION

The type of incidental taking authorization that is being requested and the method of incidental taking.

The Applicant requests ITRs from NMFS for the incidental take by harassment (Level A and Level B as defined in 50 CFR 216.3) of a small number of marine mammals during its planned construction activities during ice-free conditions (April - October) Seasons 1-5 as identified in Table 12. Planned activities outlined in Sections 1 and 2 of this petition have the potential to result in a small number of takes by harassment of marine mammals by acoustic disturbance during construction operations. The effects would depend on the species and the distance and received level of the sound as detailed in Section 7. Temporary disturbance or localized displacement reactions may occur as a result of sound exposure to marine mammals inhabiting Cook Inlet.

In addition, while the Applicant does not believe the construction activities would result in a serious injury or mortality of any marine mammals, it is requesting Level A takes for humpback whales, harbor porpoises, and harbor seals over the 5-year period based on analyses of the potential acoustic harassment. This request is a precautionary measure. Implementation of the mitigation and monitoring measures described in Sections 11 and 13 are expected to minimize potential take.

6. TAKE ESTIMATES FOR MARINE MAMMALS

By age, sex, and reproductive condition, the number of marine mammals [by species] that may be taken by each type of taking, and the number of times such takings by each type of taking are likely to occur.

6.1. Applicable Sound Criteria

Under the MMPA, NMFS categorizes harassment of marine mammals into two levels. Level A harassment involves actions that could potentially injure marine mammals or their populations in the wild. This includes any act of pursuit, torment, or annoyance. Level B harassment encompasses activities that may disrupt the behavioral patterns of marine mammals, such as migration, breathing, nursing, breeding, feeding, or finding shelter, without necessarily causing physical harm.

The impact of underwater noise on marine mammals varies depending on each species' ability to perceive sound. Sound frequency is a critical factor in determining audibility. Generally, frequency bands (expressed in hertz [Hz] or kHz) are categorized into three groups:

- *Low-frequency (10 to 500 Hz):* These sounds are primarily from human activities, such as seismic surveys.
- *Mid-frequency (500 Hz to 25 kHz):* This range includes both natural and human-made sounds, like sonar and small boats, which do not travel long distances.
- *High-frequency (above 25 kHz):* Dominated by natural thermal noise and some human-made sounds, such as echo sounding in shallow waters. High-frequency sounds experience significant attenuation, limiting their range to a few kilometers (km) from the source.

The *2024 Update To: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 3.0),* underwater criteria for onset of auditory injury (AUD INJ) or temporary threshold shift (TTS) and adoption of marine mammal hearing group terminology from Southall et al. 2019 are presented in Table 14. It employs a dual metric approach to determine permanent threshold shift (PTS) for impulsive sounds, considering both cumulative sound exposure and peak sound levels. For non-impulsive sounds, the cumulative sound exposure level (SEL) is used unless the peak level threshold for impulsive sounds is surpassed. Table 14 provides specific thresholds and auditory weighting functions for five different marine mammal groups (based on hearing sensitivity) as a result of exposure to sound from impulsive and non-impulsive sources.

6.1.1. Threshold Criteria for Level A Harassment

For Level A harassment, the NOAA Technical Memorandum NMFS- OPR-7171 (NMFS2024a) provides guidelines for assessing the onset of PTS from anthropogenic sound. Under these guidelines, marine mammals are separated into five functional hearing groups (Table 14) with sound source types separated into impulsive (impact pile driving) and non-impulsive (vibratory pile driving); and analyses of the distance to the peak received sound pressure level (SPL) (L_{pk}) and 24-hour cumulative sound exposure level (SEL_{24h}) are required.

6.1.2. Threshold Criteria for Level B Harassment

NMFS (2018, 2024a) forecasted that marine mammals may experience behavioral disruption, classified as Level B harassment, upon exposure to underwater noise exceeding a root-mean-square (RMS) received level of 120 dB re 1 µPa from continuous sources like vibratory pile driving or drilling. Non-explosive, impulsive or intermittent noises such as those from seismic airguns, impact pile driving, or scientific sonar, if above 160 dB re 1 µPa, are likely to cause similar disturbances.

Table 14: Marine Mammal Injury and Disturbance Thresholds for Underwater Sound

Marine Mammals Hearing Groups & Generalized Hearing Range[1]	Level A Harassment[2]		Level B Harassment[3]	
	Impulsive Sound	Non-Impulsive Sound	Impulsive Sound	Non-Impulsive Sound
Low-Frequency (LF) Cetaceans 7 Hz to 36 kHz	PK SPL 222 dB SEL_{24h} 183 dB	SEL_{24h} 197 dB	160 dB RMS	120 dB RMS
High-Frequency (HF) Cetaceans 150 Hz to 160 kHz	PK SPL 230 dB SEL_{24h} 193 dB	SEL_{24h} 201 dB	160 dB RMS	120 dB RMS
Very High-Frequency (VHF) Cetaceans 200 Hz to 165 kHz	PK SPL 202 dB SEL_{24h} 159 dB	SEL_{24h} 181 dB	160 dB RMS	120 dB RMS
Phocid Pinnipeds (PW) 40 Hz to 90 kHz	PK SPL 223 dB SEL_{24h} 183 dB	SEL_{24h} 195 dB	160 dB RMS	120 dB RMS
Otariid Pinnipeds (OW) 60 Hz to 68 kHz	PK SPL 232 dB SEL_{24h} 203 dB	SEL_{24h} 199 dB	160 dB RMS	120 dB RMS

[1] Adoption of marine mammal hearing group terminology as defined by Southall et al. 2019.
[2] NMFS (2024a) Level A thresholds indicating the onset of AUD INJ; peak sound pressure level = PK SPL; Decibel = dB; cumulative sound exposure level over 24-hours = SEL_{24h}.
[3] NMFS (2024a) Level B thresholds indicating the onset of temporary threshold shift (TTS); root-mean-square sound pressure level = RMS SPL.

NMFS has also established an airborne disturbance threshold of 90 dB re 20 µPa (un-weighted) for harbor seals. The nearest documented harbor seal haul-out to the Marine Terminal construction site is near the mouth of the Kenai River, approximately 20 miles south of the proposed Marine Terminal where the pile driving would take place (Montgomery et al., 2007). Because none of the pinniped haulouts in Cook Inlet occur within the areas that the proposed construction activities ensonify to levels exceeding 90 dB, there is no potential for Level B harassment of hauled out pinnipeds. Airborne sound is not assessed further in this document.

6.2. Description of Underwater Sound Sources

The description of the specified activity is provided in Section 1 of this ITR petition. The following sections detail the sound associated with those specified activities, along with the acoustic modeling that covers threshold distances, ensonification areas, duration, and distance for the overall take analysis and exposure estimates.

6.2.1. *Dredging and Trenching*

Other underwater sound sources expected during Project construction include sound associated with dredging and trenching. These sound sources are considered non-impulsive sounds and exceed the 120 dB RMS disturbance threshold at the source, but are not considered to result in Level B harassments by NMFS. Measured sound levels for these activities diminish to less than 120 dB RMS within approximately 200 meters (219 yards) (Table 15). URS (2007) measured underwater sound levels between 136 and 141 dB re 1 µPa rms at 12 to 19 meters (13 to 21 yards) associated with U.S. Army Corps of Engineers (USACE) dredging activities at the Port of Alaska (formerly Port of Anchorage). Dredging is, therefore, not considered further in this document with regard to calculation of marine mammal exposure estimates.

Table 15: Representative Underwater Sound Levels from Other Proposed Activities

Activity	Sources	SPL Documented	Source Level Ref. to 11 yd.	Distance to Threshold	Source
Dredging	Clamshell dredge of mixed coarse sand/gravel	113 dB @ 179.4 yd	136.5 dB	68 m (74.4 yd)	Dickerson et al. (2001)
	Clamshell dredge in soft sediments	107 dB @ 11 yd	107 dB	3 m (3.3 yd)	Dickerson et al. (2001)
	Winching in/out	117 dB @ 164 yd	140.5 dB	107 m (117 yd)	Dickerson et al. (2001)
	Dumping into barge	109 dB @ 164 yd	132.5 dB	43 m (47 yd)	Dickerson et al. (2001)
	Empty barge at placement site	109 dB @ 345.6 yd	139 dB	135 m (98.4 yd)	Dickerson et al. (2001)
	Clamshell dredge at the POA	141 dB @ 13.1 yd	142.6 dB	178 m (194.7 yd)	URS (2007)
Underwater trenching	With backhoe in shallow water	125 dB @ 109 yd	145 dB	178 m (194.7 yd)	Greene et al. (2007)

6.2.2. *Impact Pile Driving*

Consistent with the NMFS 2024 updated guidance, the Optional Multi-Species Pile Driving Calculator (NMFS calculator) was used to calculate exposure thresholds. The previous application indicated linear feet of typical AZ sheet piles. To calculate thresholds using the NMFS spreadsheet, the number of piles and sheet piles were identified and are provided in Table 23. The estimated number of piles driven per day was based the number of workings days / the number of piles or sheets. In addition, Table 23 provides total hours of in-water work and total working day rounded to the nearest whole number. A summary of parameter inputs for impact and vibratory isopleths is provided in Table 18.

NMFS (2024b) summarized Caltrans (2015; 2020) *Compendium of Pile Driving Sound Data*, providing a summary of measured underwater proxy sound levels for a variety of pile driving situations, included in the NMFS calculator. As described in Section 1, the pile sizes for this Project include 24-, 48-, 60-, and 66-

inch pipe and sheet piles. The NMFS calculator implements the practical spreading value of 15 model to estimate areas of potential impact for the peak, SEL and RMS distances from the pile driving action. Those source levels are shown in Table 16, model parameters are summarized in Table 18, and the resultant isopleths using the NMFS calculator are depicted in Table 19.

Table 16: Near-Source Sound Pressure Levels From Impact Pile Driving

Representative Pile Type and Approximate Size[1]	Water Depth	Average Sound Pressure Level (dB)[2]			Project Pile
		Peak	SEL	RMS	
24-inch AZ sheet pile	15 m (49 ft)	205	180	190	Sheet pile
24-inch steel pipe pile	5 m (16 ft)	203	177	190	24-inch piles
48-inch steel pipe pile	NA	213	179	192	48-inch piles
60-inch cast-in-shell steel (CISS) pile	5 m (16 ft)	210	185	195	60-inch piles

[1] NMFS 2024b proxy sound levels from Caltrans 2015, 2020
[2] Source level distance is approximately 10 meters (33 feet)

6.2.3. *Vibratory Pile Driving*

Vibratory pile drivers use a system of counter-rotating eccentric weights to transmit vertical vibrations into the pile. These vibrations "liquefy" the contacted sediments, allowing easy gravitational sinking into the sediment bed, facilitated by the heavy-weighted hammer.

Proxy sound sources for vibratory pile driving were selected from the compiled sound sources provided by the NMFS calculator. As described in Section 1, the pile sizes for this Project include 24-, 48-, and 66-inch piles plus sheet piles. Selected proxy sources from Caltrans (2015; 2020) listed in Table 17 were used for vibratory piling driving of the 24-inch bearing pile, 66-inch steel shell (king pile), and the 24-inch AZ steel. Those sources are summarized in Table 18 and modeled results are provided in Table 19.

Table 17: Near-Source Sound Pressure Levels from Vibratory Pile Driving

Representative Pile Type and Approximate Size[1]	Water Depth	Average Sound Pressure Level (dB)[2]			Project Pile
		Peak	SEL	RMS	
24-inch AZ sheet pile	15 m (49 ft)	175	160	160	Sheet pile
24-inch steel pile	3 m (10 ft)	196	159	159	Bearing pile
66-inch steel shell pile	8-11 m (26-36 ft)	206	170	162	King pile

[1] NMFS 2024b proxy sound levels from Caltrans 2015, 2020
[2] Source level distance is approximately 10 meters (33 feet)

6.2.4. Vessel Sounds Associated with Construction Activities

Some vessels such as tugs and cargo ships can under some circumstances generate underwater sound exceeding the non-impulsive threshold of 120 dB due largely to the continuous cavitation sound produced from the propeller arrangement of both drive propellers and thrusters. Underwater sound levels associated with offshore pipelay operations include general sounds from the pipelay vessel such as those associated with winching of anchor cables, and thruster sound from the AHTs during anchor pulling. Large ships produce broadband SPLs of about 180 dB re 1 µPa rms at 1 m (Richardson et al., 1995; Blackwell and Greene, 2003). However, because these sound levels are transient (the vessel is moving), NMFS does not consider transiting vessel sound to rise to the level of “take” (S. Guan, NMFS, pers. comm.). Thus, there is no requirement to quantify threshold-level sound exposures of marine mammals from vessels in an MMPA assessment.

Thrusters have generally smaller blade arrangements operating at higher rotations per minute and, therefore, largely produce more cavitation sound than drive propellers. For example, Blackwell and Greene (2003) measured a tug pushing a full barge near the Port of Alaska and recorded SPLs equating to 163.8 dB re 1 µPa rms at 1 meter. The sound emanating from the same tug increased dramatically to 178.9 dB re 1 µPa rms at 1 meter (based on a measured 149 dB re 1 µPa rms at 100 meters/ 328 feet) when the tug was using its thrusters to maneuver the barge during docking.

The Project intends to use similar tug and pipelay vessels to handle anchors, so the source level of 178.9 dB re 1 µPa rms at 1 meter was used to assess Level B exposures estimates in Table 19. Modeled source levels and frequencies were used from Hannay et al. (2004) and Blackwell and Greene (2003).

6.2.5. Underwater Sound Propagation

Transmission Loss (TL) is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, and bottom composition and topography. The general formula for underwater TL is:

***TL* = B * Log10 (R1 /R2),**

Where:

TL = transmission loss in dB

B = transmission loss coefficient

R1 = the distance of the modeled SPL from the driven pile, and

R2 = the distance from the driven pile of the initial measurement

This formula neglects loss due to scattering and absorption, which is assumed to be zero here. The degree to which underwater sound propagates away from a sound source is dependent on a variety of factors, most notably the water bathymetry and presence or absence of reflective or absorptive conditions including in-water structures and sediments. Spherical spreading occurs in a perfectly unobstructed (free-field) environment not limited by depth or water surface, resulting in a 6-dB reduction in sound level for each doubling of distance from the source (20*log[range]). Cylindrical spreading occurs in an environment in which sound propagation is bounded by the water surface and sea bottom, resulting in a reduction of 3 dB in sound level for each doubling of distance from the source (10*log[range]). A practical spreading value of 15 is often used under conditions, such as the project site, where water increases with depth as the receiver moves away from the shoreline, resulting in an expected propagation environment that would lie between spherical and cylindrical spreading loss conditions. For coastal activities, such as pile driving, if area-specific information on propagation/transmission loss is not available, NMFS typically recommends practical spreading (TL=15 log R2/R1).

6.2.6. Estimating Potential Marine Mammal Exposures

The current application uses NMFS updated guidance along with output from the NMFS calculator to estimate potential marine mammal exposure from pile driving activities. For Mainline pipelay across Cook Inlet, the acoustic model developed for the previous application was retained. It estimated underwater sound at the 120 dB rms SPL Level B threshold to predict the zones of sound exposure exceeding the Level A thresholds using a frequency and range dependent model to refine predictions of noise propagation in Cook Inlet.

Using the acoustic ranges for the Level A and B harassment thresholds, the ensonified area around each construction site was determined with the following formula:

Ensonified Area = Pi x $\boldsymbol{r^2}$

Where $\boldsymbol{r^2}$ is the calculated the isopleth to the Level A and B harassment thresholds.

The exposures were calculated using the following static formula:

Exposures = area ensonified × (days) × density

Where the area ensonified is equal to ***Pi ×*** $\boldsymbol{r^2}$, where ***r*** is equal to the Level A or B harassment isopleth distance, ***days*** constituted the total number of days needed for marine activities in Table 23 and densities (Tables 25 and 26) were incorporated as species-specific during the construction activities.

6.2.7. Level A Ensonification Area

Parameters and assumptions used as inputs to the NMFS calculator are described below.

- Vibratory Pile Driving:
    - Actual pile driving occurs during 40 percent of a 12-hour day (4.8 hours).
    - In general, a penetration speed of 20-inch (50 cm) per minute is considered as lower limit for vibratory piling when constructing coffer and combi installations.
    - Depending on soil conditions and profile type, installation (>28 m) and heavy piling, it should be possible to install at least 3-4 king piles per day.
    - Estimated production rate for two crews:
        - 7 king piles per day; 30 sheet piles (see Table 18).

- Impact Pile Driving:
  - Actual pile driving occurs during 25 percent of a 12-hour day (3 hours).
  - In general, a penetration rate of 11 blows per foot (300 mm) is a typical considered for impact piling.
  - Estimated production rate:
    - +/-1,000 strikes per pile; depending on drilling depth.
- Anchor Handling:
  - Actual anchor handling occurs during 25 percent of 24-hour day (6 hours).
  - Vessel speed of 1.54 meters per second or 3 knots.

The calculated distances to the thresholds and areas of ensonification for pile driving are summarized in Table 19 and for anchor handling are summarized in Table 20. In practice, the distances to the Level A thresholds are controlled by the cumulative SEL_{24hr}, so the distances to the Level A peak thresholds were not modeled.

For the low-frequency cetaceans (humpback whale), the predicted distances to the Level A SELs range from 30 meters for the vibratory driving of sheet piles at the temporary MOF to 1,120 meters for the impact pile diving of 48-inch pipe piles at the temporary MOF. For the high-frequency cetaceans (beluga and killer whales), the predicted distances to the Level SELs range from 0 to 773 meters for the impact driving of sheet piles at the Mainline (ML) MOF. For the high-frequency cetaceans (harbor porpoise), the predicted distances to the Level A SEL ranges from 0 to 1,733 meters at for 48-inch impact pile driving and 0 to 5,274 meters for 60-inch CISS piles at the PLF. For phocids (harbor seals), the predicted distances to the Level A SEL ranges from 0 to 995 meters for impact pile driving of 48-inch pipe, and 0 to 3,028 meters 60-inch CISS piles at the PLF. As identified in the previous ITR, the Applicant will perform an SSV study at the beginning of the pile driving to characterize the sound levels associated with different pile and hammer types, as well as to establish the marine mammal monitoring and mitigation zones.

Table 18: Summary of NMFS User Spreadsheet Input Parameters

Pile Size / Material / Eq. Type	Peak (dB)	SEL (dB)	RMS (dB)	Water Depth / Distance from Pile	Proxy Sound Source[1]	Number of Piles / Sheets per day (24-hour)[2]	Typical Strike per Pile / Minutes per Pile [2]	Transmission Loss Constant[2]
Parameters for Impact Pile Driving								
24-inch AZ sheet pile	205	180	190	15 m / 10 m	Caltrans 2015	30	1,000	15
24-inch steel pipe pile[2]	203	177	190	5 m / 10 m	Caltrans 2015	4	1,000	15
48-inch steel pipe pile [2]	213	179	192	NA / 10 m	Caltrans 2020	3	1,000	15
60-inch CISS steel pile	210	185	195	5 m / 10 m	Caltrans 2015	4	1,000	15
Parameters for Vibratory Pile Driving								
24-inch AZ sheet pile	175	160	160	15 m / 10 m	Caltrans 2015	30	15 min	15
24-inch steel pile	196	159	159	3 m / 10 m	Caltrans 2020	8	15 min	15
66-inch steel shell pile	206	170	162	8-11 m / 10 m	Caltrans 2020	7	15 min	15

[1] NMFS.2024b. Sound source proxy levels for impact pile driving, generic examples, Multi-Species Pile Driving Calculator tool. https://www.fisheries.noaa.gov/s3/2025-02/BLANK-Multi-Species-OCT-2024f-public-508-OPR1.xlsx

[2] NMFS Comments on updated proxy sound sources for 24-inch and 48-inch piling, number of piles installed within a 24-hour period. Estimated number of strikes per pile and number of minutes per pile, and transmission loss coefficient used.

Table 19: Calculated Distances to NMFS Level A Thresholds and Ensonified Area

Activity / Method	LF Cetacean		HF Cetacean		VHF Cetacean		PW Pinniped	
	Isopleth (m)	AOE (km^2)	Isopleth (m)	AOE (km^2)	Isopleth (m)	AOE (km^2)	Isopleth (m)	AOE (km^2)
Impact Pile Driving								
ML MOF Wall; MOF Combi Wall; Coffer Cell - 24-inch AZ Sheet Pile	6,061	115	773	2	9,380	276	5,385	91
MOF RoRo Quads -24-inch Steel Pipe	998	3	127	0.051	1,545	7	887	2
MOF RoRo Quads; PLF - 48-inch Steel Pipe	1,120	4	143	0.064	1,733	9	995	3
PLF - 60-inch CISS Pile	3,408	36	435	0.594	5,274	87	3,028	29
Vibratory Pile Driving								
ML MOF Wall; MOF Combi Wall; Coffer Cell - 24-inch AZ Sheet Pile	30	0.003	12	0.0004	25	0.002	39.0	0.005
MOF Coffer Cell Template - 24-inch Bearing Pile	11	0.000	4	0.0001	9	0.000	13.9	0.001
MOF Combi Wall - 66-inch Steel Shell Pile	16	0.001	6	0.0001	13	0.001	20.1	0.001

Notes:
AOE = Area of Ensonification

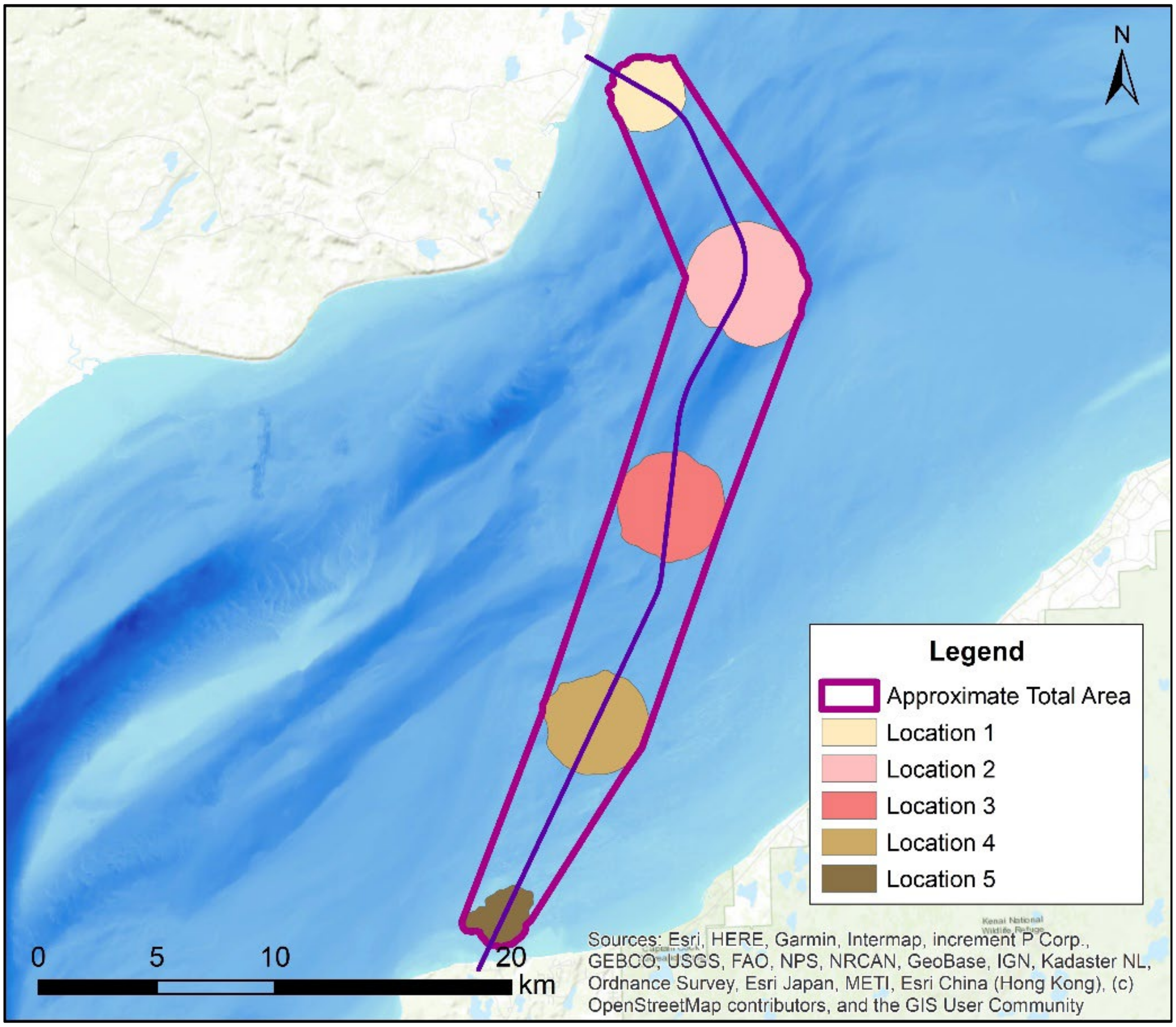
6.2.8. Level B Ensonification Area

The calculated distances to the Level B thresholds for pile driving and anchor handling are summarized in Table 20. The calculated distances to the appropriate thresholds for all marine mammals range from 1,000 meters to 2,154 meters (3.14 to 14.58 km^2) for impact pile driving of all sizes of piles, between 3,981 meters and 6,310 meters (50 to 125 km^2) for vibratory pile driving, and between 1,896 to 2,855 meters (8.2 to 20.7 km^2) for anchor handling.

Table 20: Calculated Distances to NOAA Fisheries NMFS Level B Thresholds and Ensonified Areas

Activity / Method	RMS Isopleth (m)	Ensonified Area (km^2)
Impact Pile Driving		
ML MOF Wall; MOF Combi Wall; MOF Coffer Cell; MOF Walls - 24-inch AZ Sheet Pile	1,000	3.14
MOF RoRo Quads -24-inch Steel Pipe	1,000	3.14
MOF RoRo Quads; PLF - 48-inch Steel Pipe	1,359	5.81
PLF - 60-inch CISS Pile	2,154	14.58
Vibratory Pile Driving		
ML MOF Wall; MOF Combi Wall; Coffer Cell - 24-inch AZ Sheet Pile	4,642	67.68
MOF Coffer Cell Template - 24-inch Bearing Pile	3,981	49.79
MOF Combi Wall - 66-inch Steel Shell Pile	6,310	125.07
Anchor Handling		
Anchor Handling Location 1	1,896	8.17
Anchor Handling Location 2	2,855	20.67
Anchor Handling Location 3	2,446	16.50
Anchor Handling Location 4	2,349	15.16
Anchor Handling Location 5	2,195	5.01

Figure 11: Predicted Level B Contours for Anchor Handling.



6.2.9. Duration of Sound per Activity

Estimated durations in total number of days estimated per season, per facility, and by pile type and size are provided in Table 21. The total number of structures (bents or quadropods) and needed days for driving the piles are based on an assumed period of April through October, a 12-hour workday, 25 percent of actual driving for impact pile driving, and 40 percent of actual driving for vibratory pile driving.

Table 21: Calculation of Duration of Pile Driving in Total Days for Each Facility and Season

Season	Structural Element	Pile Type	Hammer	Months	Number of Piles / Sheets	Piles / Sheets per Day[1]	Hours Pile Driving (In-Water)[2]	Number of Days[3]
Temporary Material Offloading Facility (Nikiski)								
1	MOF combi wall	66-inch pile	vibratory	July	70	7	52	11
1	MOF combi wall	AZ sheet pile	vibratory	July	144	13	52	11
1	MOF coffer cell	AZ sheet pile	vibratory	July–October	1,496	30	240	50
1	MOF coffer cell	24-inch pile[4]	vibratory	July–October	48	8	29	6
				Subtotal Season 1	***1,758***	***58***	***372***	***78***
2	MOF coffer cell	AZ sheet pile	vibratory	April–June	1,491	30	235	49
2	MOF coffer cell	24-inch pile	vibratory	April–June	24	8	24	5
2	MOF RoRo Dolphin Quads	48-inch pile	impact	April–June	28	4	21	7
2	MOF RoRo Dolphin Quads	24-inch pile[4]	impact	April–June	7	1	21	7
				Subtotal Season 2	***1,566***	***43***	***301***	***68***
Mainline Material Offloading Facility (Beluga)								
2	MOF wall	AZ sheet pile	vibratory	April–May	146	21	34	7
2	MOF wall	AZ sheet pile	impact	April–May	146	21	21	7
				Subtotal Season 2	***292***	***42***	***55***	***14***
Product Loading Facility (Nikiski)								
3	E-W Access Trestle	60-inch pile	impact	April–June	33	2	66	22
3	E-W Access Trestle	60-inch pile	impact	June–August	40	2	60	20
3	Berth 1	48-inch pile	impact	April–May	20	3	24	8
3	Berth 2	48-inch pile	impact	April–May	20	3	24	8
3	N-S Access Trestle	48-inch pile	impact	May–June	40	3	48	16

Season	Structural Element	Pile Type	Hammer	Months	Number of Piles / Sheets	Piles / Sheets per Day[1]	Hours Pile Driving (In-Water)[2]	Number of Days[3]
				Subtotal Season 3	***153***	***11***	***222***	***74***
4	E-W Access Trestle	60-inch pile	impact	April–May	28	2	42	14
4	Operations Platform	60-inch pile	impact	May–June	12	2	18	6
4	Breasting Dolphin Berth 1 & 2	48-inch pile	impact	April–May	8	2	12	4
4	Breasting Dolphin Berth 1 & 2	60-inch pile	impact	April–May	32	3	36	12
4	Mooring Dolphin	48-inch pile	impact	May	2	1	6	2
4	Mooring Dolphin	60-inch pile	impact	May	8	4	6	2
4	N-S Access Trestle	48-inch pile	impact	April–May	30	3	36	12
				Subtotal Season 4	***120***	***16***	***156***	***52***
5	Mooring Dolphin	48-inch pile	impact	April–June	10	2	18	6
5	Mooring Dolphin	60-inch pile	impact	April–June	40	3	42	14
5	Catwalk	60-inch pile	impact	April–May	8	1	48	16
				Subtotal Season 5	***58***	***5***	***108***	***36***
				Total All 5 Seasons	**3,949**	**177**	**1,214**	**322**

[1] Number of piles and sheets installed in a 24-hour period.
[2] In-water pile driving cumulative hours is based on 3-hours per day for impact and 4.8-hours a day for vibratory.
[3] Number of days, rounded up to the nearest whole number.
[4] These are temporary bearing piles for the coffer cell template(s), includes installation and removal.

The total duration per season of anchor handling was calculated differently for the two seasons. In Season 3 the duration was calculated by assuming actual anchor handing would occur 25 percent of each day that anchor handling is ongoing. In Season 4 anchor handling duration was estimated by calculating the likely number of times individual anchors would be reset (based on resetting 12 anchors once per day and a lay rate of 2,500 feet per day) and assuming it takes 15 minutes to pull the anchor and 15 minutes to reset (Table 22).

Table 22: Calculation of Duration of Anchor Handling in Total Days for Each Season

Season	Activity	Anchors Reset	Reset Time (hours)[1]	Days	Percent of Day	Total 24-hour Periods
3	9 days mooring, 14 days pipe trenching	--	--	23	25%	6
4	Pipeline days at rate of 2,500 feet per day	636	0.5	53	25%	13

[1] Includes 15 minutes to pull an anchor and 15 minutes to reset (lower and then tension up)

These are estimates, the actual production rates and durations would be dependent on weather, conditions of substrate, equipment, and other delays.

6.2.10. Marine Mammal Densities

Density estimates were calculated for marine mammals in Cook Inlet (except beluga whales) using aerial survey data collected by NMFS' National Marine Mammal Laboratory (NMML), typically flown in early June, from 2000 to 2022 (Rugh et al., 2005; Shelden et al., 2013, 2015, 2017, 2019, 2022; Goetz et al., 2023). To estimate marine mammal densities, the total number of individuals per species was divided by the total area surveyed each year (Tables 23).

6.2.10.1. Marine Mammals Other than Beluga Whales

Table22 summarizes the number of marine mammals, other than beluga whales, observed each year during the NMFS' NMML aerial surveys and the area covered. To calculate a conservative density for exposure estimation, the total number of individuals per species observed in each survey year was divided by the area covered during that year and then averaged across all years. The total number of animals observed accounts for the entire Cook Inlet, so these densities may not be representative of the expected densities at Project locations. The raw densities were not corrected for animals missed during the aerial surveys as no accurate correction factors are currently available for these species; however, observer error may be limited as the NMFS surveyors often circled marine mammal groups to get an accurate count of group size. Further, the density for harbor seals is inflated because it includes the large number of hauled out seals, which is not representative of the expected number of harbor seals at Project locations.

6.2.10.2. Cook Inlet Beluga Whale

Table23 summarizes the maximum number of beluga whales observed during each survey year of the NMFS' NMML Annual Aerial Surveys and the area covered. To estimate beluga densities, the maximum number of belugas observed each survey year was divided by the area covered, and these annual densities were then averaged across surveys conducted between 2000-2022 in Table 24. The survey area can be separated into upper, middle, and lower Cook Inlet, resulting in different densities for beluga whales in each area. Using these combined data for middle and lower Cook Inlet, the density for beluga whales using the NMFS' NMML Annual Aerial Surveys for all Project components is 0.00305 whales per km^2 listed in Table 25.

Table 23: Non-Beluga Marine Mammal Sightings and Calculated Densities from NMFS Annual Surveys 2000–2022

Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2014	2016	2018	2021	2022
Humpback whale	11	47	20	22	15	18	14	3	7	5	2	9	1	11	6	0	0	7
Killer whale	0	15	0	0	0	0	0	0	0	0	33	0	9	0	0	0	0	4
Harbor porpoise	29	26	0	0	101	2	0	4	6	42	10	30	11	129	17	0	41	7
Harbor seal	2,023	1,853	1,608	1,165	1,886	1,364	1,799	1,474	2,037	1,415	1,156	2,318	1,812	2,115	1,910	1,380	2,557	2,120
Area surveyed	6,911.2	5,445.2	5,445.2	5,235.8	6,492.3	5,445.2	6,701.8	5,235.8	7,120.6	5,864.0	6,073.5	6,701.8	6,282.9	6,701.8	8,377.2	10,471	8,377.2[1]	8,377.2[1]
Density Estimates (individuals/km^2)																		
Humpback whale	0.00159	0.00477	0.00367	0.00382	0.00246	0.00331	0.00209	0.00057	0.00098	0.00085	0.00033	0.00134	0.00016	0.00164	0.00072	0.00000	0.00000	0.00084
Killer whale	0.00000	0.00275	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00543	0.00000	0.00143	0.00000	0.00000	0.00000	0.00000	0.00048
Harbor porpoise	0.00420	0.00477	0.00000	0.00000	0.01556	0.00037	0.00000	0.00076	0.00084	0.00716	0.00165	0.00463	0.00175	0.01910	0.00203	0.00000	0.00489	0.00084
Harbor seal	0.29271	0.34030	0.29531	0.22251	0.29050	0.25050	0.26844	0.28153	0.28607	0.24130	0.19034	0.34588	0.28840	0.31559	0.22800	0.13179	0.30523	0.25307

[1]Total area surveyed was not reported by Shelden et al., 2022 or Goetz et al., 2023 and is estimated based on previous reports.

Table 24: Cook Inlet Beluga Whale Sightings and Calculated Densities from NMML Annual Surveys 2000–2022

Location	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2014	2016	2018	2021	2022
Turnagain Arm[1]	0	10	0	25	50	21	0	76	0	0	4	0	2	0	5	1	9	3
Chickaloon Bay to Point Possession[1]	28	34	11	64	176	66	60	50	33	40	131	72	30	51	72	56	61	55
Point Possession to East Foreland[1]	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	7	5	0
Middle Cook Inlet east of Trading Bay[2]	0	0	0	0	0	0	15	0	0	0	9	0	7	0	2	0	0	21
East Foreland to Homer[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Kachemak Bay[3]	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
West side Lower Cook Inlet[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redoubt Bay[2]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trading Bay[2]	0	0	0	0	0	0	0	0	0		0	0	21	0	0	52	142	116
Susitna Delta[1]	114	114	93	41	99	155	126	152	103	290	160	187	286	333	191	152	501	833
Knik Arm[1]	42	60	88	94	0	43	9	23	0	0	0	0	0	0	0	0	16	0
Fire Island[1]	0	0	0	0	0	16	0	2	0	0	9	2	0	0	0	0	0	4
Correction factor	1.021	1.021	1.021	1.021	1.021	1.021	1.021	1.021	1.021	1.021	1.031	1.031	1.001	1.036	1.022	1.640	3.930	1.940
Density Estimates (Individuals/km^2)																		
Total Cook Inlet	0.01684	0.02138	0.02138	0.02223	0.01793	0.02138	0.01737	0.02223	0.01635	0.01985	0.01935	0.01754	0.01816	0.01762	0.01391	0.02381	0.23503	0.19291
Upper Cook Inlet only[1]	0.01684	0.02138	0.01744	0.01833	0.02768	0.02906	0.01920	0.02964	0.01477	0.05049	0.02716	0.02877	0.04557	0.05148	0.02330	0.02381	0.23503	0.19291
Middle Cook Inlet only[2]	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00229	0.00000	0.00000	0.00000	0.00153	0.00000	0.00335	0.00000	0.00024	0.00814	0.06662	0.02686
Lower Cook Inlet only[3]	0.00000	0.00038	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00003	0.00000	0.00023

Table 25: Density Estimates for All Marine Mammals

Species	Mean Density Animals/km^2
Humpback Whale [1]	0.00185
Killer Whale [1,2]	0.00061
Beluga Whale	0.00305
Harbor Porpoise [1]	0.00380
Harbor Seal [2]	0.26819

[1] Densities calculated by dividing the total number of animals NMFS observed each survey year by the area surveyed and then averaging over the 2000-2022 survey years

[2] Killer whale density is for all killer whales regardless of stock.

Table 26: Summary of Unmitigated Number of Marine Mammals Exposed to Level A and Level B Thresholds Per Season and Per Facility

Season	Facility	Activities	Humpback Whales		Killer Whales		Beluga Whales		Harbor Porpoises		Harbor Seals	
			Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B
1	Temp MOF	Vibratory pipe & sheet piling driving	0.85	10.72	0.00	3.55	1.00	26.41	2.44	17.42	0.08	1,556.37
		Subtotal Season 1	***0.85***	***10.72***	***0.00***	***3.55***	***1.00***	***26.41***	***2.44***	***17.42***	***0.08***	***1,556.37***
2	Temp MOF	Vibratory; Impact pipe & sheet piling driving	0.09	5.23	0.00	1.77	0.00	8.86	3.15	11.05	20.97	986.37
	Mainline MOF	Vibratory & Impact sheet piling driving	0.07	0.92	0.00	0.30	0.00	1.51	0.54	1.88	12.58	132.96
		Subtotal Season 2	***0.16***	***6.14***	***0.00***	***2.08***	***0.00***	***10.37***	***3.69***	***12.93***	***33.55***	***1,119.34***
3	PLF	Impact pipe pile driving	3.06	1.47	0.02	0.49	0.08	2.43	19.83	3.03	351.10	214.07
	Pipelay	Anchor handling[2]	0	0.229	0	0.076	0	0.378	0	0.471	0	33.261
		Subtotal Season 3	***3.06***	***1.70***	***0.02***	***0.56***	***0.08***	***2.81***	***19.83***	***3.50***	***351.10***	***247.33***
4	PLF	Impact pipe pile driving	2.42	1.30	0.01	0.29	0.07	1.83	1.87	2.28	305.19	160.99
	Pipelay	Anchor handling[2]	0	0.534	0	0.177	0	0.881	0	1.099	0	77.609
		Subtotal Season 4	***2.42***	***1.84***	***0.01***	***0.47***	***0.07***	***2.71***	***1.87***	***3.38***	***305.19***	***238.60***
5	PLF	Impact pipe pile driving	2.07	0.97	0.01	0.29	0.07	1.44	1.29	1.79	236.72	126.66
		Subtotal Season 5	***2.07***	***0.97***	***0.01***	***0.29***	***0.07***	***1.44***	***1.29***	***1.79***	***236.72***	***126.66***
		Total (5 Seasons)	**8.56**	**21.36**	**0.04**	**6.95**	**1.22**	**43.73**	**29.11**	**39.03**	**926.64**	**3,288.31**

[1] Level A and Level B thresholds calculated using NMFS (2024b) Optional Multi-Species Pile Driving Calculator VERSION 2.0-Multi-Species: 2024
[2]Anchor Handling modeled previously modeled (AKLNG, 2020)

6.3. Calculation of Potential Unmitigated Acoustic Exposures

To estimate the total number of marine mammals potentially exposed to sound exceeding NMFS thresholds (Table 26), the following three variables were multiplied:

1. The area (in km^2) of ensonification for Level A and B for pile driving for each size and hammer type (Table 19 and Table 20);
2. The duration (in days) of the sound activity per facility per season (Table 21); and
3. The density (number of marine mammals/square kilometer (Table 25).

These estimates do not include any reductions from mitigation measures, such as shutdowns or construction windows, or reductions from the variability in seasonal habitat use or distribution of the marine mammals in Cook Inlet. The Applicant will perform the required SSV study at the beginning of the pile driving to characterize the sound levels associated with different pile and hammer types, as well as to establish the marine mammal monitoring and mitigation zones. The Applicant will also work with the construction contractor to evaluate potential noise attenuation systems for further source level reductions.

The exposure assessment estimates the numbers of individuals potentially exposed to the effects of pile driving noise exceeding NMFS established thresholds. Results from the Project's acoustic impact exposure assessments should be regarded as conservative overestimates that are strongly influenced by limited marine mammal data, the assumption that marine mammals will be present during pile driving, and the assumptions that the maximum number of piles will be installed.

6.3.1. Summary of Requested Takes

The Applicant seeks authorization for the potential taking through injury or mortality (Level A) of small numbers of humpback whale, harbor porpoise, and harbor seal in Cook Inlet from in-water pile driving. This is precautionary, as the Applicant does not anticipate injury or mortality with the application of the mitigation measures discussed in Section 11.

The Applicant seeks authorization for the potential taking through disturbance (Level B) of small numbers of humpback whale, beluga whale, killer whale, harbor porpoise, and harbor seal in Cook Inlet. Any takes would most likely result from construction noise, specifically in-water pile driving. These takes are expected to have no more than a minor effect on individual animals and no effect on the populations of these five species.

The total number of requested annual Level B takes is shown in Table 27. No additional Level B takes for Cook Inlet beluga whales are requested over the estimated number of exposures. As noted in Section 11, mitigation measures are planned to decrease potential for the worst-case encounter scenario even though it is identified here. The requested annual Level A and B take authorizations by season are presented in Table 28.

Table 27: Requested Total Level A and B Take Authorizations

Species	Population Estimate	Level A			Level B		
		Total Estimated Exposure Without Mitigation	Total Take Authorization Requested	Percent of Population	Total Estimated Exposure Without Mitigation	Total Take Authorization Requested	Percent of Population
Humpback Whale[1]	13,280	8.56	9	0.07%	21.36	22	0.17%
Killer Whale	2,507	0.04	0	0.00%	6.95	7	0.28%
Beluga Whale[2]	331	1.22	0	0.00%	43.73	44	13.29%
Harbor Porpoise	31,046	29.11	30	0.10%	39.03	40	0.13%
Harbor Seal	28,411	926.64	927	3.26%	3,288.31	3,289	11.58%

[1] Estimated population size is the total of Western North Pacific DPS, Mexico North Pacific DPS, and Hawai'i DPS
[2] Goetz et al., 2023

Table 28. Requested Annual Level A and B Take Authorizations by Season

Species / Stock	Population	Level A			Level B		
		Estimated Exposure	Requested Takes	Percentage of Population	Estimated Exposure	Requested Takes	Percentage of Population
Season 1							
Humpback Whales	13,280	0.85	1	0.01%	10.72	11	0.08%
Killer Whales	2,507	0.00	0	0.00%	3.55	4	0.16%
Beluga Whales	331	1.00	0	0.00%	26.41	27	8.16%
Harbor Porpoises	31,046	2.44	3	0.01%	17.42	18	0.06%
Harbor Seals	28,411	0.08	1	0.00%	1,556.37	1,557	5.48%
Season 2							
Humpback Whales	13,280	0.16	1	0.01%	6.14	7	0.05%
Killer Whales	2,507	0.00	0	0.00%	2.08	3	0.12%
Beluga Whales	331	0.00	0	0.00%	10.37	11	3.32%
Harbor Porpoises	31,046	3.69	4	0.01%	12.93	13	0.04%
Harbor Seals	28,411	33.55	34	0.12%	1,119.34	1,120	3.94%
Season 3							
Humpback Whales	13,280	3.06	4	0.03%	1.70	2	0.02%
Killer Whales	2,507	0.02	0	0.00%	2.08	3	0.12%
Beluga Whales	331	0.08	0	0.00%	2.81	3	0.91%
Harbor Porpoises	31,046	19.83	20	0.06%	3.50	4	0.01%
Harbor Seals	28,411	351.10	352	1.24%	247.33	248	0.87%
Season 4							
Humpback Whales	13,280	2.42	3	0.02%	1.84	2	0.02%
Killer Whales	2,507	0.01	0	0.00%	0.47	1	0.04%
Beluga Whales	331	0.07	0	0.00%	2.71	3	0.91%
Harbor Porpoises	31,046	1.87	2	0.01%	3.38	4	0.01%
Harbor Seals	28,411	305.19	306	1.08%	238.60	239	0.84%
Season 5							
Humpback Whales	13,280	2.07	3	0.02%	0.97	1	0.01%
Killer Whales	2,507	0.01	0	0.00%	0.29	1	0.04%
Beluga Whales	331	0.29	0	0.00%	1.44	2	0.60%
Harbor Porpoises	31,046	1.29	2	0.01%	1.79	2	0.01%
Harbor Seals	28,411	236.72	237	0.83%	126.66	127	0.45%

7. DESCRIPTION OF IMPACT ON MARINE MAMMALS

The anticipated impact of the activity upon the species or stock.

7.1. General Effects of Sound on Marine Mammals

Sound (hearing and vocalization/echolocation) serves four primary functions for marine mammals, including: 1) providing information about their environment, 2) communication, 3) prey detection, and 4) predator detection. The distances to which vessel and construction activities are detectable by marine mammals depends on source levels, frequency, ambient sound levels, the propagation characteristics of the environment, and sensitivity of the receptor (Richardson et al., 1995).

The effects of sounds from industrial activities on marine mammals might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and temporary or permanent hearing impairment, or non-auditory physical effects (Richardson et al., 1995). In assessing potential effects of sound, Richardson et al. (1995) has suggested four criteria for defining zones of influence. These zones are described below from greatest to least influence.

Zone of Hearing Loss, Discomfort, or Injury – The area within which the received sound level is potentially high enough to cause discomfort or tissue damage to auditory or other systems. This includes TTS (temporary loss in hearing) or PTS (loss in hearing at specific frequencies or deafness). Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage.

Zone of Masking – The area within which the sound may interfere with detection of other sounds, including communication calls, prey sounds, or other environmental sounds.

Zone of Responsiveness – The area within which the animal reacts behaviorally or physiologically. The behavioral responses of marine mammals to sound is dependent on several factors, including: 1) acoustic characteristics of the sound source of interest; 2) physical and behavioral state of animals at time of exposure; 3) ambient acoustic and ecological characteristics of the environment; and 4) context of the sound (e.g., whether it sounds like a predator) (Richardson et al., 1995; Southall et al., 2007). However, temporary behavioral effects are often simply evidence that an animal has heard a sound and may not indicate lasting consequence for exposed individuals (Southall et al., 2007).

Zone of Audibility – The area within which the marine mammal might hear the sound. Marine mammals as a group have functional hearing ranges of 10 Hz to 180 kHz, with best thresholds near 40 dB (Ketten, 1994; Kastak et al., 2005; Southall et al., 2007). These data show reasonably consistent patterns of hearing sensitivity within each of three groups: small odontocetes (such as the harbor porpoise), medium-sized odontocetes (such as the beluga and killer whales), and pinnipeds (such as harbor seals). There are no applicable criteria for the zone of audibility due to difficulties in human ability to determine the audibility of a sound for a species.

The following text describes the potential impacts on marine mammals due to the sources associated with this program. Due to relatively low sound levels and short period of time over the entire season the louder activities would occur, and the mitigation measures, it is unlikely there would be any temporary or especially permanent hearing impairment, or non-auditory physical effects on marine mammals.

7.2. Potential Effects of Sounds on Marine Mammals

7.2.1. Tolerance

Studies have shown that underwater sounds from anthropogenic activities are often detectable underwater at distances of many miles away from the source. Studies have also shown that marine mammals at distances more than a few km away often show no apparent response to various types of industry activities (Moulton et al., 2005; Harris et al., 2001; LGL et al., 2014). This is often true even in cases when the sounds are likely audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. All marine mammals have exhibited some behavioral reaction to underwater industry sounds, but they have also exhibited no overt reactions to underwater sounds (Stone and Tasker, 2006; Hartin et al., 2013). In general, pinnipeds and small odontocetes appear to be more tolerant of exposure to some types of underwater sound than are baleen whales. It is anticipated that some marine mammals would be exposed to the low levels of underwater sounds from Alaska LNG construction activities, but the exposures would not result in long-term disturbance.

7.2.2. Temporary Threshold Shift and Permanent Threshold Shift

Sound has the potential to induce TTS or PTS hearing loss (Weilgart, 2007). The level of loss is dependent on sound frequency, intensity, and duration. Like masking, hearing loss reduces the ability of marine mammals to forage efficiently, maintain social cohesion, and avoid predators (Weilgart, 2007). For example, Todd et al. (1996) found an unusual increase in fatal fishing gear entanglement of humpback whales to coincide with blasting activities, suggesting hearing damage from the blasting may have compromised the ability for the whales to use sound to passively detect the nets. Experiments with captive bottlenose dolphins and beluga whales found that short duration impulsive sounds can cause TTS (Finneran et al., 2002).

PTS occurs when continuous sound exposure causes hairs within the inner ear system to die. This can occur due to moderate durations of very loud sound levels, or long-term continuous exposure of moderate sound levels. However, PTS is not an issue with impulsive sound, and continuous sound from the cavitation of boat propellers and thrusters are short-term for a given location, since the vessels are either constantly moving, or operating intermittently.

7.2.3. Hearing Impairment and Other Physical Effects

NMFS has developed new sound exposure criteria for marine mammals that account for the currently available scientific data on TTS and other relevant factors in marine and terrestrial mammals (NMFS, 2016b). Several aspects of the planned monitoring and mitigation measures for this project are designed to detect marine mammals occurring near the construction activities to avoid exposing them to underwater sound levels that might, at least in theory, cause hearing impairment. In addition, many cetaceans are likely to show some avoidance of the proposed activities. In those cases, the avoidance responses of the animals themselves would reduce or (most likely) avoid any possibility of hearing impairment.

Non-auditory physical effects might also occur in marine mammals exposed to strong underwater sound. Possible types of non-auditory physiological effects or injuries that theoretically might occur in marine mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) may be especially susceptible to injury and/or stranding when exposed to strong pulsed sounds. However, as discussed below, there is no definitive evidence that any of these effects occur even for marine mammals near industrial sound sources and beaked whales do not occur in the proposed Project area. It is unlikely that any effects of these types would occur during the proposed Project given the brief duration of exposure of any given mammal, and the planned monitoring and mitigation measures.

Available data on the potential for underwater sounds from industrial activities to cause auditory impairment or other physical effects in marine mammals suggest that such effects, if they occur at all, would be temporary and limited to short distances. Marine mammals that show behavioral avoidance of the proposed activities, including most baleen whales, some odontocetes (including belugas), and some pinnipeds, are especially unlikely to incur auditory impairment or other physical effects. Animals exposed to intense sound may experience reduced hearing sensitivity for some period following exposure. This increased hearing threshold is known as sound induced threshold shift (TS). The amount of TS incurred in the animal is influenced by several sound exposure characteristics, such as amplitude, duration, frequency content, temporal pattern, and energy distribution (Kryter, 1985; Richardson et al., 1995; Southall et al., 2007).

It is also influenced by characteristics of the animal, such as behavior, age, history of sound exposure, and health. The magnitude of TS generally decreases over time after sound exposure and if it eventually returns to zero, known as temporary threshold shift (TTS). If TS does not return to zero after some time (generally on the order of weeks), it is known as PTS. TTS is not considered to be auditory injury and does not constitute “Level A Harassment” as defined by the MMPA. Sound levels associated with TTS onset are generally considered to be below the levels that would cause PTS, which is auditory injury. For more information on TTS and PTS, please refer to NMFS Acoustic Criteria for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NMFS, 2016b, 2018).

7.2.4. Masking

Masking occurs when louder sounds interfere with marine mammal vocalizations or ability to hear natural sounds in their environment (Richardson et al., 1995), which limit their ability to communicate or avoid predation or other natural hazards. Masking is of special concern for baleen whales that vocalize at low frequencies over long distances, as their communication frequencies overlap with anthropogenic sounds such as shipping traffic. Some baleen whales have adjusted their communication frequencies, intensity, and call rate to limit masking effects. For example, McDonald et al. (1995) found that California blue whales (*Balaenoptera musculus*) have shifted their call frequencies downward by 31 percent since the 1960s, possibly to communicate below shipping sound frequencies. Melcon et al. (2012) found blue whales to increase their call rates in the presence of typically low-frequency shipping sound, but to significantly decrease call rates when exposed to mid-frequency sonar. Also, Di Iorio and Clark (2010) found blue whales to communicate more often in the presence of seismic surveys, which they attributed to compensating for an increase in ambient sound levels. Fin whales have reduced their calling rate in response to boat noise (Watkins, 1986).

Odontocetes hear and communicate at frequencies well above the frequencies of pile driving, dredging, and ship propellers/thrusters (Wartzok and Ketten, 1999). Beluga whales have a well-developed and well-documented sense of hearing. White et al. (1978) measured the hearing of two belugas whales and described hearing sensitivity between 1 and 130 kHz, with best hearing between 30 to 50 kHz. Awbrey et al. (1988) examined their hearing in octave steps between 125 Hz and 8 kHz, with average hearing thresholds of 121 dB re1 µPa at 125 Hz and 65 dB re 1 µPa at 8 kHz. Johnson et al. (1989) further examined beluga hearing at low frequencies, establishing that the beluga whale hearing threshold at 40 Hz was 140 dB re 1 µPa. Ridgway et al. (2001) measured hearing thresholds at various depths down to 330 yards at frequencies between 500 Hz and 100 kHz. Beluga whales showed unchanged hearing sensitivity at this depth. Finneran et al. (2005) measured the hearing of two belugas, describing their auditory thresholds between 2 and 130 kHz. In summary, these studies indicate that beluga whales hear from approximately 40 Hz to 130 kHz, with maximum sensitivity from approximately 30 to 50 kHz. It is important to note that these audiograms represent the best hearing of belugas, measured in very quiet conditions. These quiet conditions are rarely present in the wild, where high levels of ambient sound may exist.

It is expected that while odontocetes such as beluga whales and harbor porpoise would be able to detect sound from the planned pile driving and vessel operations, it is unclear whether the operations would mask the ability of these high-frequency animals to communicate.

7.3. Behavioral Response of Marine Mammals

7.3.1. Baleen Whales

Southall et al. (2007) reviewed several papers describing the responses of marine mammals to non-pulsed sound. In general, little or no response was observed in animals exposed at received levels from 90–120 dB re 1 µPa rms. Probability of avoidance and other behavioral effects increased when received levels were 120-160 dB re 1 µPa rms. Some of the relevant reviews of Southall et al. (2007) are summarized as follows.

7.3.1.1. Humpback Whales

Humpbacks and other large baleen whales have shown strong overt reactions to impulsive sounds, such as seismic operations, at received levels between 160 and 173 dB re 1 µPa rms (Richardson et al., 1986; Ljungblad et al., 1988; Miller et al., 2005; McCauley et al., 1998). However, baleen whales seem to be less tolerant of continuous sound (Richardson and Malme, 1993), often detouring around drilling activity when received levels are as low as 119 dB re 1 µPa (rms) (Malme et al., 1983; Richardson et al., 1985). Based on the previously cited studies, NMFS developed the 120 dB re 1 µPa rms harassment criteria for continuous sound sources.

Based upon the information regarding baleen whale disturbance reactions, it is anticipated that some baleen whales may exhibit minor, short-term disturbance responses to underwater sounds from construction activities. Any potential impacts on baleen whale behavior are expected to be localized within the activity area and would not result in population-level effects.

7.3.2. Toothed Whales

Most toothed whales have the greatest hearing sensitivity at frequencies much higher than that of baleen whales and may be less responsive to low-frequency sound commonly associated with industry activities. Richardson et al. (1995) reported that beluga whales did not show any apparent reaction to playback of underwater drilling sounds at distances greater than 200 to 400 meters (656 to 1,312 feet). Reactions included slowing down, milling, or reversal of course after which the whales continued past the projector, sometimes within 50 to 100 meters (164 to 328 feet).

In reviewing responses of cetaceans with best hearing in mid-frequency ranges, which includes toothed whales, Southall et al. (2007) reported that combined field and laboratory data for mid-frequency cetaceans exposed to non-pulsed sounds did not lead to a clear conclusion about received levels coincident with various behavioral responses. In some settings, individuals in the field showed profound behavioral responses to exposures from 90 to 120 dB re 1 µPa rms, while others failed to exhibit such responses for exposure to received levels from 120 to 150 dB re 1 µPa rms. Contextual variables other than exposure received level, and probable species differences, are the likely reasons for this variability. Context, including the fact that captive subjects were often directly reinforced with food for tolerating sound exposure, may also explain why there was great disparity in results from field and laboratory conditions—exposures in captive settings generally exceeded 170 dB re 1 µPa rms before inducing behavioral responses. Below we summarize some of the relevant material reviewed by Southall et al. (2007).

Two papers deal with important issues related to changes in marine mammal vocal behavior as a function of variable background sound levels. Foote et al. (2004) found increases in the duration of killer whale calls over the period 1977 to 2003, during which time vessel traffic in Puget Sound, and particularly whale-watching boats around the animals, increased dramatically. Scheifele et al. (2005) demonstrated that belugas in the St. Lawrence River increased the levels of their vocalizations as a function of the background sound level (the “Lombard Effect”).

7.3.2.1. Cook Inlet Beluga Whales

Cook Inlet beluga whales are familiar with, and likely habituated to, the presence of large vessels. For example, beluga whales near the Port of Alaska did not appear to be bothered by the sounds from a passing cargo freight ship (Blackwell and Greene, 2003). Beluga whales have displayed avoidance reactions when approached by watercraft, particularly small, fast-moving craft that can maneuver quickly and unpredictably. Larger vessels that do not alter course or motor speed around beluga whales seem to cause little, if any, reaction (NMFS, 2008). Disturbance from vessel traffic, whether because of the physical presence of the vessels or the sound created by them, could cause short-term behavioral disturbance to nearby beluga whales, or localized short-term displacement of belugas from their preferred habitats (Richardson et al., 1995). A study conducted by Markowitz and McGuire (2007) found that while beluga whale numbers were generally low near the Port of Alaska Marine Terminal Redevelopment Project (MTRP), 64 percent of the groups observed entered the proposed Project footprint (which extended offshore about 150 meters [164 yards]).

7.3.2.2. Harbor Porpoise

Harbor porpoises tend to move away from boats and ships. Reaction to boats can be strong when within 400 meters (437 yards) (Polacheck and Thorpe, 1990) out to 1.5 km (0.9 miles) (Barlow, 1988). There is little information on harbor porpoise reaction to impulsive sound such as pile driving. However, Lucke et al. (2009) recently exposed harbor porpoise to impulsive sound signals and found that harbor porpoises showed behavioral aversion to impulsive sounds as low as 174 dB re 1 µPa (peak-peak), indicating a greater sensitivity to impulsive sound than beluga whales. Acoustic harassment devices with full spectrum impulsive source levels of 180 dB re 1 µPa effectively deterred harbor porpoise from salmon pens (Johnston, 2002).

7.3.2.3. Dall's Porpoise

Dall's porpoises are known to have an affinity for bow-riding both large and small vessels (Richardson et al., 1995). There is little information on how Dall's porpoise react to pile driving (largely because these animals are rarely found near shore). However, given the lack of sensitivity of other odontocetes to low-frequency vessel noise (Richardson et al., 1995) and their propensity to bow-ride, it is not anticipated they would avoid the pipelay vessels if encountered.

7.3.2.4. Killer Whale

There is very little information on killer whale reactions to boats other than studies on tour boat impacts to inland stocks of Washington and British Columbia. As odontocetes, killer whales are probably less sensitive to low-frequency vessel sounds. However, killer whales are sensitive to impulsive sounds (such as pile driving) as evidenced by the effective use of acoustical harassment devices to protect salmon pen fisheries (Morton and Symonds, 2002).

Based on the above information regarding toothed whale disturbance reactions, it is anticipated that some toothed whales may exhibit minor, short-term disturbance responses to underwater sounds from construction and sonar activities. Any potential impacts on toothed whale behavior would be localized within the activity area and would not result in population-level effects.

7.3.3. Pinnipeds

7.3.3.1. Harbor Seal

Literature suggests that pinnipeds may be tolerant of underwater industrial sounds, and they are less sensitive to lower frequency sounds. Pinnipeds generally seem to be less responsive to exposure to industrial sound than most cetaceans. Pinniped responses to underwater sound from some types of industrial activities such as seismic exploration appear to be temporary and localized (Harris et al., 2001; Reiser et al., 2009).

Southall et al. (2007) reviewed literature describing responses of pinnipeds to non-pulsed sound and reported that the limited data suggest exposures between ~90 and 140 dB re 1 µPa rms generally do not appear to induce strong behavioral responses in pinnipeds exposed to non-pulsed sounds in water; no data exist regarding exposures at higher levels. It is important to note that among these studies of pinnipeds responding to non-pulsed exposures in water, there are some apparent differences in responses between field and laboratory conditions. In contrast to the mid-frequency odontocetes, captive pinnipeds responded more strongly at lower levels than did animals in the field. Again, contextual issues are the likely cause of this difference.

Richardson et al. (1995) were not aware of any detailed data on reactions of seals to impulsive sounds (seismic in this case), and expected them to tolerate or habituate to underwater sound, especially if food sources were present. Most information on the reaction of seals and sea lions to boats relates to disturbance of animals hauled out on land. There is little information on the reaction of these pinnipeds to ships while in the water, other than some anecdotal reports that sea lions are often attracted to boats (Richardson et al., 1995).

Based upon the above information regarding pinniped disturbance reactions, it is anticipated that some pinnipeds may exhibit minor, short-term disturbance responses to underwater sounds from construction and sonar activities. Any potential impacts on pinniped behavior would be localized within the activity area and would not result in population-level effects.

7.3.4. Stress and Mortality

Marine mammal stranding or mortality would be highly unlikely to result from any of the proposed activities. Marine mammal strandings have been correlated with pulsed sounds produced during previous marine survey activities. The most likely potential cause of mortality to marine mammals from the proposed activities would be a ship strike. Trained observers aboard Project vessels are authorized to request mitigation measures, including reduction in vessel speed and course alteration, to minimize potential ship strikes. Given the above information, it is extremely unlikely that the proposed activities would result in stranding or mortality to marine mammals.

Although the proposed impulsive and continuous pile driving activities would operate for extended periods of time, this activity would be limited to lower Cook Inlet (Nikiski) during the summer period when belugas, harbor seals, and harbor porpoises are concentrated in important feeding and breeding nearshore waters in upper Cook Inlet. Chronic exposure to these sound levels is not expected. Safety zones would be established to prevent acoustical injury to local marine mammals, especially injury that could indirectly lead to mortality. Also, impulsive sound is not expected to cause resonate effects to gas-filled spaces or airspaces in marine mammals based on the research of Finneran (2003) on beluga whales showing that the tissue and other body masses dampen any potential effects of resonance on ear cavities, lungs, and intestines. However, chronic exposure to impulsive sound could lead to physiological stress eventually causing hormonal imbalances (National Research Council [NRC], 2005). If survival demands are already high, and/or additional stressors are present, the ability of the animal to cope decreases leading to pathological conditions or death (NRC, 2005). Effects may be greatest where sound disturbance can disrupt feeding patterns, including displacement from critical feeding grounds.

Pipelay across Cook Inlet would occur near summer beluga concentration areas. The primary sound source would be the drive propeller and thruster cavitation during anchor handling, which extends about 4.25 km (2.64 miles) to the 120-dB isopleth (Blackwell and Greene, 2003). Only low densities of summer beluga whales are expected along the planned route across Cook Inlet between June and August, as the landfall for this route is 6.0 km (3.5 miles) south of the nearest beluga summer concentration area (Beluga River). However, based on previous marine mammal surveys (Nemeth et al., 2007; Brueggeman, 2007a, b) in the area, beluga whales are expected to occur in moderate or higher numbers in this area in May and October.

8. DESCRIPTION OF IMPACT ON SUBSISTENCE USES

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

8.1. Subsistence Uses

The proposed Marine Terminal construction activities would occur closest to the marine subsistence area used by Nikiski, while the offshore pipeline and Beluga Mainline MOF would occur within the subsistence use area used by Tyonek.

The Alaska LNG Project funded a study, conducted by the Alaska Department of Fish and Game (ADF&G), to document the harvest and use of wild resources by residents of communities on the east and west sides of Cook Inlet (Jones and Kostick, 2016). Data on wild resource harvest and use were collected, including basic information about who, what, when, where, how, and how much wild resources are being used to develop fishing and hunting opportunities for Alaska residents. Tyonek was surveyed in 2013 (Jones et al., 2015), and Nanwalek, Port Graham, Seldovia, and Nikiski were surveyed in 2014 (Jones and Kostick, 2016). Marine mammals were harvested by four (Nikiski, Seldovia, Nanwalek, Port Graham) of the five communities but at relatively low rates (Table 29). The harvests consisted of harbor seals, Steller sea lions (*Eumatopia jubatus*), and northern sea otters (*Enhydra lutris*).

Table 29: Marine Mammal Harvest by Tyonek in 2013 and Nikiski, Port Graham, Seldovia, and Nanwalek in 2014

Village	Harvest (Pounds per Capita)	Households Attempting Harvest Number (% of Residents)	Number of Marine Mammals Harvested			
			Harbor Seal	Steller Sea Lion	Northern Sea Otter	Beluga Whale
Tyonek	2	6 (6 %)	6	0	0	0
Nikiski	0	0 (0 %)	0	0	0	0
Seldovia	1	2 (1 %)	5	0	3	0
Nanwalek	11	17 (7 %)	22	6	1	0
Port Graham	8	27 (18 %)	16	1	24	0

8.1.1. Cook Inlet Beluga Whale

The Cook Inlet beluga whale has traditionally been hunted by Alaska Natives for subsistence purposes. For several decades prior to the 1980s, the Native Village of Tyonek residents were the primary subsistence hunters of Cook Inlet beluga whales. During the 1980s and 1990s, Alaska Natives from villages in the western, northwestern, and North Slope regions of Alaska either moved to or visited the south-central region and participated in the yearly subsistence harvest (Stanek, 1994). From 1994 to 1998, NMFS estimated 65 whales per year (range 21 to 123) were taken in this harvest, including those successfully taken for food, and those struck and lost. NMFS has concluded that this number is high enough to account for the estimated 14 percent annual decline in population during this time (Hobbs et al., 2008). Actual mortality may have been higher, given the difficulty of estimating the number of whales struck and lost during the hunts. In 1999, a moratorium was enacted (Public Law 106-31) prohibiting the subsistence take of Cook Inlet beluga whales except through a cooperative agreement between NMFS and the affected Alaska Native organizations. Since the Cook Inlet beluga whale harvest was regulated in 1999 requiring cooperative agreements, five beluga whales have been struck and harvested. Those beluga whales were harvested in 2001 (one animal), 2002 (one animal), 2003 (one animal), and 2005 (two animals). The Native Village of Tyonek agreed not to hunt or request a hunt in 2007, when no co-management agreement was to be signed (NMFS, 2008). During the second review period (2008-2012), the Cook Inlet beluga whale population was below 350 individuals (Muto et al., 2022; Young et al., 2023), leading to a suspension of harvesting through the next 5 years (2013-2017). Post 2012, NMFS adopted a biennial survey schedule, resulting in the 5-year average abundance being calculated from two or three surveys. Although biennial surveys may increase harvest level variability, Hobbs (2013) found no impact on recovery chances. With the population count remaining under 350 (Goetz et al., 2012) during the third review period (2013-2017), based on data from 2014 and 2016, harvesting continues to be prohibited for the 5 years from 2018-2022. NMFS completed its second five-year status review in September 2022, concluding that the Cook Inlet beluga whale population should retain its status as endangered.

Residents of the Native Village of Tyonek are the primary subsistence users in Knik Arm area. No households hunted beluga whale locally in Cook Inlet due to conservation concerns; however, beluga whale resources were received from other areas of Alaska by approximately 10 percent of households in 2013 (Jones et al., 2015).

8.1.2. Steller Sea Lion and Harbor Seal

The only non-listed marine mammal available for subsistence harvest in Cook Inlet is the harbor seal (Wolfe et al., 2009), while listed Steller sea lions are also occasionally taken. Marine mammals are harvested in low numbers in the communities closest to the Project area (Nikiski and Tyonek). Higher marine mammal harvest occurs in the communities that are not accessible by the road system of Seldovia, Nanwalek, and Port Graham.

Jones and Kostick (2016) reported that 2 percent of households in Nikiski used harbor seals and 1 percent reported using unknown seal species (both gifted from another region). No marine mammals were actively hunted by Alaska Native residents in Nikiski. There is limited use of marine mammals thought to be from the small number of Alaska Natives living in Nikiski (Jones and Kostick, 2016).

In Tyonek, harbor seals were harvested between June and September by 6 percent of the households (Jones et al., 2015). Seals were harvested in several areas, encompassing an area stretching 20 miles along the Cook Inlet coastline from the McArthur Flats north to the Beluga River. Seals were searched for or harvested in the Trading Bay areas as well as from the beach adjacent to Tyonek (Jones et al., 2015).

In Seldovia, the harvest of harbor seals occurred exclusively in December (Jones and Kostick, 2016).

In Nanwalek, 22 harbor seals were harvested in 2014 between March and October, the majority of which occur in April. Nanwalek residents typically hunt harbor seals and Steller sea lions at Bear Cove, China Poot Bay, Tutka Bay, Seldovia Bay, Koyuktolik Bay, Port Chatam, in waters south of Yukon Island, and along the shorelines close to Nanwalek, all south of the Project Area (Jones and Kostock, 2016).

According to the results presented in Jones and Kostick (2016) in Port Graham, harbor seals were the most frequently used marine mammal. Harbor seals were harvested in January, February, July, August, September, November, and December. Steller sea lions were used noticeably less and harvested in November and December.

8.1.3. Other Marine Mammals

There are no harvest quotas for other non-listed marine mammals found in Cook Inlet. The only data available for subsistence harvest of harbor porpoises, and humpback and killer whales in Alaska are in the marine mammal stock assessments. However, these numbers are for the Gulf of Alaska including Cook Inlet, and they are not indicative of the harvest in Cook Inlet. Jones et al. (2015) and Jones and Kostick (2016) did not report subsistence harvest in Tyonek, Nikiski, Seldovia, Port Graham, or Nanwalek of harbor porpoise or humpback and killer whales.

8.2. Potential Impacts on Availability for Subsistence Uses

Section 101(a)(5)(A) requires NMFS to determine that the taking would not have an unmitigable adverse effect on the availability of marine mammal species or stocks for subsistence use. NMFS has defined ‘‘unmitigable adverse impact’’ in 50 CFR 216.103 as an impact resulting from the specified activity:

1. That is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by:
2. Causing the marine mammals to abandon or avoid hunting areas;
3. Directly displacing subsistence users; or
4. Placing physical barriers between the marine mammals and the subsistence hunters; and
5. That cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

The primary concern is the disturbance of marine mammals through introduction of anthropogenic sound into the marine environment during construction of the Project. Marine mammals could be behaviorally harassed and either become more difficult to hunt or temporarily abandon traditional hunting grounds. However, areas used by residents of Seldovia, Port Graham, and Nanwalek are located more than 70 miles south of the Marine Terminal, Mainline MOF, and Mainline crossing and any associated zones of influence due the generation of underwater sound during these activities. Therefore, construction activities are not anticipated to impact marine mammals in sufficient numbers to render them unavailable for subsistence harvest.

9. DESCRIPTION OF IMPACT ON MARINE MAMMAL 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. Potential Physical Impacts on Habitat

Construction would result in some seafloor disturbance and temporary increases in water column turbidity. Over time, the seabed impacts from construction would be minimized due to natural movement of sediment. The time for recovery of the seabed depends upon the energy of the system, water depth, ice scour, and sediment type as noted in the detailed paragraphs below.

9.1.1. Seafloor Disturbance

Three types of activities associated with construction would result in seafloor disturbance, including dredging/trenching, disposal of dredged material, and facility installation. Approximately 42 hectares (103 acres) would be disturbed directly by dredging of the MOF and trenching for the Mainline crossing, and another 486 hectares (1,200 acres) would be disturbed by the disposal of dredged material. Approximately 20 hectares (50 acres) of seafloor would be disturbed by installation of the MOF, Mainline MOF, and Mainline Crossing (Table 30). Additional area would be indirectly affected by the re-deposition of sediments suspended in the water column by the dredging/trenching and dredge disposal.

Table 30: Seafloor Disturbance from Construction of the Marine Terminal and Mainline Crossing

Activity	Facility	Area Affected in hectares (acres)	Impact Duration
Dredging/Trenching	MOF	20.5 (50.7)	Temporary
	Mainline Crossing	[a] 20.6 (51.0)	Temporary
	Shoreline Protection	0.6 (1.5)	Temporary
	Subtotal Dredging/Trenching	***41.7 (103.2)***	***Temporary***
Dredge Disposal	MOF	485.6 (1,200.0)	Temporary
	Subtotal Dredge Disposal	***485.6 (1,200.0)***	***Temporary***
Facility Installation	MOF	[b] 11.5 (28.3)	Long-Term
	Mainline MOF	2.2 (5.5)	Permanent
	PLF	7.6 (18.7)	Permanent
	Mainline Crossing	[c] 4.5 (11.0)	Permanent
	Subtotal Facility	***20.3 (50.1)***	***-***
	Total	**546.3 (1,350.4)**	**-**

[a] The seafloor disturbance from pipeline trenching could range from 11 to 21 hectares (26 to 51 acres) depending on terminal water depth and slope of the trench.
[b] Approximately 6.9 hectares (16.98 acres) of the MOF is also included in the dredge area.
[c] Represents the area of 42-inch-diameter pipe laying on the seafloor in the offshore un-trenched section of the route.
[d] Temporary is 1–10 years, Long-Term is 10–30 years, and Permanent is > 30 years (life of Project).

Bottom sediments in the lower inlet are coarse gravel and sand that grade to finer sand and mud toward the south (Bouma et al., 1978). Coarser substrate support a wide variety of invertebrates and fish including Pacific halibut, Dungeness crab (*Metacarcinus magister*), tanner crab (*Chionoecetes bairdi*), pandalid shrimp (*Pandalus* spp.), Pacific cod, and rock sole (*Lepidopsetta bilineata*), while the soft-bottom sand and silt communities are dominated by polychaetes, bivalves and other flatfish (Field and Walker, 2003). Sea urchins (*Strongylocentrotus* spp.) and sea cucumbers are important otter prey and are found in shell debris communities. Razor clams (*Siliqua patula*) are found along the beaches of the Kenai Peninsula. In general, the lower Cook Inlet marine invertebrate community is of low abundance, dominated by polychaetes, until reaching the mouth of the inlet (Saupe et al., 2005).

Secondary productivity at the seafloor of the upper Cook Inlet is generally low. Fukuyama et al. (2012) sampled benthic invertebrates at 44 locations in Cook Inlet. Arthropoda, dominated by the amphipods *Ischyrocerus* sp. and *Photis* sp., comprised about 12 percent of the total. Mollusca (mostly the bivalves *Ennucula tenuis* and *Axinopsida serricata*) accounted for 8 percent, and miscellaneous taxa and Echinodermata accounted for <1 percent. Distinct biological communities were found in different portions of Cook Inlet with a strong north to south gradient of increasing species diversity observed. The upper Cook Inlet was found to have much lower numbers of individuals and taxa, most likely due to the extreme physical conditions. These areas of extreme tidal currents, low salinity, and high turbidity regimes produce environments with low total organic carbon and sediment fines, resulting in suboptimal environments for diverse and productive infaunal communities.

The Applicant conducted some sampling for benthic infauna at five locations near the Marine Terminal and found similar results (Table 31). Abundance (number of individuals) and richness (number of taxa) were found to be low in the sampled communities. Approximately 14 percent of the organisms in the samples were annelids, 34 percent were crustaceans, and 52 percent were miscellaneous taxa (primarily platyhelminths, nematodes, and nemerteans).

Table 31: Benthic Infaunal Sampling Results near Proposed Marine Terminal

Parameter	Sample Station [1]					
	1	2	3	4	5	All
Abundance [2]	8	9	25	41	28	111
Mean Abundance	-	-	-	-	-	22
Taxa Richness [3]	6	6	9	14	5	19
Mean Richness	-	-	-	-	-	8
Margalef's Index (SR)	2.40	2.28	2.49	3.50	1.20	3.82
Mean SR	-	-	-	-	-	2.37
Diversity H	2.53	2.42	2.82	3.64	2.03	3.74
Mean H	-	-	-	-	-	2.69
Evenness J	0.98	0.94	0.89	0.96	0.87	0.88
Mean J	-	-	-	-	-	0.93
Simpson's Index (SDV)	0.71	0.79	0.72	0.87	0.59	0.0.84
Mean SDV	-	-	-	-	-	0.74

[1] Samples collected in May 2016 in MOF dredge area, with 0.1 square meter KC Day sampler, an sieved with 0.5-mm mesh screen, one sample per station
[2] Number of organisms in a 0.1 m^2 sample, range (mean)
[3] Organisms per square meter, range (mean)
[4] Number of unique taxonomic classifications within the sample, range (mean)
[5] Margalef's species richness index, range (mean)
[6] Pielou index to species evenness J', range (mean)
[7] Shannon-Weiner index to diversity, range (mean)
[8] Simpson's diversity index SDV, range (mean)
Source: Marine Taxonomic Services, 2016

Organisms in the areas that would be disturbed by construction of the Project are adapted to the high-energy environment. They would be removed or killed through excavation or burial; however, re-colonization would be expected to occur relatively quickly. No areas of higher productivity such as razor clam beds, kelp, or eelgrass beds are known to occur in or near the Marine Terminal Area, along the Mainline route, or in the dredge disposal areas.

9.1.2. Water Quality Disturbance

The primary effects on water quality from construction of the Project in Cook Inlet would be the temporary suspension of sediment in the water column from dredging, trenching, and dredge disposal. The Project would also result in the discharge of hydrostatic test waters, and normal vessel discharges from construction vessels, including deck drainage (runoff of precipitation and deck wash water), ballast water, bilge water, non-contact cooling water, and gray water.

9.1.2.1. Water Quality Disturbance from Dredging/Trenching

Dredging operations during construction of the temporary MOF would cause a temporary, localized increase in turbidity and sedimentation in the marine waters of Cook Inlet. Turbidity and sedimentation rates are naturally high in the upper Cook Inlet due to the abundance of glacial sediments and strong currents. High suspended sediment concentrations characterize the entire upper Cook Inlet, with sediment loads increasing between the Forelands, at approximately 100 to 200 parts per million (ppm), to the Anchorage area at the head of the inlet, at levels greater than 2,000 ppm. Annual suspended-sediment load to Cook Inlet is more than 44 million tons (Brabets et al., 1999). High local tidal currents tend to keep this sediment suspended. Soils within Cook Inlet consist of silts, sands, granular material, cobbles, and boulders—all can be moved by the tidal fluctuations (U.S. Environmental Protection Agency, 2002). Additional mobilization of sediment is not anticipated to have significant impact.

The preferred disposal area for dredged materials consists of one of two offshore unconfined aquatic disposal sites located within 8 km (5 miles) of the dredged area (Figure 2 above), with water depths greater than 24 meters (80 feet) and dispersive currents. The expected method of dredge disposal would be a split hull barge over the disposal site. The strong tidal currents of Cook Inlet would naturally disperse the sediment from the disposal site. Disposal of dredged sediments would cause a localized, short-term increase in turbidity and sedimentation near the disposal site for the duration of disposal activities. Currents would be expected to rapidly entrain and remobilize any sediment deposited.

9.1.2.2. Water Quality Disturbance from Hydrostatic Testing

Approximately 10 million gallons of Cook Inlet seawater would be required to conduct hydrostatic testing of the offshore segment of the Mainline. After use, the hydrostatic test water would be discharged back to Cook Inlet according to regulatory requirements and permit conditions. Because Cook Inlet would be the water source and the pipe in which the water has been held would be on the Cook Inlet seafloor, there would be little difference in the physical characteristics of the discharge water and the receiving water body such as temperature and salinity. Because Cook Inlet is a high-energy system with strong currents, extreme tides, and short tidal exchange rate, the discharge would mix quickly and have few if any noticeable effects on ambient waters.

The discharge would be permitted with the Alaska Department of Environmental Conservation (ADEC) under its Alaska Pollutant Discharge Elimination System, and would be conducted in a manner that meets applicable regulatory requirements.

9.2. Potential Impacts on Food Sources from Sound Generation

9.2.1. Zooplankton

Zooplankton is a food source for several marine mammal species, including humpback whales, as well as a food source for fish that are prey for marine mammals. Population effects on zooplankton could therefore have indirect effects on marine mammals. The primary generators of sound energy associated with construction of the Project include anchor handling and vessel docking, dredging, and pile driving. Popper and Hastings (2009) reviewed information on the effects of pile driving and concluded that there are no substantive data on whether the high sound levels from pile driving or any man-made sound would have physiological effects on invertebrates. Any such effects would be limited to the area very near (1–5 meters [3.2–16.4. feet])]) the sound source and would result in no population effects due to the relatively small area affected at any one time and the reproductive strategy of most zooplankton species (short generation, high fecundity, and very high natural mortality).

No adverse impact on zooplankton populations would be expected to occur from pile driving, due in part to large reproductive capacities and naturally high levels of predation and mortality of these populations. Any mortalities or impacts that might occur would be expected to be negligible compared to the naturally occurring high reproductive and mortality rates. Impacts from sound energy generated by vessels and dredging would be expected to have even less impact, as these activities produce much lower sound energy levels.

9.2.2. Benthos

In Cook Inlet, the benthos is a food source for marine mammals such as sea otters. They are generally not a food source for NMFS species, but are a food source for fish that are prey for marine mammals. No adverse impacts on benthic populations would be expected due in part to large reproductive capacities and naturally high levels of predation and mortality of these populations. Any mortalities or impacts that might occur because of operations is negligible compared to the naturally occurring high reproductive and mortality rates.

9.2.3. Fish

Fish are a food source for all marine mammals in Cook Inlet. Fish have been shown to react when engine and propeller sounds exceeds a certain level (Olsen et al., 1983; Ona, 1988; Ona and Godo, 1990). Avoidance reactions have been observed in fish such as cod and herring when vessel sound levels were 110–130 dB re 1 µPa rms (Nakken, 1992; Olsen, 1979; Ona and Godo, 1990; Ona and Toresen, 1988). Vessel sound source levels in the audible range for fish are typically 150–170 dB re 1 µPa/Hz (Richardson et al., 1995). The construction vessels during anchor handling and docking would be expected to produce levels of 170–175 dB re 1 µPa rms when in transit. Based upon the reports in the literature and the predicted sound levels from these vessels, there may be some avoidance by fish in the immediate area.

Pile driving has more potential to affect fish given the higher source levels and rapid rise times. Fish with swim bladders are particularly sensitive to underwater impulsive sounds due to swim bladder resonance; as the pressure wave passes through a fish, the swim bladder is rapidly squeezed as the high-pressure wave, and then under pressure component of the wave, passes through the fish. The swim bladder may repeatedly expand and contract at the high SPL, creating pressure on the internal organs surrounding the swim bladder. There have been several thorough reviews of the literature on the effects of pile driving on fish (Hastings and Popper, 2005; Popper and Hastings, 2009). The Fisheries Hydroacoustic Working Group (2008) provided criteria agreed to by the Federal Highway Administration, NMFS, U.S. Fish and Wildlife Service (USFWS), and various state agencies. Another working group (Popper et al., 2014) provided the guidelines in Table 32.

Table 32: NMFS Guidelines for Assessing Acoustical Impacts to Fish from Pile Driving

Type of Fish	Mortality and Potential Mortal Injury	Recoverable Injury	TTS	Masking	Behavior
No swim bladder	>219 dB SEL_{cum} or >213 dB_{peak}	>216 dB SEL_{cum} or >213 dB_{peak}	>>186 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Swim bladder not involved in hearing	210 dB SEL_{cum} or >207 dB_{peak}	203 dB SEL_{cum} or >207 dB_{peak}	186 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Swim bladder involved in hearing	207 dB SEL_{cum} or >207 dB_{peak}	203 dB SEL_{cum} or >207 dB_{peak}	186 dB SEL_{cum}	(N) High (I) High (F) Moderate	(N) High (I) High (F) Moderate

Source: Popper et al. (2014)

Several caged fish studies of the effects of pile driving have been conducted, and most have involved salmonids. Ruggerone et al. (2008) exposed caged juvenile coho salmon (93–135 millimeters) at two distance ranges (near 1.8–6.7 meters and distant 15 meters) to 0.5-meter-diameter steel piles driven with a vibratory hammer. Sound pressure levels reached 208 dB re 1 µPa peak, 194 dB re 1 µPa rms, and 179 dB re 1 μPa^2 s SEL, leading to a cumulative SEL of approximately 207 dB re 1 μPa^2 s during the 4.3-hour period. Observed behavioral responses of salmon to pile strikes were subtle; avoidance response was not apparent among fish. No gross external or internal injuries associated with pile driving sounds were observed. The fish readily consumed hatchery food on the first day of feeding (day 5) after exposure. The study suggests that coho salmon were not significantly affected by cumulative exposure to the pile driving sounds.

Hart Crowser, Inc. et al. (2009) similarly exposed caged juvenile (86–124 millimeters, 10–16 grams) coho salmon to sheet pile driving in Cook Inlet using vibratory and impact hammers. Sound pressures measured during the acoustic monitoring were relatively low, ranging from 177 to 195 dB re 1 µPa peak, and cumulative SEL sound pressures ranging from 179.2 to 190.6 dB re 1 μPa^2 s. No measured peak pressures exceeded the interim criterion of 206 dB. Six of the 13 tests slightly exceeded the SEL criterion of 187 dB for fish weighing more than 2 grams. No short-term or long-term mortalities of juvenile hatchery coho salmon were observed in exposed or reference fish, and no short- or long-term behavioral abnormalities were observed in fish exposed to pile driving sound pressures or in the reference fish during post-exposure observations.

The California Department of Transportation (Caltrans, 2010) exposed juvenile steelhead (*Onchorhynchus mykiss*) to a variety of peak SPLs and SELs at various distances (35–150 meters) from driving 2.2-meter-diameter cast-in-steel-shell piles driven immediately adjacent to the Mad River. Peak SPLs ranged from 69–188 dB re 1 µPa and cumulative SELs ranged from 179–194 dB re 1 μPa^2 s. No physical trauma was observed. Hematocrit and plasma cortisol levels were not significantly related to exposure to sound generated by pile driving.

Vessel docking and anchor handling are likely to have no more effect on fish than temporary habitat displacement/avoidance while the activity is conducted. Information in the literature indicates that pile driving could potentially result in injury or mortality to fish, but the results of *in situ* studies on salmonids indicates that such effects are unlikely. Any such effects would be minor given the size of the Cook Inlet and the area that would be affected.

9.3. Invasive Species

Vessels can impact habitat quality for marine mammals through the introduction of aquatic invasive organisms. Construction vessel traffic would arrive from Asia and could potentially transport non-native tunicates, green crab (*Carcinus maenas*), and Chinese mitten crab (*Eriocheir sinensis*) (ADF&G, 2002), which impact food webs and can outcompete native invertebrates, resulting in habitat degradation.

All vessels brought into the State of Alaska or federal waters are subject to U.S. Coast Guard (USCG) 33 CFR 151 regulations, which are intended to reduce the transfer of aquatic invasive organisms. Management of ballast water discharge is regulated by federal regulations (33 CFR 151.2025) that prohibit discharge of untreated ballast water into the waters of the United States unless the ballast water has been subject to a mid-ocean ballast water exchange (at least 200 nautical miles offshore). Vessel operators are also required to remove “fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations” (33 CFR 151.2035(a)(6). Adherence to the USCG 33 CFR 151 regulations would reduce the likelihood of Project-related vessel traffic introducing aquatic invasive species.

9.4. Potential Impacts from Habitat Contamination

9.4.1. Petroleum Release

Spills and leaks of oil or wastewater arising from the Project activities that reach marine waters could result in direct impacts to the health of exposed marine mammals. Individual marine mammals could show acute irritation or damage to their eyes, blowhole or nares, and skin; fouling of baleen, which could reduce feeding efficiency; and respiratory distress from the inhalation of vapors (Geraci and St. Aubin, 1990). Long-term impacts from exposure to contaminants to the endocrine system could impair health and reproduction (Geraci and St. Aubin, 1990). Ingestion of contaminants could cause acute irritation to the digestive tract, including vomiting and aspiration into the lungs, which could result in pneumonia or death (Geraci and St. Aubin, 1990).

Indirect impacts from spills or leaks could occur through the contamination of lower-trophic-level prey, which could reduce the quality and/or quantity of marine-mammal prey. In addition, individuals that consume contaminated prey could experience long-term effects to health (Geraci and St. Aubin, 1990).

The Project will meet applicable Federal and state legal requirements, and associated permit and approval conditions, for handling of petroleum during construction. These requirements are extensive and will minimize potential for release of petroleum to the marine environment and require extensive reporting and response in the event of a release.

9.4.2. Contamination and Waste

The Project is expected to comply with extensive local, state and Federal legal requirements for waste management and disposal. Impacts to marine mammals that are directly related to waste and waste disposal are not anticipated.

10. DESCRIPTION OF IMPACT FROM LOSS OR MODIFICATION TO HABITAT

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

In addition to noise impacts, marine mammal habitat could be affected by Project activities including habitat modification from dredging and spoil disposal activities, or impairment from incidental or accidental spills. Project activities that could potentially impact marine mammal habitats include temporary disturbance primarily through increases in underwater SPLs from pile driving and vessel propeller/thruster operation, and temporary habitat loss from dredging. The primary effect from pipelay might be permanent displacement of mobile benthic resources, such as crabs. However, upper Cook Inlet supports a low abundance and diversity of marine invertebrates (Saupe et al., 2005).

Five major rivers (Knik, Matanuska, Susitna, Little Susitna, and Beluga) deliver freshwater to upper Cook Inlet, carrying a heavy annual sediment load of over 40 million tons of eroded materials and glacial silt (Brabets, 1999). As a result, upper Cook Inlet is relatively shallow, averaging 18 meters (60 feet) in depth. A deep trough exists between Trading Bay and the Middle Ground Shoal, ranging from 64 to 140 meters (210 to 460 feet) deep (NOAA Nautical Chart 16660). The substrate consists of a mixture of coarse gravels, cobbles, pebbles, sand, clay, and silt (Bouma et al., 1978; Rappeport, 1982). Upper Cook Inlet experiences some of the most extreme tides in the world, as demonstrated by a mean tidal range from 4 meters (13 feet) at the Gulf of Alaska end to 28.8 feet near Anchorage (USACE, 2013). Tidal currents reach 6.6 feet/second (3.9 knots) (Mulherin et al., 2001) in upper Cook Inlet, increasing to 9.8 to 13 feet/second (5.7 to 7.7 knots) near the Forelands where the inlet is constricted. Each tidal cycle creates significant turbulence and vertical mixing of the water column in the upper inlet (USACE, 2013), and are reversing, meaning that they are marked by a period of slack tide followed an acceleration in the opposite direction (Mulherin et al., 2001). Because of scouring, mixing, and sediment transport from these currents, the marine invertebrate community is very limited (Pentec, 2005). Of the 50 stations sampled by Saupe et al. (2005) for marine invertebrates in Southcentral Alaska, their upper Cook Inlet station had, by far, the lowest abundance and diversity. Furthermore, the fish community of upper Cook Inlet is characterized largely by migratory fish—eulachon and Pacific salmon—returning to spawning rivers, or out-migrating salmon smolts. Moulton (1997) documented only 18 fish species in upper Cook Inlet compared to at least 50 species found in lower Cook Inlet (Robards et al., 1999).

Fish are a primary dietary component of the odontocete and pinniped species in Cook Inlet. Impact driving of steel piles can produce sound pressure waves that can injure and kill small fish (multiple sources as cited in NMFS 2005). Impacts of proposed pile driving are addressed further in the Essential Fish Habitat Assessment. In contrast to pile driving, vibratory pile driving does not produce the same percussive sound waves that are harmful to fish and has not resulted in any known fish kills (USFWS, 2004), and has been employed in Puget Sound partially as a mitigation measure to limit effects to fish. Vibratory hammer studies by Carlson (1996) in Oregon and Nedwell et al. (2003) in the United Kingdom have confirmed that fish are little impacted by this hammering method.

Short-term turbidity is a water quality effect of most in-water work, including installing piles. A study conducted during pile driving measured water quality before, during, and after pile removal and pile replacement (Roni and Weitkamp, 1996) and found that construction activity at the site had "little or no effect on dissolved oxygen, water temperature, and salinity", and turbidity (measured in nephelometric turbidity units [NTU]) at all depths nearest the construction activity was typically less than 1 NTU higher than stations farther from the construction area throughout construction. None of the marine mammals are expected to be close enough to the pile driving activity to experience turbidity. This fact, coupled with the fact that Cook Inlet currently carries a heavy sediment load naturally in the water column, means the impact from increased turbidity levels is expected to be negligible to marine mammals.

Dredging and dredge spoil placement would temporarily impact the benthic resources within the dredging and spoils footprint. However, few benthic resources are expected where the dredging would occur. The footprint of the pipelay on the Cook Inlet seafloor and the Marine Terminal facilities is less than 1 percent of the Cook Inlet beluga whale CHA-2.

10.1. Cook Inlet Beluga Whale Habitat

An assessment of potential impacts of the Project to Beluga Critical Habitat is outlined below using Primary Constituent Elements (PCEs) established by NMFS.

10.1.1. Cook Inlet Waters <30 feet Deep and within 5 Miles of Anadromous Streams

The shore crossing of the Mainline on the west side of Cook Inlet is located within 8 km (5 miles) of several anadromous streams (Threemile Creek, Indian Creek, and two unnamed streams). The shore crossing of the Mainline on the east side of Cook Inlet is also located within 8 km (5 miles) of an anadromous stream (Bishop Creek). The Marine Terminal is located more than 8 km (5 miles) from any anadromous stream. Trenching for the nearshore sections would result in increased suspended sediment load in the water column, but any such effects would be minor, temporary, and likely restricted to the area within 61 meters (200 feet) of the trenching activity. Trenching would result in the destruction and burial of benthic invertebrates in the footprint of the trench and any anchor scars. Benthic communities are generally sparse in Cook Inlet and adapted to the high-energy environment. The seafloor habitat would be re-colonized naturally by a similar community. Any effects would be temporary and minor given the amount of available habitat of this type within Cook Inlet.

10.1.2. Primary Beluga Prey Species

Construction of the Marine Terminal, pipelay, and construction vessel traffic would not be expected to have an effect on the beluga prey species (Pacific salmon, Pacific eulachon, Pacific cod, saffron cod, yellowfin sole) by the sound generated by pile driving or anchor handling, physical disturbance of the fish habitat, or discharges associated with vessels. Any acoustical effects on beluga prey resources would be negligible, if they were to occur.

10.1.3. Waters Free of Toxins or Other Agents Harmful to Beluga Whales

Hydrostatic test waters associated with Mainline construction would be discharged to Cook Inlet. Any such discharges would be conducted in accordance with ADEC permit stipulations and requirements and would have no harmful effects on beluga whales.

10.1.4. Unrestricted Passage Within or Between Critical Habitat Areas

Belugas may avoid areas where construction and pipelay activities would occur in Cook Inlet because of vessel activity, sound generated by the vessel traffic, dredging, trenching, pipelay, and increased turbidity. These activities would be conducted in open areas of Cook Inlet within CHA-2. Given the size and openness of Cook Inlet in the survey areas, and the small area and mobile/temporary nature of the zones of ensonification, the activities would not be expected to result in any restriction of passage of belugas within or between critical habitat areas. The program would have no effect on this PCE.

10.1.5. In-Water Noise Levels Below that which would Cause Abandonment by Belugas

Operation of the construction and pipelay equipment would generate sound with frequencies within the beluga hearing range and at levels above threshold values, and may result in temporary displacement of belugas. The greatest potential for such effects rests with the operation of vibratory or impact pile drivers at the Marine Terminal and anchor handling associated with Mainline trenching and pipelay. However, these effects are not likely to diminish the value of the PCE of the critical habitat for the conservation of Cook Inlet beluga whales. Whale movements between and among habitat areas are not likely to be impeded and the quantity and quality of prey are unlikely to be diminished. Impacts from sound energy are temporary, lasting only if the activity is being conducted. The areas of ensonification for received sound levels exceeding NMFS thresholds for Level B harassment of marine mammals are provided in Section 6. These areas represent small portions of the critical habitat area within CHA-2. This is the area in which beluga whales expand their spring-summer distribution during the late fall and winter months, and the area into which the beluga whale population will expand as it recovers. Water quality may occasionally be affected by small infrequent spills at the Marine Terminal that would have only minor and transitory effects on water quality, and larger spills associated with a catastrophic release of fuel oil or other contaminants are so unlikely as to be discountable.

In 2011, after designation of critical habitat for Cook Inlet beluga whales, NMFS issued a BiOp analyzing the effects of the Port of Alaska MTRP on critical habitat. Although the Port of Alaska was excluded from the critical habitat designation pursuant to Section 4(b)(2) of the ESA, the action area for the MTRP extended beyond the exclusion into areas that are designated. Despite the exclusion, NMFS analyzed the effect of the MTRP on the PCE values of habitat in the excluded area as well. NMFS found the values of shallow water foraging habitat, prey species abundance and availability, absence of toxins and other harmful agents, and unrestricted passage within and between areas were not likely to be affected by dredging, filling, or construction activities in the action area (including the excluded port areas). NMFS determined only the value "absence of in-water noise at levels resulting in the abandonment of habitat (PCE 5)" had the potential to adversely affect Cook Inlet belugas. In assessing the effect of the action on that value, NMFS determined that construction and operation of the expanded Port would introduce significant sound in the waters of Knik Arm. After review of available information on sources of noise, intensity and duration, and beluga responses, NMFS concluded: "It is unlikely that belugas would alter their behavior in a way that prevents them from entering and/or transiting through Knik Arm causing abandonment of critical habitat." Further, NMFS' BiOp concluded that the action, as proposed, is not likely to destroy or adversely modify Cook Inlet beluga whale critical habitat. NMFS' opinion indicated that critical habitat will remain functional and able to serve its intended conservation role for Cook Inlet beluga whales. In addition, in the BiOp issued for the Alaska LNG Project (NMFS, 2020b), NMFS determined that the level of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat. Therefore, the Project is not likely to adversely modify critical habitat for Cook Inlet beluga whales.

11. MEASURES TO REDUCE IMPACTS TO MARINE MAMMALS

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 on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

The activities of most concern regarding noise harassment to marine mammals include vibratory and impact pile driving and anchor handling. Pile driving is considered a discreet, non-routine action with the potential for Level A harassment. Anchor handling is of short duration and allows ample time for marine mammals to move away from the stimulus. Implementation of mitigation measures for anchor handling, such as shutdown zones, is impractical because to ensure safety and sound constructability of the pipeline, the process cannot be stopped once it has begun. Thus, mitigation measures are focused on pile driving. The Applicant will perform the required SSV study at the beginning of the pile driving to characterize the sound levels associated with different pile and hammer types, as well as to establish the marine mammal monitoring and mitigation zones. The Applicant will also work with the construction contractor, when selected, to identify potential for a noise attenuation system to further reduce sound levels from pile driving.

The Mainline crossing of Cook Inlet has been routed to the greatest extent practicable, outside of CHA-1 to minimize effects on Cook Inlet beluga whales and critical habitat. Contractors would comply with the legal requirements for spill prevention and control, including having a project specific Spill Prevention, Control, and Countermeasure Plan. In addition, the measures described in the Marine Mammal Mitigation and Monitoring Plan (4MP), would be implemented for noise and activity associated with construction activities and anchor handling. The 4MP is provided as Appendix A to this petition.

Project-related vessels would comply with applicable requirements in USCG 33 CFR 151 for ballast water discharge. Oil spill response plans for vessel groundings or other accidental releases of oil would be implemented as required by Federal and state laws and regulations.

11.1. Protected Species Observers

Protected Species Observers (PSOs) would monitor during pile driving and anchor handling activities. Two PSOs would be on watch during pile driving activities, rotating at least every four hours to minimize observer fatigue. PSOs would observe from the best vantage point near the pile driving activity, which would likely be at an elevated location on the construction site. High-powered binoculars (7x50 and Big Eyes [x100-150]) and the increased height of the observation platform would facilitate monitoring and mitigation efforts. PSOs would be responsible for initiating mitigation measures, such as requesting a shutdown or power down to reduce sound levels when marine mammals are observed within the applicable acoustic zones.

For safety and sound constructability of the pipeline, anchor handling cannot be stopped once the activity has begun. Two PSOs would be stationed on the pipe-laying barge during pipe laying operations. The PSOs would rotate at least every four hours to minimize observer fatigue, and one PSO would be on watch during pipe laying operations. In addition, PSOs would monitor for marine mammals and record sightings data, including distance and heading relative to the PSO, behavior, pace, potential reactions to activities, etc.

11.2. In-Water Activity Mitigation Measures

The Applicant would implement PSOs to oversee marine mammals during pile driving and pipe laying in-water activities. Monitoring would commence 30 minutes before and continue until 30 minutes after these activities. Should marine mammals enter the exclusion zone, operations would pause until the area is clear. Upon sighting a marine mammal, contractors would wait 30 minutes for large cetaceans, such as humpback whales, and 15 minutes for smaller cetaceans, like belugas, killer whales, harbor porpoises, and pinnipeds, before resuming work. If no further sightings occur within these intervals, it's presumed the animal has left the exclusion zone. If pile driving stops for 30 minutes or more and a marine mammal is detected within the exclusion zone, the PSO would alert the authorized individual and monitor the area. Construction operations would only restart once the marine mammal has left the exclusion zone or after the stipulated waiting period post-sighting.

The Applicant would implement the following timing restrictions, exclusion zones, and monitoring distances to mitigate impacts for in-water activities.

- In-water pile driving would occur only during daylight hours. Times for other construction activities, such as pipe laying, anchor handling, and dredging would not be restricted.
- Pile driving associated with the Mainline MOF would not occur from June 1 to September 7 (pile driving can occur from September 8 to May 31).
- Other than in-water sheet pile driving and pile removal, anchor handling, trenching, pipe laying, and vessel transits related to these activities, the Applicant would not engage in in-water sound-producing activities that produce sound levels in excess of 120 dB rms re 1µPa @ 1 m within 10 miles (16 km) of MHHW line of the Susitna Delta (Beluga River to the Little Susitna River) between April 15 and October 15.
- For all relevant in-water construction activity, the Applicant has designated Level A and Level B harassment zones with radial distances as identified in Table 33.
- For all in-water pile driving work, the Applicant would implement an exclusion zone for each specific activity as identified in Table 33. If a marine mammal comes within or enters the exclusion zone, the Project would cease all operations.
- A 2,900-meter exclusion zone would be established for Cook Inlet beluga whale before pipe laying activity associated with anchor handling could occur.

Soft start would be required for impact driving, including at the beginning of the day, and following a cessation of impact pile driving of 30 minutes or longer. The Applicant would implement soft start techniques for impact driving as follows.

- Initial hammering starts will not begin during periods of poor visibility (e.g., night, fog, wind).

- Conduct an initial set of three strikes from the impact hammer at 40 percent energy, followed by a 30-second waiting period, followed by a one-minute waiting period, then two subsequent three strike sets with associated 30-seconds waiting periods at the reduced energy.
- For pile-driving at the Mainline MOF near the Beluga River, and on the east side of Cook Inlet near Nikiski associated with the liquefaction facility, the Applicant would deploy noise attenuation device (bubble curtain) around piles. If the SSV study measurements indicate that the best-performing bubble curtain configuration provides less than a 2 dB reduction in in-water sound beyond the bubble curtain, use of the bubble curtain may be discontinued.

Table 33: Marine Mammal Exclusion Zones

Activity	Level A Shutdown Zone Radius (m)					Level B Zone Radius (m)
	LF Cetaceans	HF Cetaceans	VHF Cetaceans	Phocids	Otariids	All Marine Mammals
PLF impact pile driving	3,200	250	2,400	1,100	200	3,600
Temporary MOF impact pile driving	3,300	250	1,800	1,000	250	3,600
Temporary MOF vibratory pile driving	300	250	250	250	--	5,600
Mainline MOF vibratory pile driving	300	250	250	250	--	3,200
Mainline MOF impact pile driving	1,200	250	1,000	650	300	800
Anchor Handling	--	--	--	--	--	2,900

11.3. Vessel Transit Mitigation Measures

Operators of vessels would avoid approaching marine mammals within 100 yards (approximately 92 meters). Operators will observe direction of travel of marine mammals and attempt to maintain a distance of 100 yards (92 meters) or greater between the animal and the vessel by working to alter vessel course or velocity.

The vessel operator would avoid placing the vessel between members of a group of marine mammals in a way that may cause separation of individuals in the group from other individuals in that group. A group is defined as being three or more whales observed within 500-meters (547 yards) of one-another and displaying behaviors of directed or coordinated activity (e.g., migration or group feeding).

If the vessel approaches within 1.6 km (1-mile) of one or more whales, the vessel operator would take reasonable precautions to avoid potential interaction with the whales by taking one or more of the following actions, as appropriate:

- Steering to the rear of whale(s) to avoid causing changes in their direction of travel.
- Maintaining vessel speed of 10 knots (19 km/hour) or less when transiting to minimize the likelihood of lethal vessel strikes.
- Reducing vessel speed to less than 5 knots (9 km/hour) within 274 meters (300 yards) of the whale(s).

Project vessels would remain a minimum of 2.8 km (1.5 nm) seaward of MLLW line between the Little Susitna River and -150.80 degrees west longitude to minimize the impacts of vessel sound and avoid strikes on Cook Inlet beluga whales between June 1 and September 7. The Susitna Delta Exclusion Zone is defined by:

- A 16-km (10-mile) buffer of the Beluga River thalweg seaward of the MLLW line;
- A 16-km (10-mile) buffer of the Little Susitna River thalweg seaward of the MLLW line;
- A 16-km (10-mile) seaward buffer of the MLLW line between the Beluga River and Little Susitna River; and.
- The buffer extends landward along the thalweg to include intertidal waters within rivers and streams up to their MHHW. The seaward boundary has been simplified so that it is defined by lines connecting readily discernable landmarks.

12.MEASURES TO REDUCE IMPACTS TO SUBSISTENCE USERS

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, the applicant must submit either a plan of cooperation 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.

Regulations at 50 CFR 216.104(a)(12) require applicants for activities that take place in Arctic waters to provide a Plan of Cooperation or information that identifies what measures have been taken and/or would be taken to minimize adverse effects on the availability of marine mammals for subsistence purposes. NMFS regulations define Arctic waters as waters above 60° N latitude. Much of Cook Inlet is north of 60° N latitude.

NMFS makes distinctions between waters in in Cook Inlet and waters of the Chukchi Sea and Beaufort Sea, more commonly thought of as Arctic (above the Arctic Circle). Because the level of subsistence hunting of marine mammals in Cook Inlet is low, a detailed Plan of Cooperation is not provided as part of this petition. Additionally, Tribal members from Seldovia, Port Graham, and Nanwalek are located more than 70 miles south of the proposed Project Area. The community of Nikiski reported low subsistence harvests (Jones and Kostick, 2016) and Tyonek’s distance to the Project Area is thought to minimize impacts to subsistence harvest.

The Applicant has met and would continue to meet with stakeholders throughout Cook Inlet, including many of the villages and traditional councils throughout the Cook Inlet region. The Applicant has identified the following measures, which is intended to reduce impacts to subsistence users: In-water activities would follow mitigation procedures to minimize effects on the behavior of marine mammals and, therefore, opportunities for harvest by Alaska Native communities.

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.

During the Project, the Applicant proposes to implement a marine mammal monitoring and mitigation strategy that would reduce impacts to marine mammals to the lowest extent practicable. The monitoring plan includes two general components, acoustic measurements and visual observations. The Applicant would develop a detailed Marine Mammal Monitoring and Mitigation Plan for the Project each year construction activities covered under this petition were expected to occur. Standard monitoring mechanisms are summarized in this section. The Marine Mammal Monitoring and Mitigation Plan would be implemented for in-water activities that have potential to impact marine mammals as described in this petition.

13.1. Sound Source Verification

The Applicant would perform a SSV study for impact pile driving for each pile and hammer type and during anchor handling to determine the actual distances to the 160 dB re 1µPa rms isopleths, which are used by NMFS to define the Level B harassment zone for marine mammals for these activities. The Applicant may also conduct acoustic monitoring for vibratory pile driving to determine the actual distance to the 120 dB re 1µPa rms isopleth for behavioral harassment relative to background levels.

13.2. Protected Species Observations

The Applicant would implement a robust monitoring and mitigation program for marine mammals using NMFS-approved PSOs. The activities will use land-based or vessel-based PSOs, depending on the project-specific activities. The Applicant recognizes some details of the monitoring and mitigation program may change upon receipt of the individual LOAs issued by NMFS each year.

The specific objectives of the monitoring and mitigation program provide:

- The basis for real-time mitigation, as required by the various permits;
- The information needed to estimate the number of “takes” of marine mammals by harassment, which must be reported to NMFS;
- Data on the occurrence, distribution, and activities of marine mammals in the areas where the Petition activity was conducted; and,
- Information to compare the distances, distributions, behaviors, and movements of marine mammals relative to the Petition activities.

PSOs would be on watch during daylight periods for project-specific activities that have the potential to impact marine mammals. The observer(s) will watch for marine mammals from the best available vantage point on the vessel or shore-based station, typically an elevated location from which the PSO has an unobstructed 360° view of the water. The PSOs would scan systematically with the naked eye and with binoculars. When a marine mammal is observed, the following information about the sighting would be recorded:

- Species, group size, age/sex categories (if determinable), behavior, heading (if consistent), bearing and distance from the PSO, apparent reaction to activities, closest point of approach, and behavioral pace.
- Time, location, and Project activity.
- Environmental conditions such as sea state, cloud cover, precipitation, visibility, and sun glare will also be recorded at the start and end of each observation watch, every 30 minutes during a watch, and whenever there is a change in any of those variables.

An electronic database would be used to record and collate data obtained from visual observations.

The Applicant proposes to have two shore-based PSOs on watch during pile driving activities, and one vessel-based PSO on watch during pipe laying activities. To reduce observer fatigue, monitoring shifts would not exceed four hours. PSOs would be outfitted with high-powered binoculars (7x50 and Big Eyes [x100-150), to assist with observations.

13.3. Reporting

PSO monitoring results, including estimates of exposure to key sound levels, would be presented in weekly, monthly, and 90-day reports. Reporting would address the requirements established by NMFS in the LOAs. The technical report(s) would include:

- Summaries of monitoring effort: total hours, total distances, and distribution of marine mammals throughout the study period compared to sea state, and other factors affecting visibility and detectability of marine mammals;
- Analyses of the effects of various factors influencing detectability of marine mammals: sea state, number of observers, and fog/glare;
- Species composition, occurrence, and distribution of marine mammal sightings including date, group size, location, and age//sex categories (when discernable);
- Analyses of the effects of the construction activities:
    - Sighting rates of marine mammals during periods with and without project activities (and other variables that could affect detectability);
    - Initial sighting distances versus project activity;
    - Closest point of approach versus project activity;

- Observed behaviors and types of movements versus project activity;
- Numbers of sightings/individuals seen versus project activity;
- Distribution around the vessels versus project activity;
- Summary of implemented mitigation measures; and
- Estimates of “take by harassment”.

14. RESEARCH COORDINATION

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

To minimize the likelihood that impacts would occur to the species, stocks, and subsistence use of marine mammals, Project activities would be conducted in accordance with applicable federal, state, and local regulations. The Applicant would cooperate with other marine mammal monitoring and research programs taking place in Cook Inlet to coordinate research opportunities when feasible. The Applicant would also assess mitigation measures that can be implemented to eliminate or minimize any impacts from these activities.

Marine mammal monitoring would be conducted to collect information on presence of marine mammals within the disturbance and injury zones for this Project. Results of monitoring efforts from the Project would be provided to NMFS in a draft summary report within 90 days of the conclusion of monitoring. This information could be made available to regional, state, and federal resource agencies, universities, and other interested private parties upon written request to NMFS. The monitoring data would inform NMFS and future permit applicants about the behavior and adaptability of pinnipeds and cetaceans for future projects of a similar nature.

Prior to the start of construction activities each year, the Applicant would attempt to identify other monitoring programs in Cook Inlet so that information on species sightings can be shared among programs to minimize impacts.

15.REFERENCES

Alaska Department of Fish and Game. 2002. Alaska aquatic nuisance species management plan Available online at: http://www.adfg.alaska.gov/FedAidPDFs/RIR.5J.2002.10.pdf. Accessed October 3, 2015.

Alaska Fisheries Science Center (AFSC). 2020. AFSC/RACE/GAP/Zimmermann: Cook Inlet Bathymetry Features from 2010-06-15 to 2010-08-15. NOAA National Centers for Environmental Information, https://inport.nmfs.noaa.gov/inport/item/22167.

Allen, B.M. and R.P. Angliss. 2014. Alaska marine mammal stock assessments, 2013. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-AFSC-277, 294 p.

Allen, B. M., and R. P. Angliss. 2015. Alaska marine mammal stock assessments, 2014. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS AFSC-301, 304 p. doi:10.7289/V5NS0RTS.

Austin, M., S. Denes, J. MacDonnell, and G. Warner. 2016. *Hydroacoustic Monitoring Report*: Anchorage Port Modernization Project Test Pile Program. Version 3.0. Technical report by JASCO Applied Sciences for Kiewit Infrastructure West Co.

Awbrey, F.T., J.A. Thomas, and R.A. Kasetelein. 1988. Low frequency underwater hearing sensitivity in belugas, *Delphinapterus leucas*. Journal of the Acoustical Society of America 84:2273-2275.

Barlow J. 1988. Harbor porpoise, *Phocoena*, abundance estimation for California, Oregon, and Washington: I. Ship surveys. Fishery Bulletin 86:417-432.

Barlow, Jay, J. Calambokidis, E.A. Falcone, C.S. Baker, A.M. Burdin, P.J. Clapham, and J.K.B. Ford. 2011. Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Marine Mammal Science 27:793-818.

Blackwell, S.B. 2005. Underwater measurements of pile-driving sounds during the Port MacKenzie dock modifications, 13-16 August 2004. Prepared for Knik Arm Bridge and Toll Authority by Greeneridge Sciences, Inc. and LGL Alaska Research Associates, Inc., at the request of HDR Alaska, Inc. Goleta, CA.

Blackwell, S.B. and C.R. Greene, Jr., 2003. Acoustic measurements in Cook Inlet, Alaska, during August 2001. Greeneridge Rep. 271-2. Revised June 2003. Prepared by Greeneridge Sciences, Inc., Santa Barbara, Calif., for National Marine Fisheries Service, Anchorage.

Bouma, A.H., M.A. Hampton, J.W. Whitney, and W.G. Noonan. 1978. Physiography of Lower Cook Inlet, Alaska. U.S. Geological Survey Open-File Report 78-728.

Boveng, P.L., J.M. London, and J.M. VerHoef. 2012. Distribution and abundance of harbor seals in Cook Inlet, Alaska. Task III: Movements, marine habitat use, diving behavior, and population structure, 2004-2006. Final Report. BOEM Report 2012-065. BOEM, Alaska OCS Region, Anchorage, AK. 58 pp.

Brabets et al. 1999. Water-Quality Assessment of the Cook Inlet Basin, Alaska – Environmental Setting. U.S. Geological Survey Water-Resources Investigations Report 99-4025.

Brueggeman, J.J., M. Smultea, H. Goldstein, S. McFarland, and D. J. Blatchford. 2007a. 2007 spring marine mammal monitoring program for the ConocoPhillips Beluga River seismic operations in Cook Inlet Alaska: 90-day report. Prepared by Canyon Creek Consulting for ConocoPhillips Alaska, Inc.

Brueggeman, J.J., M. Smultea, K. Lomac-MacNair, D. J. Blatchford, and R. Dimmick. 2007b. 2007 fall marine mammal monitoring program for the Union Oil Company of California Granite Point seismic operations in Cook Inlet Alaska: 90-day report. Prepared by Canyon Creek Consulting for Union Oil Company of California.

Bureau of Ocean Energy Management (BOEM). 2023. Center for Marine Acoustics, Sound source list: a description of sounds commonly produced during ocean exploration and industrial activity. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. 69 p. Report No.: BOEM OCS 2023-016.

California Department of Transportation (Caltrans). 2010. Mad River bridges replacement project: effects of pile driving sound on juvenile steelhead. CALTRANS, Eureka, CA. 22 pp.

Caltrans. 2015. *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish.* Prepared by ICF Jones & Stokes and Illingworth and Rodkin. Sacramento, CA. November 2015.

Caltrans. 2020. *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish.* Prepared by ICF International, Illingworth and Rodkin, Inc.

Calkins, D.G. 1989. Status of beluga whales in Cook Inlet. Pp. 109-112 *in* Jarvela L.E., Thorsteinson L.K. (eds) Proceedings of the Gulf of Alaska, Cook Inlet, and North Aleutian Basin Information Update Meeting, Anchorage, AK, Feb. 7-8. U.S. Dept. Commerce, NOAA, OCSEAP, Anchorage, AK.

Carlson, T.J. 1996. The Characterization of Underwater lnfrasound Generated by Vibratory Pile Driving Within the Context of the Characteristics of Sound Known to Result in Avoidance Response by Juvenile Salmonids. Thesis. Oregon State University. 17 pp.

Carr, S.A., M.H. Laurinolli, C.D.S Tollefsen and S.P. Turner. 2006. Cacouna Energy LNG Terminal: Assessment of Underwater Noise Impacts. Technical report by JASCO Applied Sciences for Golder Associates Ltd, February 8 2006.

Crocker, Steven E. and Frank D. Fratantonio. 2016. Characteristics of Sounds Emitted During High-Resolution Marine Geophysical Surveys. Naval Undersea Warfare Center Division Newport, Rhode Island. 259 pp.

Dahlheim, M., A. York, R. Towell, J. Waite, and J. Breiwick. 2000. Harbor porpoise (*Phocoena phocoena*) abundance in Alaska: Bristol Bay to Southeast Alaska, 1991-1993. Marine Mammal Science 16:28-45.

Di Iori, L. and C.W. Clark. 2010. Exposure to seismic survey alters blue whale acoustic communication. Biology letters 6:51-54. http://rsbl.royalsocietypublishing.org/content/roybiolett/6/1/51.full.pdf

Federal Energy Regulatory Commission (FERC). 2020. Alaska LNG Project, Final Environmental Impact Statement, Volumes 1-3, FERC/EIS-0296F. FERC Docket No. CP17-178-000. March. ferc.gov.

Field, C. and C. Walker. 2003. Kachemak Bay Research Reserve, a unit of the National Estuarine Research Reserve System: A site profile of the Kachemak Bay Research Reserve. Homer, AK.

Finneran, J.J. 2003. Whole-lung response in a bottlenose dolphin (*Tursiops truncates*) and white whale (*Delphinapterus leucas*). J. Acous. Soc. 114:529-535.

Finneran, J.J., C.E. Schlundt, R. Dear, D.A. Carder, and S.H. Ridgway. 2002. Temporary shift in masked hearing thresholds (MTTS) in odontocetes after exposure to single underwater impulses from a seismic watergun. Journal of the Acoustical Society of America 111:2929-2940.

Finneran, J.J., D.A. Carder, C.E. Schlundt, and S.H. Ridgway. 2005. Temporary threshold shift in bottlenose dolphins (*Tursiops truncatus*) exposed to mid-frequency tones. J. Acoust. Soc. Am. 118(4):2696-2705.

Finneran, J.J., D. A. Carder, R. Dear, T. Belting, J. McBain, L. Dalton, and S. H. Ridgway. 2005. Pure tone audiograms and possible aminoglycoside-induced hearing loss in belugas (*Delphinapterus leucas*). Journal of Acoustical Society of America 117:3936-3943.

Fisheries Hydroacoustic Working Group. 2008. Agreement in principle for interim criteria for injury to fish from pile driving activities. Memorandum 4 pp.

Foote, A.D., R.W. Osborne, and A.R. Hoelzel. 2004. Whalecall response to masking boat noise. Nature 428:910.

Fukuyama, A.K., Gillingham, G., and Hartwell, S.I. 2012. Integrated Cook Inlet Environmental Monitoring and Assessment Program (ICIEMAP): Benthic Infaunal Communities. Alaska Marine Science Symposium, Anchorage Alaska. January 2012.

Geraci, J.R., and St. Aubin, D.J. (eds.), 1990. Sea Mammals and Oil: Confronting the Risks, Academic Press, San Diego, CA, 282 pp.

Goetz, K.T., P.W. Robinson, R.C. Hobbs, K.L. Laidre, L.A. Huckstadt, and K.E.W. Shelden. 2012. Movement and dive behavior of beluga whales in Cook Inlet, Alaska. AFSC Processed Rep. 2012-03, 40 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.

Goetz, K.T., Shelden, K.E.W., Sims, C.L., Waite, J.M., and Wade, P.R. 2023. Abundance of belugas (*Delphinapterus leucas)* in Cook Inlet, Alaska, June 2021 and June 2022. AFSC Processed Rep. 2023-03, 47 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.

Hannay, D., A. MacGillivray, M. Laurinolli, and R. Racca. 2004. *Sakhalin Energy: Source Level Measurements from 2004 Acoustics Program*, Ver. 1.5. Technical report prepared for Sakhalin Energy by JASCO Research Ltd., December 2004.

Hansen, D.J., and J.D. Hubbard. 1999. Distribution of Cook Inlet beluga whales (*Delphinapterus leucas*) in winter. Final Rep. OCS Study. MMS 99-0024. U.S. Department of the Interior, Minerals Management Service. Alaska OCS Region, Anchorage, AK.

Harris, R.E., Miller, G.W. and W.J. Richardson. 2001. Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. Mar. Mamm. Sci. 17(4):795-812.

Hart Crowser, Inc./Pentec Environmental and Illingworth & Rodkin, Inc. 2009. Acoustic monitoring and in-situ exposures of juvenile coho salmon to pile driving noise at the Port of Anchorage Marine Terminal Redevelopment Project, Knik Arm, Anchorage, Alaska. Prepared for URS Corporation, ICRC, and Maritime Administration. Oct 21, 2009.

Hartin, K.G., C.M. Reiser, D.S. Ireland, R. Rodrigues, D.M.S. Dickson, J. Beland, and M. Bourdon. 2013. Chukchi Sea vessel-based monitoring program. (Chapter 3) In: Funk, D.W., C.M. Reiser, D.S. Ireland, R. Rodrigues, and W.R. Koski (eds.). 2013. Joint Monitoring Program in the Chukchi and Beaufort seas, 2006–2010. LGL Alaska Report P1213-2, Report from LGL Alaska Research Associates, Inc., LGL Ltd., Greeneridge Sciences, Inc., and JASCO Research, Ltd., for

Hastings, M.C. and A.N. Popper. 2005. Effects of sound on fish. California Department of Transportation (Caltrans). Contract 43A0139 Task Order 1.

Hobbs, R.C. 2013. Detecting changes in population trends for Cook Inlet beluga whales (*Delphinapterus leucas*) using alternative schedules for aerial surveys. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-252, 25 p.

Hobbs, R.C. and J.M. Waite. 2010. Abundance of harbor porpoise (*Phocoena phocoena*) in three Alaskan regions, corrected for observer errors due to perception bias and species misidentification, and corrected for animals submerged from view. Fishery Bulletin 108:251-267.

Hobbs, R. C., Shelden, K. E. W., Rugh, D.J. and S.A Norman. 2008. *2008 status review and extinction risk assessment of Cook Inlet belugas*. AFSC Processed Report 2008-02, 116 p. Alaska Fisheries Science Center, NOAA, National Marine Fisheries Service. 7600 Sand Point Way NE, Seattle, WA 98115.

Hobbs, R.C., K.L. Laidre, D.J. Vos, B.A. Mahoney, and M. Eagleton. 2005. Movements and Area Use of Belugas, *Delphinapterus leucas*, in a Subarctic Alaskan Estuary. Arctic 58(4), 331-340.

Illingworth & Rodkin, Inc. 2007. Compendium of pile driving sound data. Report prepared for California Department of Transportation (Caltrans). Illingworth & Rodkin, Inc., Petaluma, CA.

Illingworth & Rodkin, Inc. 2013 Cook Inlet Exploratory Drilling Program – Underwater Sound Source Verification Assessment. Report prepared for BlueCrest Energy, Inc. Illingworth & Rodkin, Inc., Petaluma, CA. 20 pp.

Johnson, C.S., McManus, M.W. and D. Skaar. 1989. Masked tonal hearing thresholds in the beluga whale. Journal of the Acoustical Society of America 85:2651–54.

Johnston, D.W. 2002. The effect of acoustic harassment devices on harbour porpoises (*Phocoena phocoena*) in the Bay of Fundy, Canada. Biological Conservation 108:113-118.

Jones, B, D. Holen, and D. S. Koster. 2015. The Harvest and Use of Wild Resources in Tyonek, Alaska, 2013. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 404. Anchorage.

Jones, B and M.L. Kostick. 2016. The Harvest and Use of Wild Resources in Nikiski, Seldovia, Nanwalek, and Port Graham, Alaska, 2014. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 420. Anchorage.

Kastak, D., B.L. Southall, R.J. Schusterman and C. Reichmuth Kastak. 2005. Underwater temporary threshold shift in pinnipeds: effects of noise level and duration. J. Acoust. Soc. Am. 118(5):3154-3163.

Kendall, L.S., K. Lomac-MacNair, G. Campbell, S. Wisdom, and N. Wolf. 2015. *SAExploration 2015 Cook Inlet 3D Seismic Surveys Marine Mammal Monitoring and Mitigation Report*. Prepared for National Marine Fisheries Service Permits and Conservation Division Office of Protected Resources 1315 East-West Highway Silver Spring, MD 20910, National Marine Fisheries Service, Alaska Region Protected Resources Division 222 W. 7th Ave, #43, Anchorage, AK 99513, and U.S. Fish and Wildlife Service 1011 East Tudor Rd. Anchorage, AK 99503. Prepared by Fairweather Science 301 Calista Court, Anchorage, AK 99518. 12.18.2015.

Ketten, D.R. 1994. Functional analysis of whale ears: adaptations for underwater hearing. IEEE Proc. Underwater Acoustics 1:264-270.

Kryter, K.D. 1985. The effects of noise on man, 2nd ed. Academic Press, Orlando, FL. 688 p.

Laidre, K.L., Shelden, K.E.W., Rugh, D.J., and B. Mahoney. 2000. Beluga, *Delphinapterus leucas*, distribution and survey effort in the Gulf of Alaska. Mar. Fish. Rev. 62(3):27-36.

LGL Alaska Research Associates, Inc., JASCO Applied Sciences, Inc., and Greeneridge Sciences, Inc. 2014. Joint Monitoring Program in the Chukchi and Beaufort Seas, 2012. LGL Alaska Final Report P1272-2 for Shell Offshore, Inc. ION Geophysical, Inc., and Other Industry Contributors, National Marine Fisheries Service, and U.S. Fish and Wildlife Service. 320 p. plus Appendices. http://www.nmfs.noaa.gov/pr/permits/incidental/oilgas/ion_shell_2012iha_jmp_final_comprpt.pdf.

Ljungblad, D.K., B. Würsig, S.L. Swartz, and J.M. Keene. 1988. Observations on the behavioral responses of bowhead whales (*Balaena mysticetus*) to active geophysical vessels in the Alaskan Beaufort Sea. Arctic 41(3):183-194.

Locarnini, R.A., A.V. Mishonov, O.K. Baranova, T.P. Boyer, M.M. Zweng, H.E. Garcia, J.R. Reagan, D. Seidov, K.W. Weathers, C.R. Paver, and I.V. Smolyar. 2019. World Ocean Atlas 2018, Volume 1: Temperature. A. Mishonov, Technical Editor. NOAA Atlas NESDIS 81, 52pp.

Lomac-MacNair, K., M.A. Smultea and G. Campbell. 2014. Draft NMFS 90-Day Report for Marine Mammal Monitoring and Mitigation during Apache's Cook Inlet 2014 Seismic Survey, 2 April – 27 June 2014. Prepared for Apache Alaska Corporation, 510 L Street #310, Anchorage AK 99501. Prepared by Smultea Environmental Sciences (SES), P.O. Box 256, Preston, WA 98050.

Lomac-MacNair, K.S., Kendall, L.S., and S. Wisdom. 2013. Marine Mammal Monitoring and Mitigation, 90-Day Report, May 6- September 30, 2012, Alaska Apache Corporation 3D Seismic Program, Cook Inlet, Alaska. Prepared by SAExploration 8240 Sandlewood Pl. Suite 102 Anchorage, AK and Fairweather Science 9525 King Street, Anchorage, AK. Prepared for Apache Alaska Corporation and National Marine Fisheries Service. 87 p.

Lucke, K., U. Siebert, P.A. Lepper, and M.A. Blanchet. 2009. Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli. Journal of the Acoustical Society of America 125(6):4060-4070.

MacGillivray, A., G. Warner, R. Racca, and C. O'Neill. 2011. Tappan Zee Bridge construction hydroacoustic noise modeling: Final report. Report by JASCO Applied Sciences for AECOM. 63 pp.

Mackenzie, K.V. 1981. *Nine-term equation for the sound speed in the oceans.* Journal of the Acoustical Society of America 70(3), pp 807-812.

Mahoney, B.A. and K.E.W. Shelden. 2000. Harvest history of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska. Marine Fisheries Review 62(3), 124-133.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J.E. Bird. 1983. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior (BBN Report No. 5366; NTIS PB86-174174). Report from Bolt Beranek and Newman Inc. for U.S. Minerals Management Service, Anchorage, AK.

Markowitz, T.M. and T.L. McGuire, eds. 2007. Temporal-spatial distribution, movements and behavior of beluga whales near the Port of Anchorage, Alaska. Report from LGL Alaska Research Associates, Inc., Anchorage, AK, for Integrated Concepts and Research Corporation and the U.S. Department of Transportation Maritime Administration.

Marine Taxonomic Services. 2016. Benthic infaunal sampling and analysis of samples collected for AK LNG dredge material sampling characterization project in Nikiski, AK 2016. Attachment 16 Benthic testing report by Marine Taxonomic Services, in CH2M. Nikiski Capital Dredge Material Characterization Report. AKLNG-4040-MAR-RTA-DOC-00088. Report prepared for Alaska Gasline Development Corporation, Anchorage, AK. 239 pp.

McCauley, R.D., Jenner, M.N., Jenner, C., McCabe, K.A., and J. Murdoch. 1998. The response of humpback whales (*Megaptera novaeangliae*) to offshore seismic survey noise: Preliminary results of observations about a working seismic vessel and experimental exposures. Australian Petroleum Production and Exploration Association Journal, 38, 692-707.

McDonald, M.A., Hildebrand, J.A., and S.C. Webb. 1995. Blue and fin whales observed on a seafloor array in the Northeast Pacific. Journal of the Acoustical Society of America 98:712-721.

Melcón ML, A.J. Cummins, S.M. Kerosky, L.K. Roche, S.M. Wiggins, and J.A. Hildebrand. 2012. Blue Whales Respond to Anthropogenic Noise. PLoS ONE 7(2): e32681. https://doi.org/10.1371/journal.pone.0032681.

Miller, G.W., V.D. Moulton, R.A. Davis, M. Holst, P. Millman, A. MacGillivray and D. Hannay. 2005. Monitoring seismic effects on marine mammals – southeastern Beaufort Sea, 2001–2002. In S. L. Armsworthy, P. J. Cranford, and K. Lee (Editors), Offshore Oil and gas environmental effects monitoring: approaches and technologies, p. 511–542. Battelle Press, Columbus, Ohio.

Montgomery, R.A., Ver Hoef, J.M. and P.L. Boveng. 2007. Spatial modeling of haul-out site use by harbor seals in Cook Inlet, Alaska. Mar. Ecol. Progr. Ser. 341:257-264.

Morton, A.B. and H. K. Symonds. 2002. Displacement of O*rcinus orca* (L.) by high amplitude sound in British Columbia, Canada. Jour. of. Mar. Sci. 59:71-80.

Moulton, L.L. 1997. Early marine residence, growth, and feeding by juvenile salmon in northern Cook Inlet, Alaska. Alaska Fisheries Research Bulletin 4: 154-177.

Moulton, V.D. and G.W. Miller. 2005. Marine mammal monitoring of a seismic survey on the Scotian Slope, 2003. p. 29-40 in K. Lee, H. Bain and G.V. Hurley, eds. 2005. Acoustic Monitoring and Marine Mammal Surveys in the Gully and Outer Scotian Shelf before and during Active Seismic Programs. Environmental Studies Research Funds Report. No. 151. 154 p.

Mulherin, N.D., W.B. Tucker III, O.P. Smith, and W.J. Lee. 2001. Marine Ice Atlas for Cook Inlet, Alaska.

Muto, M.M., Helker, V.T., Angliss, R.P., Allen, B.A., Boveng, P.L., Breiwick, J.M., Cameron, M.F., Clapham, P.J., Dahle, S.P., Dahlheim, M.E., Fadely, B.S., Ferguson, M.S., Fritz, L.W., Hobbs, R.C., Ivashchenko, Y.V., Kennedy, A.S., London, M.J., Mizroch, S.A., Ream, R.R., Richmond, E.L., Shelden, K.W., Towell, R.G., Wade, P.R., Waite, J.M. and Zerbini, A.N. 2017. Alaska marine mammal stock assessments, 2016. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-355, 366 p. doi:10.7289/V5/TM-AFSC-355. http://www.nmfs.noaa.gov/pr/sars/pdf/ak_2016_final_sars_june.pdf

Nakken, O. 1992. Scientific basis for management of fish resources with regard to seismic exploration. Fisheries and Offshore Petroleum Exploitation 2nd International Bergen, Norway, 6-8 April 1992.

National Marine Fisheries Service (NMFS). 2005. Assessment of acoustic exposures on marine mammals in conjunction with USS Shoup active sonar transmissions in Haro Strait, Washington, 5 May 2003 (NMFS Office of Protected Resources report).

NMFS. 2008. Conservation Plan for the Cook Inlet beluga whale (*Delphinapterus leucas*). NOAA, NMFS, Juneau, AK.

NMFS. 2016a. Recovery Plan for the Cook Inlet Beluga Whale (*Delphinapterus leucas*). National Marine Fisheries Service, Alaska Region, Protected Resources Division, Juneau, AK. https://alaskafisheries.noaa.gov/sites/default/files/cib_recovery_plan_final.pdf.

NMFS. 2016b. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Department of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 p.http://www.nmfs.noaa.gov/pr/acoustics/Acoustic%20Guidance%20Files/opr-55_acoustic_guidance_tech_memo.pdf.

NMFS. 2018. 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-59, 167 p.

NMFS. 2020a. Manual for Optional User Spreadsheet Tool (Version 2.1; December) for: 2018 Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. Silver Spring, Maryland: Office of Protected Resources, National Marine Fisheries Service.

NMFS. 2020b. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion Alaska Liquefied Natural Gas (LNG) Project NMFS Consultation Number: AKRO-2018-01319. https://doi.org/10.25923/r3mt-bn11.

NMFS. 2022. National Marine Fisheries Service Memorandum for the Record: Management Considerations in Designating Demographically Independent Populations as Stocks under the Marine Mammal Protection Act. January 3, 2022. https://www.fisheries.noaa.gov/s3/2023-08/Pacific-Humpback-DPS-Stock-Designation-Memoranda.pdf.

NMFS. 2024a. Update to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 3.0): Underwater and In Air Criteria for Onset of Auditory Injury and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-71, 182 p. October.

NMFS. 2024b. Multi-Species Pile Driving Calculator, Version 2.1, Updated October 2024. https://www.fisheries.noaa.gov/s3/2024-11/BLANK-Multi-Species-OCT-2024e-public-508-.xlsx.

National Research Council. 2005. Marine Mammal Populations and Noise: Determining When Noise Causes Biologically Significant Effects. National Academies Press.

Nedwell, J.R, Langworthy, J., Howell, D. 2003. Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; initial measurements of underwater noise during construction of offshore windfarms, and comparison with background noise. Subacoustech Report No. 544R0424 commissioned by COWRIE.

Nemeth, M. J., C. C. Kaplan, A. P. Ramos, G. D. Wade, D. M. Savarese, and C. D. Lyons. 2007. Baseline studies of marine fish and mammals in Upper Cook Inlet, April through October 2006. Final report prepared by LGL Alaska Research Associates, Inc., Anchorage, Alaska for DRven Corporation, Anchorage, Alaska.

O'Corry-Crowe, G.M., R.S. Suydam, A. Rosenberg, K.J. Frost, and A.E. Dizon. 1997. Phylogeography, population structure and dispersal patterns of the beluga whale *Delphinapterus leucas* in the western Nearctic revealed by mitochondrial DNA. Molecular Ecology 6: 955-970.

Olsen, K. 1979. Observed avoidance behaviour in herring in relation to passage of an echo survey vessel. ICES Journal of Marine Science 18: 21 pp.

Olsen, K., Angell, J., Pettersen, F., and A. Lovik. 1983. Observed fish reactions to a surveying vessel with special reference to herring, cod, capelin, and polar cod. FAO Fisheries Report 300: 131-138.

Ona, E. 1988. Observations of cod reaction to trawling noise. ICES FAST WG-meeting, Oostende, 20-22.

Ona, E. and O.R. Godo. 1990. Fish reaction to trawling noise; the significance for trawl sampling. Rapp. O-v Reun. Coast. Int. Explor. Mer. 189:159-166.

Ona, E. and R. Toresen. 1988. Reaction of herring to trawl noise. ICES. CM 1988/B-36:1-8.

Owl Ridge Natural Resource Consultants. 2014. Cosmopolitan State 2013 Drilling Program Marine Mammal Monitoring and Mitigation 90-day Report. Prepared for BlueCrest Alaska Operating LLC. 74 pp.

Pentec. 2005. Marine Fish and Benthos Studies in Knik Arm, Anchorage, Alaska. Prepared for Knik Arm Bridge and Toll Authority and HDR Alaska, Inc. Report 12214-10/12214-12. Prepared by Pentec Environmental, Edmonds, Washington.

Polacheck, T. and L. Thorpe. 1990. The swimming direction of harbor porpoise in relationship to a survey vessel. Report. Int. Whal. Comm. 40:463-470.

Popper, A., A. Hawkins, R. Fay, D. Mann, S. Bartol, T. Carlson, S. Coombs, W. Ellison, R. Gentry, M. Halvorsen, S. Lokkeborg, P. Rogers, B. Southall, D. Zeddies, amd W. Tavolga. 2014. Sound exposure guidelines for fishes and sea turtles: A technical report prepared by ANSI-Accredited Standards Committee. ASA S3/SC1.4 TR-2014 88pp.

Popper, A.N. and M.C. Hastings. 2009. The effects of anthropogenic sources of sound on fishes. Journal of Fish Biology 75:455-489.

Rappeport, M.L. 1982. An analysis of oceanographic and meteorological conditions for central lower Cook Inlet, Alaska. U.S. Geological Survey Open-File Report 82-128.

Reiser, C.M., B. Haley, J. Beland, D.M. Savarese, D.S. Ireland, and D.W. Funk. 2009. Evidence for short-range movements by phocid species in reaction to marine seismic surveys in the Alaskan Chukchi and Beaufort Seas. Poster presented at: 18th Biennial Conference on the Biology of Marine Mammals, 12–16 October 2009, Quebec City, Canada.

Richardson, W.J. and C.I. Malme. 1993. Man-made noise and behavioral responses. Pp. 631-700 In J.J. Burns, J.J. Montague, and C.J. Cowles (eds.). The Bowhead Whale. Soc. Mar. Mammal., Spec. Publ. No. 2.

Richardson, W.J., B. Wursig, and C.R. Greene. 1986. Reactions of bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea. Journal of the Acoustical Society of America 79:1117-1128.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1995. Marine mammals and noise. San Diego, CA: Academic Press, Inc. 576 pp.

Richardson, W.J., R.S. Wells, and B. Wursig. 1985. Disturbance responses of Bowheads, 1980-1984. p. 255-306 in: W.J. Richardson, editor. Behavior, disturbance responses, and distribution of bowhead whales, *Balaena mysticetus* in the Eastern Beaufort Sea, 1980-84. OCS Study MMS 85-0034 USDOI, Minerals Management Services, Alaska OCS Region, Anchorage, AK.

Ridgway, S. H., D.A. Carder, T. Kamolnick, R.R. Smith, C.E. Schlundt, and W.R. Elsberry. 2001. Hearing and whistling in the deep sea: Depth influences whistle spectra but does not attenuate hearing by white whales (*Delphinapterus leucas*) (*Odontoceti, Cetacea*). Journal of Experimental Biology 204:3829-3841.

Robards, M.D., J.F. Piatt, A.B. Kettle and A.A. Abookire. 1999. Temporal and geographic variation in fish communities of lower Cook Inlet, Alaska. Fishery Bulletin 97:962–977.

Roni, P. and L. Weitkamp. 1996. Environmental Monitoring of the Manchester Naval Fuel Pier Replacement, Puget Sound, Washington, 1991-1994. Prepared for Department of the Navy, Naval Facilities Engineering Command, Western Division; and Coastal Zone and Estuarine Studies Division, NMFS, NOAA, Seattle, WA.

Ruggerone, G., S. Goodman, and R. Miner. 2008. Behavioral response and survival of juvenile coho salmon exposed to pile driving sounds. Prepared for the Port of Seattle, Seattle, WA.

Rugh, D. J., B. A. Mahoney, and B. K. Smith. 2004. Aerial surveys of beluga whales in Cook Inlet, Alaska, between June 2001 and June 2002. U.S. Department of Commerce. NOAA Tech. Memo. NMFS-AFSC-145.

Rugh, D.J., K.E.W. Shelden, C.L. Sims, B.A. Mahoney, B.K. Smith, L.K. (Litzky) Hoberecht, and R.C. Hobbs. 2005. Aerial surveys of belugas in Cook Inlet, Alaska, June 2001, 2002, 2003, and 2004. NOAA Technical Memorandum NMFS-AFSC-149. 71 pp.

Rugh D. J., K.E.W. Shelden, R. C. Hobbs. 2010. Range contraction in a beluga whale population. Endangered Species Research 12:69-75.

Saupe, S., J. Gendron, and D. Dasher. 2005. The Condition of Southcentral Alaska’s Bays and Estuaries. A Statistical Summary for the National Coastal Assessment Program, Alaska Department of Environmental Conservation, March 15, 2006.

Scheifele, P.M., S. Andrews, R.A. Cooper, M. Darre, F.E. Musick, and L. Max. 2005. Indication of a Lombard vocal response in the St. Lawrence River beluga. Journal of the Acoustical Society of America, 117, 1486-1492.

Scientific Fishery Systems, Inc. 2009. 2008 underwater noise survey during construction pile driving, Port of Anchorage Marine Terminal Development Project, in support of Alaska Native Technologies, LLC. Prepared for U.S. Department of Transportation Maritime Administration, Port of Anchorage, and Integrated Concepts and Research Corporation.

Shelden, K.E.W., C.L. Sims, L. Vate Brattström, K.T. Goetz, and R.C. Hobbs. 2015. Aerial surveys of beluga whales (*Delphinapterus leucas*) in Cook Inlet, Alaska, June 2014. AFSC Processed Rep. 2015-03, 55 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.

Shelden, K.E.W., D.J. Rugh, B.A. Mahoney, and M.E. Dahlheim. 2003. Killer whale predation on belugas in Cook Inlet, Alaska: implications for a depleted population. Marine Mammal Science 19:529-544.

Shelden, K.E.W., D.J. Rugh, K.T. Goetz, C.L. Sims, L. Vate Brattström, J.A. Mocklin, B.A. Mahoney, B.K. Smith, and R.C. Hobbs. 2013. Aerial surveys of beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, June 2005 to 2012. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-263, 122 p. https://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-263.pdf.

Shelden, K.E.W., R.C. Hobbs, C.L. Sims, L. Vate Brattström, J.A. Mocklin, C. Boyd, and B.A. Mahoney. 2017. Aerial surveys, abundance, and distribution of beluga whales (*Delphinapterus leucas*) in Cook Inlet, Alaska, June 2016.

Shelden, K. E. W. and P. R. Wade (editors). 2019. Aerial surveys, distribution, abundance, and trend of belugas (*Delphinapterus leucas)* in Cook Inlet, Alaska, June 2018. AFSC Processed Rep. 2019-09, 93 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.

Shelden, K. E. W., Goetz, K. T., Brower, A. A., Willoughby, A. L. and C. L. Sims. 2022. Distribution of belugas (*Delphinapterus leucas*) in Cook Inlet, Alaska, June 2021 and June 2022. AFSC Processed Rep. 2022-04, 80 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.

Sitkiewicz, S., W. Hetrick, K. Leonard, and S. Wisdom. 2018. 2018 Harvest Alaska Cook Inlet Pipeline Project Monitoring Program Marine Mammal Monitoring and Mitigation Report. Prepared for Harvest Alaska, LLC, 3800 Centerpoint Drive, Suite 1400, Anchorage, Alaska 99503 Submitted to National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, 1315 East West Highway, Silver Spring, MD 20910. Fairweather Science, 301 Calista Court, Anchorage, AK 99518.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.K. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Special Issue of Aquatic Mammals, 33(4): 412-522.

Southall, B.L., J.J. Finneran, C. Reichmuth, P.E. Nachtigall, D.R. Ketten, A.E. Bowles, W.T. Ellison, D.P. Nowacek, and P.L. Tyack. 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals 45: 125-232.

Stanek, R. T. 1994. The subsistence use of beluga whale in Cook Inlet by Alaska Natives. 1993. Draft Final Report for year two, subsistence study and monitoring system No.50ABNF200055. Technical Paper No. 232. ADF&G, Juneau, Alaska. 23-pp.

Stone, C.J. and M.L. Tasker. 2006. The effects of seismic airguns on cetaceans in UK waters. J. Cetac. Res. Manage. 8(3):255-263.

Todd, S., P. Stevick, J. Lien, F. Marques, and D. Ketten. 1996. Behavioral effects of exposure to underwater explosions in humpback whales (*Megaptera novaeangliae*). Can. J. Zool. 74:1661-1672.

URS. 2007. Port of Anchorage Marine Terminal Development Project underwater noise survey test pile driving program, Anchorage, Alaska. Final underwater noise report. Prepared for Integrated Concepts and Research Corp. Infrastructure Support Services.

U.S. Army Corps of Engineers. 2013. Maintenance Dredging, Cook Inlet Navigation Channel, Alaska. Environmental Assessment and Finding of No Significant Impact. Alaska District. 112 pp.

U.S. Environmental Protection Agency. 2002. Environmental Assessment for the New Source NPDES Forest Oil Redoubt Shoal Unit Production Oil and Gas Development Project. January 15, 2002. Prepared by Science Applications International Corporations, Bothell, WA for the U.S. Environmental Protection Agency, Region 10, Seattle, WA. 292 p.

U.S. Fish and Wildlife Service. 2004. Biological Opinion: Edmonds Crossing Ferry Terminal, USFWS Log # 1-3-03-F-1499. Prepared by U.S. Fish and Wildlife Service for the Federal Highway Administration, August 30, 2004.

United States Navy (U.S. Navy). 2015. Proxy source sound levels and potential bubble curtain attenuation for acoustic modeling of nearshore marine pile driving at Navy installations in Puget Sound. Prepared by Michael Slater, Naval Surface Warfare Center, Carderock Division, and Sharon Rainsberry, Naval Facilities Engineering Command Northwest. Revised January 2015.

Wade, P. R. 2021. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas. International Whaling Commission. SC/68c/IA/03. 32 pp. https://archive.iwc.int/.

Warner, G., Wladichuk. J. and D.E. Hannay. 2011. *Hydroacoustic Modeling of Airgun Noise for Apache's Cook Inlet Seismic Program: 24-Hour Harassment Area Calculations* Version 1.0. Technical report for NESLLC by JASCO Applied Sciences. June 3, 2011.

Wartzok, D. and D.R. Ketten. 1999. Marine mammal sensory systems. Pages 117-148 in J.E. Reynolds III and S.A. Rommel (eds), Biology of Marine Mammals. Washington D.C.: Smithsonian Institution Press.

Watkins, W. A. 1986. Whale reactions to human activities in Cape Cod waters. Marine Mammal Science 2: 251–262.

Weilgart, L. S. 2007. The impacts of anthropogenic ocean noise on cetaceans and implications for management. Can. J. Zool., 85, 1091-1116.

White, M.J., J. Norris, D.L. Jungblad, K. Baron, and G. Di Sciara. 1978. Auditory thresholds of two beluga whales (*Delphinapterus leucas*). HSWRI Technical Report 78-109. Prepared for Naval Ocean Systems Center, San Diego.

Wolfe, R. J., C. L. Scott, W. E. Simeone, C. J. Utermohle, and M. D. Pete. 2009. The "super-household" in Alaska Native subsistence economies. Final report to the National Science Foundation. ARC 0352611.

Young, N. C., Brower, A. A., Muto, M. M., Freed, J. C., Angliss, R. P., Friday, N. A., Boveng, P. L., Brost, B. M., Cameron, M. F., Crance, J. L., Dahle, S. P., Fadely, B. S., Ferguson, M. C., Goetz, K. T., London, J. M., Oleson, E. M., Ream, R. R., Richmond, E. L., Shelden, K. E. W., Sweeney, K. L., Towell, R. G., Wade, P. R., Waite, J. M., and Zerbini, A. N. 2023. Alaska marine mammal stock assessments, 2022. U.S. Department of Commerce, NOAA Technical Memorandum NMFS/AFSC-474, 316 p.

APPENDIX A

Marine Mammal Mitigation and Monitoring Plan (4MP)

PUBLIC

Marine Mammal Monitoring and Mitigation Plan for Construction of the Alaska LNG Project in Cook Inlet, Alaska

April 4, 2025

3062-REG-PLN-00032

Alaska Gasline Development Corporation
3201 C Street, Suite 505
Anchorage, Alaska 99503
T: 907-330-6300
www.alaska-lng.com

REVISION HISTORY

Rev	Date	Description	Originator	Reviewer	Approver
0	4/18/2019	For Use	Fairweather Science	L. Haas	F. Richards
1	4/22/2020	For Use	Fairweather Science	L. Haas	F. Richards
2	12/5/2024	For Use	AGDC	L. Haas	F. Richards
3	4/4/2025	For Use	AGDC	L. Haas	F. Richards
Approver Signature*	D. J. Miller				

*This signature approves the most recent version of this document.

MODIFICATION HISTORY

Rev	Section	Modification
1	All	Modified to address NMFS input from April 16, 2020
1	Table 3	Correct typo
1	Tables 4	Modified to address NMFS request from April 21, 2020 to clearly indicate pile sizes covered in each category
2	DCN	Previously submitted under AKLNG-6020-REG-PLN-DOC-00032, Rev. 1
2	All	Updated to include revisions from the reapplication to NMFS and updated timeframe for Project construction activities
3	All	Includes 2024 updated NMFS technical guidance for sound

TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

ACRONYMS AND ABBREVIATIONS

4MP .... Marine Mammal Monitoring and Mitigation Plan
AGDC .... Alaska Gasline Development Corporation
AOE .... Area of Ensonification
CISS .... Cast-in-shell steel
dB re 1 µPa .... decibels referenced to one microPascal
ESA .... Endangered Species Act
FR .... Federal Register
GTP .... Gas Treatment Plant
ITR .... Incidental Take Regulations
km^2 .... square kilometers
km/hr .... kilometer per hour
L_{pk} .... peak level
LNG .... liquefied natural gas
LOA .... Letter of Authorizations
MLLW .... mean lower low water
MMPA .... Marine Mammal Protection Act
MOF .... Material Offloading Facility
NMFS .... National Marine Fisheries Service
NOAA .... National Oceanic and Atmospheric Administration
PBU .... Prudhoe Bay Unit
PK .... peak
PLF .... Product Loading Facility
PM .... Project Manager
PSO .... Protected Species Observer
PTU .... Point Thomson Unit
QA/QC .... quality assurance and quality control
rms .... root-mean-square
RoRo .... roll-on/roll-off
ROW .... right-of-way
SEL .... sound exposure level
SEL_{24h} .... 24-hour cumulative sound exposure level
SPL, L_{pk} .... peak received sound pressure level
SPL .... sound pressure level
SSV .... sound source verification

1. DESCRIPTION OF ACTIVITIES

1.1. Purpose of the Plan

The Alaska Gasline Development Corporation (AGDC) is the project sponsor and "Applicant" for the Alaska LNG Project (Project). The Applicant has requested the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), issue incidental take regulations (ITR) pursuant to Section 101(a)(5) of the Marine Mammal Protection Act (MMPA) for the non-lethal unintentional taking of small numbers of marine mammals incidental to Project construction activities in Cook Inlet, Alaska from January 1, 2026 to December 31, 2030. This Marine Mammal Monitoring and Mitigation Plan (4MP) has been prepared in support of the ITR petition. The overall goal of the 4MP is to define procedures and practices to comply with the MMPA and Endangered Species Act (ESA) during in-water Project construction activities.

The Alaska LNG Project is expected to produce noise levels that could exceed Level B (disturbance) harassment thresholds established by NMFS for marine mammals under the MMPA (70 Federal Register [FR] 1871-1875). Level B harassment means any act of pursuit, torment, or annoyance that 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 that does not have the potential to injure a marine mammal or marine mammal stock in the wild.

The Applicant is requesting an ITR for the take of small numbers of marine mammals, by Level B harassment, incidental to the Alaska LNG Project within Cook Inlet. The humpback whale (*Megaptera novaeangliae*), Cook Inlet stock of beluga whale (*Delphinapterus leucas*), harbor porpoise (*Phocoena phocoena*), harbor seal (*Phoca vitulina*), killer whale (*Orcinus orca*) and sea otter (*Enhydra lutris*) may be encountered near the construction activities in the Cook Inlet Project area. A small number of Level B takes is requested for these six species of marine mammals. Marine mammals are protected under the MMPA; the Cook Inlet beluga whale is listed as endangered under the ESA.

In addition, the Alaska LNG Project could produce noise exceeding the new NMFS Level A thresholds. Level A harassment means any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild. Although levels are not expected to result in injury or mortality, as a precautionary step the Applicant has requested small numbers of Level A takes for humpback whales, harbor porpoises, and harbor seals over the 5-year period based on analyses of the potential acoustic harassment.

Marine mammal monitoring and mitigation methods for the Project have been designed to meet the requirements and objectives which would be specified in the individual Letters of Authorization (LOA). As this current 4MP is submitted as part of the ITR petition, the Applicant recognizes some details of the 4MP may change upon receipt of the authorizations.

1.2. Project Location

The Applicant plans to construct one integrated liquefied natural gas (LNG) Project (Figure 1) with interdependent facilities for the purpose of liquefying supplies of natural gas from Alaska, in particular from the Point Thomson Unit (PTU) and Prudhoe Bay Unit (PBU) production fields on the Alaska North Slope (North Slope), for export in foreign commerce and for in-state deliveries of natural gas. The Project includes a liquefaction facility (Liquefaction Facility) in Southcentral Alaska; an approximately 807-mile (1,299-kilometer) natural gas pipeline (Mainline); a gas treatment plant (GTP) within the PBU on the North Slope; an approximately 63-mile (101-kilometer) gas transmission line connecting the GTP to the PTU gas production facility (PTU Gas Transmission Line or Point Thompson Transmission Line); and an approximately 1-mile (1.6-kilometer) gas transmission line connecting the GTP to the PBU gas production facility (PBU Gas Transmission Line or Prudhoe Bay Transmission Line). These facilities are essential to export natural gas in foreign commerce and would have a nominal design life of 30 years.

The proposed facilities in Cook Inlet include a Marine Terminal and the Mainline crossing of Cook Inlet. The Marine Terminal consists of a permanent Product Loading Facility (PLF) and a Temporary Material Offloading Facility (MOF) (Figure 2). The Mainline crossing includes the installation of the 42-inch-diameter natural gas pipeline across the inlet, and construction of a Mainline MOF on the west side of Cook Inlet. Descriptions of these proposed facilities can be found in the ITR applications. These petitions ask for coverage of facility construction activities that are expected to generate underwater sound energy at levels that NMFS has deemed sufficient to potentially result in Level A and B harassment of marine mammals. Those activities have been identified as pile driving associated with construction of the PLF, Temporary MOF, and Mainline MOF, and anchor handling associated with installation of the Mainline crossing of Cook Inlet.

The petition requests coverage for Project activities within Cook Inlet north of Latitude 60° 30’ (Figure 2). The activities would be conducted primarily at: the site of the proposed Marine Terminal; the site of the Mainline MOF; and within the construction right-of-way (ROW) for the Mainline crossing of Cook Inlet.

Figure 1: Alaska LNG Project Vicinity Map

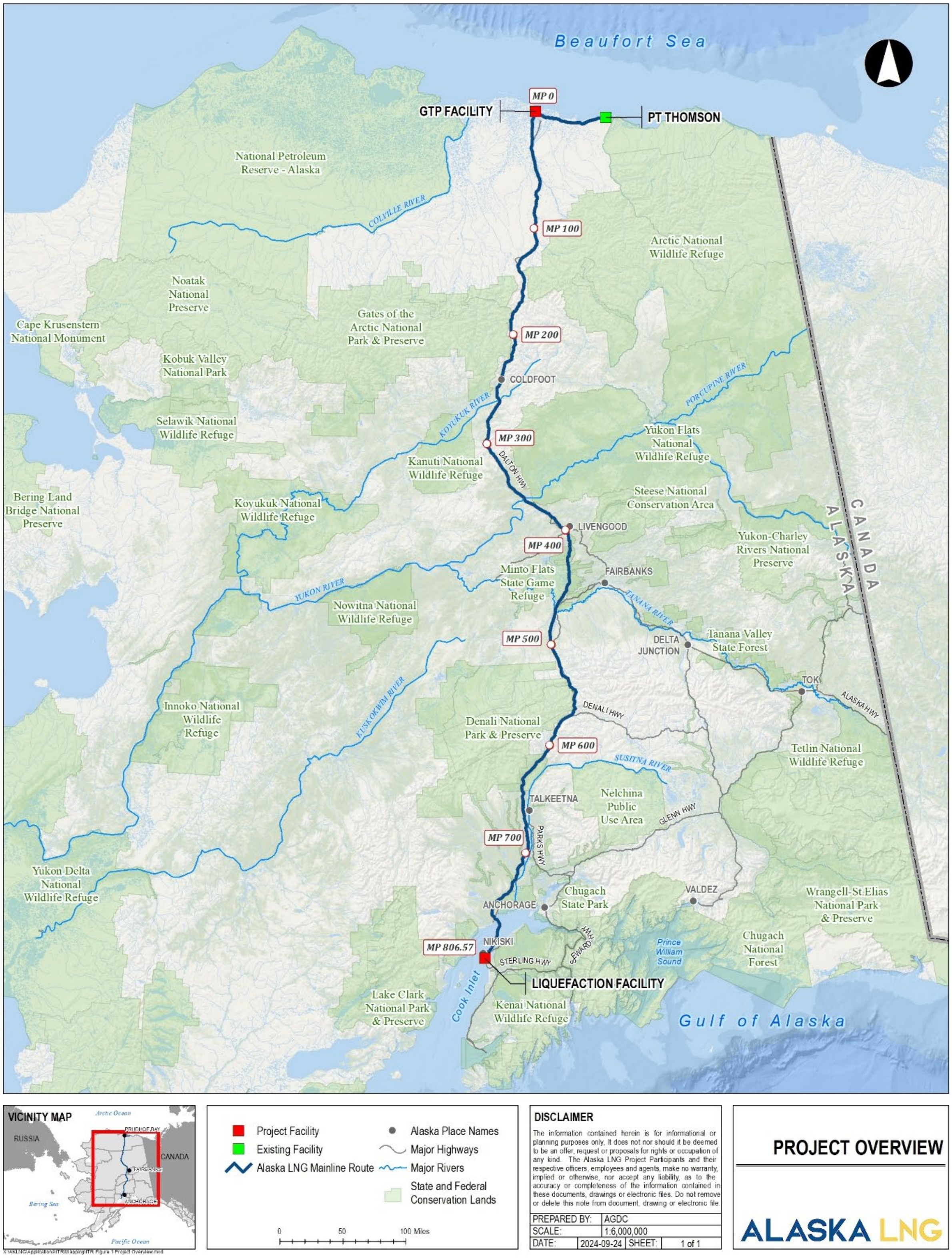


Figure 2: Geographic Region: Cook Inlet Construction

1.3. Description of Alaska LNG Activities

This 4MP pertains to the in-water construction activities of the Project in the Cook Inlet area that would take place in the marine environment and potentially result in the incidental harassment of marine mammals, as defined by the MMPA. The proposed Marine Terminal would be constructed adjacent to the proposed onshore LNG Plant near Nikiski, Alaska, (Figure 2) and would allow LNG carriers to dock and be loaded with LNG for export. Primary components of the Marine Terminal include a PLF and the Temporary MOF. The two primary underwater sound sources associated with the Project that could potentially affect marine mammals include:

- Impact and vibratory pile driving (sheet and pipe piles) associated with the Marine Terminal and Mainline MOF construction.
- Anchor handling associated with the pipelay of the Mainline across Cook Inlet.
    - The primary underwater sound sources from pipelay would be from the anchor handling tugs (AHTs) during the anchor handling for the pipelay vessel.

1.3.1. Marine Terminal

The proposed PLF would be a permanent facility used to load LNG carriers for export. It consists of two loading platforms, two berths, a Marine Operations Platform, and an access trestle that supports the piping that delivers LNG from shore to LNG carriers and includes the equipment to dock LNG carriers. A detailed description of the total number of pilings associated with each component and analyzed for noise is included in the ITR application. Elements analyzed for noise include:

- PLF Loading Platforms (x 2; one located at either end of the north-south portion of the trestle);
- PLF Berths (x 2; located in natural water depths greater than -53 feet mean lower low water at opposite ends of the north-south portion of the trestle);
- Marine Operations Platform (located along the east-west portion of the access trestle that would support the proposed Marine Terminal Building); and
- Access Trestle which carries pipe rack, roadway, and walkway.

The Temporary MOF is proposed to be used during the construction of the Liquefaction Facility to enable direct deliveries of equipment modules, bulk materials, construction equipment, and other cargo to minimize the transport of large and heavy loads over road infrastructure. The Temporary MOF would be constructed using both land-based (from shore and subsequently from constructed portions of the MOF) and marine construction methods.

1.3.2. Mainline MOF Construction

The Mainline MOF on the west side of Cook Inlet is required to support installation of the Cook Inlet shoreline crossing, and onshore construction between the South of Beluga Landing shoreline crossing and the Yentna River. The Mainline MOF would consist of anchored sheet pile walls backed by granular fill.

1.3.3. Mainline Crossing of Cook Inlet

The offshore portion of the proposed pipeline (Mainline) would be laid on the seafloor across Cook Inlet using conventional pipelay vessel methods. The pipelay vessel would likely employ 12 anchors to keep it positioned and provide resistance. Dynamic positioning may be used in addition to the conventional mooring system. It is anticipated that three anchor handling attendant tugs would be used to repeatedly reposition the anchors, thereby maintaining proper position and permitting forward movement.

1.4. Marine Mammal Monitoring and Mitigation Program

The Applicant would implement a robust land-based marine mammal monitoring and mitigation program using experienced and trained Protected Species Observers (PSOs) during in-water construction activities. Marine mammal monitoring and mitigation methods have been designed to meet the expected requirements and objectives specified in the ITR that would be issued by NMFS. This 4MP may also be modified to incorporate other future stipulations in agreements between the Applicant and other agencies or groups. The Applicant recognizes some details of the monitoring and mitigation plan may change upon receipt of the ITR from NMFS.

The specific objectives of the monitoring and mitigation program are to provide:

- The basis for avoiding and minimizing potential impacts to marine mammals
- The information needed to estimate the number of takes of marine mammals by harassment
- Data on the occurrence, distribution, and activities of marine mammals in the areas where project activities were conducted
- Information to compare the distances, distributions, behaviors, and movements of marine mammals relative to the project activities

Details on PSO qualifications, monitoring methodology, mitigation measures, and reporting are provided in the following sections.

2. MARINE MAMMAL MONITORING OVERVIEW

2.1. Protected Species Observers

During in-water pile driving, two PSOs would be stationed on a bluff immediately above the pile driving activity to monitor the required monitoring zones (Table 3). In total, four PSOs would rotate throughout the day such that each PSO would observe for no more than 4 hours at a time and no more than 12 hours in a 24-hour period. PSOs would be located at the top of the bluff to maximize potential for viewing marine mammals. The PSO observation site(s) would be determined prior to the commencement of construction activities to provide for safety of the PSOs and allow for communication with the construction team. There are bluffs of at least 60 feet above the water line at both the marine terminal near Nikiski and temporary MOF at Beluga, on which PSOs would be stationed. If needed, one Field Lead PSO would be stationed with the construction team for better communication for the PSOs on the bluff.

In general, PSOs stationed on a stable, land-based platform with sufficient height (like the bluffs) provide excellent viewing conditions for marine mammals, although detection varies by species and is affected by weather conditions. Land-based PSOs were stationed at the top of the bluffs near Ladd Landing near Beluga in 2018 for the Hilcorp Cook Inlet Pipeline Project. Sitkiewicz et al. (2018) reported humpback whales sighted at up to 4 kilometers, beluga whales at up 3 kilometers, harbor porpoises at up to 2 kilometers, and harbor seals within 1 kilometer. Therefore, the following text summarizes the expected viewing ranges for the Project:

- **Humpback whales:** All Level A zones for humpback whales are within the expected detection range and can be effectively monitored. The Level B zone during vibratory driving at the temporary MOF is likely outside of the detectable range, although humpback blows have been detected in excellent weather conditions at distances of 7 kilometers in Cook Inlet (Fairweather Science 2020). The Level B zone for the remaining activities are generally within the detectable range for this species. PSOs report viewing range as part of their data collection, so final reports would extrapolate the actual take for humpback whales based on the area not viewable and actual duration of pile driving activity.
- **Killer whales:** The Level A zone of 250 meters for killer whales can be effectively monitored. The Level B zone of 5,600 meters during vibratory driving at the temporary MOF is likely outside of the detectable range, although killer whales often travel in groups, increasing the opportunity to detect blows from this species at greater distances. The Level B zones for the impact pile driving of 3,200 to 3,600 meters is likely on the edge of the detectable range for individuals of killer whales, but again, the fact that killer whales travel in groups allows for increased detection distances for multiple blows. Final reports would extrapolate the actual take for killer whales based on the area not detectable and actual duration of pile driving activity.
- **Beluga whales:** The Level A zone of 250 meters for beluga whales can be effectively monitored. For beluga whales, the Level B zone is also managed as a shutdown zone. Only the Level B zone of 800 meters for impact pile driving at the Mainline MOF can be effectively monitored with

certainty. As the zones increase in size, the detectable range for beluga whales decreases. The Level B zone of 5,600 meters during vibratory driving at the temporary MOF is outside of the detectable range, although beluga whales often travel in groups and spend more time at the surface than some other species, increasing the opportunity to detect this species at greater distances. The Level B zones for the impact pile driving of 3,200 to 3,600 meters is on the edge of the detectable range for individuals of beluga whales, although beluga whales were detectable at distances up to 4 kilometers from land-based observers as part of the Apache seismic program in 2012 (Lomac-MacNair et al. 2013). Beluga whales travel in groups, which allows for increased detection distances for multiple blows. In addition, they typically transit within a few kilometers of shore, so PSOs would scan for beluga whales up and down Cook Inlet, instead of straight out from shore. Final reports would extrapolate the actual take for beluga whales based on the area not detectable and actual duration of pile driving activity. As part of the annual LOA process, the Applicant would coordinate with NMFS to determine if additional PSOs stationed north and south of the pile driving are needed during early summer months when belugas are more commonly observed in these areas.

- **Harbor porpoises:** Harbor porpoises are the most difficult species to detect, as they often travel as individuals or very small groups, they do not spend much time at the surface, and are detected by the small dorsal fin. The Level A zone of 250 meters for the vibratory pile driving and the Level A zone of 1,000 meters for the Mainline MOF impact pile driving can be effectively monitored for this species. The Level A zones for the impact pile driving at the PLF and temporary MOF are generally outside of the effective monitoring range, although the bluff height would increase the range. The Level B zone of 800 meters for the mainline can be effectively monitored, but the remaining Level B zones greater than 1,000 meters would likely be outside of the range of detectability. Final reports would extrapolate the actual take for harbor porpoises based on the area not detectable and actual duration of pile driving activity.
- **Harbor seals:** Harbor seals are also challenging to detect at distances greater than 1 kilometer because they are typically solitary, only their head is at the surface, and they do not follow a predictable surfacing pattern. However, the Level A zones for this species are within the detectable range. The Level B zones for everything, except the Mainline MOF impact pile driving, would not be effectively monitored, so takes would be extrapolated.

One PSO would be on watch on the pipe laying barge to report all sightings (two PSOs would be on the barge for rotation), as there is no shutdown for this activity.

2.2. Protected Species Observer Qualifications and Training

The PSO team would be comprised of experienced Lead PSO and three PSOs (two on watch at a time). The Field Lead PSO would have significant marine mammal monitoring experience with previous experience in Alaska and PSOs would have previous marine mammal experience. PSOs would observe for no more than 4 hours at a time and no more than 12 hours in a 24-hour period.

The Field Lead PSO would also have the following qualifications:

- Previous experience working in Alaska as a PSO
- Previous experience managing a PSO field team
- Previous experience coordinating marine mammal monitoring programs with industrial activities, with a preference for construction activities

PSOs would be familiar with the marine mammals of the area and would complete a project-specific training session on operational activities, marine mammal monitoring protocol, permit stipulations and mitigation measures, and data collection protocol. The training session would be provided shortly before the anticipated start of the season and would be conducted by marine mammologists with extensive crew lead experience from previous marine mammal monitoring programs in Alaska. Primary objectives of the training include:

- Review of the 4MP for this Project, including any amendments adopted or specified by NMFS, and other agreements in which the Applicant may elect to participate;
- Review of marine mammal sighting, identification, and distance estimation methods;
- Review operation of specialized equipment (e.g., reticle binoculars, spotting scopes);
- Review of data recording and data entry systems, including procedures for recording data on marine mammal sightings, environmental conditions, project activities and mitigation measures, and entry error control; and
- Review of mitigation procedures.

The main activities of PSOs are: to conduct visual watches for marine mammals; to provide observations and data as the basis for implementation of mitigation measures; to document numbers of marine mammals present; to record observed reactions of marine mammals to Petition activities; and, to identify whether there was observed or likely effect on accessibility of marine mammals to subsistence hunters in Cook Inlet. These observations would provide the real-time data needed to implement some of the key protection measures.

At a minimum, PSOs would meet the following qualifications:

- Demonstrated ability to conduct field observations and collect data according to assigned protocols;
- Ability to collect the required marine mammal observation data;
- Documented marine mammal monitoring experience or training, or an undergraduate degree in biological science or a related field;
- Visual acuity (correction is permissible) sufficient to allow detection and identification of marine mammals (binoculars may be necessary for species identification);
- Sufficient training, orientation, or experience with construction operations to conduct observations safely;

- Ability to communicate with project personnel about marine mammals observed in the area;
- Ability to coordinate shutdown procedures with the Construction Project Manager (PM), when necessary; and
- PSOs would be independent observers and would not be engaged in construction activities.

PSOs would be on watch during Project activities conducted in daylight periods. The observer(s) would watch for marine mammals from the best available vantage point at the Project site, with unobstructed views of the marine environment. The PSOs would scan systematically with the naked eye and with binoculars. When a mammal sighting is made, the following information about the sighting would be carefully and accurately recorded:

- Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from the PSO, apparent reaction to activities (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace;
- Time, location, construction activity, sea state, ice cover, visibility, and sun glare; and
- The sea state, ice cover, visibility, and sun glare would also be recorded at the start and end of each observation watch, every 30 minutes during a watch, and whenever there is a change in any of those variables.

2.3. Equipment

Monitoring equipment includes:

- Portable radios and cell phones for communication;
- Hand-held binoculars (7X magnification or better) with built-in reticles;
- Spotting scope (25X magnification or better); and
- Data collection system and necessary hardware if an electronic data entry process is used.

An electronic database or paper form would be used to record and collate data obtained from visual observations, discussed further in Section 2.5. PSOs would also have the PSO handbook with definitions for data entry, maps of the project area and monitoring zones, and contact lists on hand electronically or hard copy at the observation station(s).

2.4. PSO Handbook

A PSO handbook with specifics of the Alaska LNG Project would be prepared and distributed to PSOs during training. The handbook would provide guidance and reference information to trained PSOs and would contain maps, illustrations, photographs, copies of important documents, and descriptive text. The following topics would be covered in the PSO Handbook:

- Summary description of the project, marine mammals and underwater sound energy, the 4MP, the NMFS ITR, and other regulations/permits/agencies;

- Monitoring and mitigation objectives and procedures, including Level A and Level B harassment zones;
- Responsibilities of staff and construction crew regarding the 4MP;
- Instructions for staff and construction crew regarding the 4MP;
- Data recording procedures, including codes and coding instructions, common coding mistakes;
- Use of specialized field equipment (e.g., reticle binoculars, spotting scope);
- Reticle binocular distance scale;
- Table of wind speed, Beaufort wind force, and sea state codes;
- Data storage and backup procedures;
- List of marine mammal species that might be encountered and identification, behavior, and natural history information;
- Safety precautions while on-site;
- Crew and/or personnel discord, conflict resolution among PSOs and crew;
- Drug and alcohol policy and testing;
- Scheduling of watches;
- Communications;
- List of field gear provided;
- Suggested literature or literature cited; and
- Field reporting requirements and procedures.

2.5. Communications

A clear chain of command and communication system would be in place to help PSOs, the construction crew, and any other personnel onsite understand roles and responsibilities. Anticipated roles are highlighted below, although titles may change:

- ***Alaska LNG Construction Project Manager (Construction PM):*** The Construction PM communicates directly with the Field Lead PSO each day before pile installation begins. The Construction PM would communicate to the Field Lead PSO the plan for that day, including start and stop times, the number of piles, sizes of piles, and method of installation. The Field Lead PSO would use this information to determine the appropriate harassment zones for that day. Mitigation action items would be discussed and adjusted, as needed, based on conditions.
- ***Field Lead PSO:*** In addition to daily operational communications with the Construction PM and typical PSO duties, the Field Lead would perform quality assurance and quality control (QA/QC) on data at the end of the day.

- ***PSO:*** PSOs are responsible for monitoring for marine mammals, collecting required data, QA/QC of their data, and reporting to the Field Lead PSO. PSOs are also responsible for understanding the mitigation measures and initiating implementation, as necessary, with the Construction PM.

2.6. Data Collection

Data regarding environmental conditions, marine mammal sightings, communications, and project activities would be collected manually on paper copies or electronically using a rugged hardware system (i.e., Toughbook or tablet) with data collection software (i.e., Microsoft or ArcGIS-based system). If electronic processes are used, hardcopy paper forms would be available as a backup, in case there are technical difficulties with equipment. Data collected on paper forms would consist of the same variables that are collected electronically.

Data would be collected in accordance with NMFS data collection best practices and definitions for standardizing data collection and entry for Cook Inlet beluga whale sightings. Because other marine mammals besides beluga whales are likely to be sighted during the Project, definitions are expanded upon to include behaviors from all marine mammal species. Excellent record keeping and documentation is an essential part of this program. It is the responsibility of the observer to detail and document environmental and sighting data objectively, accurately, and professionally. High quality data are required for a number of reasons. Clear and concise data records ensure accurate data interpretation and facilitate post-season data QA/QC, analyses, and reporting. Survey data would also contribute to existing scientific knowledge, inform management decisions, and determine permit stipulations.

The data that would be collected are separated into three major categories: effort, sightings, and mitigation. The data fields are detailed in the following text and definitions and entry values are provided in Appendix A.

2.6.1. Effort

The PSOs would document monitoring effort, environmental conditions, and types of project activities. PSOs would document the start and stop times of monitoring. Environmental conditions would be documented at the beginning and end of every monitoring period and approximately every half hour, or as conditions change. Data collected would include PSO names, location of the observation station, time and date of observation, weather conditions, air temperature, sea state, cloud cover, visibility, glare, and ice coverage (if applicable). The PSOs would document the type of project activities, including type of pile installation, number of piles driven, as well as the time of startup (or soft start) and shutdown. PSOs would also document other, non-project-related activities that could disturb marine mammals in the area, such as the presence of vessels or aircraft.

2.6.2. Sightings

Observed marine mammals would be documented. The collected data would include a unique group letter specific to that day, start and end times of the sighting, species sighted, number of individuals (group size), age class, color classification (only for beluga whales), behavior and movement, distance at first observation, closest observed distance from project activities, type of in-water project activity at the time of sighting, and whether and when pile installation or removal was stopped in response to the sighting. The PSO would also note observed marine mammal behavioral changes or reactions that may be due to project activities.

A color classification system would be used for beluga whales only. Beluga whales would be documented as white, gray, dark gray calf, or dark gray neonate. This color classification would help estimate the age class of each animal. Adults are typically white, juveniles are generally gray, and calves/neonates are dark gray; however, the age at which a beluga whale's color matures to white is variable. The proximity of calves to the mother would also be documented. Calves, especially neonates, typically remain in direct contact with the mother. When known, sex and age classes for all other marine mammals would be documented.

PSOs would use binoculars and rangefinders to estimate distance to the marine mammal and proximity to the harassment zones. The initial distance of the sighting and closest point of approach would be recorded as the PSO tracks the path of animal. Behaviors, including potential reactions to project activities or other human activities in the area, would be recorded during each sighting. Potential indicators of a negative response to noise include abrupt dives or dispersal, change in swimming speed or direction, and an animal approaching and then departing the area. Other activities that the marine mammal could be responding to would also be documented when possible.

2.6.3. Mitigation

Communications between the PSO and Construction PM related to mitigation requests, as well as implemented mitigation measures, would be documented. Times would be recorded when: a soft start begins, pile installation reaches full energy, an animal is observed to enter the Level A and/or Level B harassment zones, the PSO has requested a shutdown, an animal has exited the harassment zone, the PSO notifies the Construction PM that the area has been cleared for operations to resume, and operations resume. The PSO would document shutdown and non-shutdown decisions with reasons for each decision.

2.6.4. Locations

PSOs would be located at vantage points to monitor the Level A and Level B harassment zones, when conditions allow. To provide full coverage of the activity area, PSOs may be stationed at up to two locations, and elevated platforms may be used when available and appropriate for the area. The PSO observation site(s) would be determined prior to the commencement of construction activities. The observation station(s) would be equipped with 7x50 reticle binoculars, a spotting scope, and means of data entry (laptop, tablet, hard copy forms, or another acceptable data entry device).

2.7. Mitigation Measures

2.7.1. Applicable Noise Criteria

Under the MMPA, NMFS has defined levels of harassment for marine mammals. Level A harassment is defined as "…any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is defined as "…any act of pursuit, torment, or annoyance which 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."

For Level A harassment, the NOAA Technical Memorandum NMFS-OPR-55 and NMFS-OPR-59 (NMFS 2016; 2018) provide guidelines for assessing the onset of permanent threshold shifts from anthropogenic sound, and NMFS-OPR-71 (NMFS 2024) provides guidelines for assessing the effects of temporary threshold shifts of anthropogenic sound. These guidelines separate marine mammals into five functional hearing groups, consider source types as impulsive (e.g., impact hammer) or non-impulsive (vibratory hammer, anchor handling tugs), and require analyses of the distance to the peak received sound pressure level (SPL, L_{pk}) as well as the 24-hour cumulative sound exposure level (SEL_{24h}) in order to more accurately estimate potential impacts.

The current threshold used by NMFS to estimate Level B harassment is 160 decibels (dB) referenced to (re) one microPascal (µPa) root mean square (rms) for impulsive sound and 120 dB re 1 µPa rms for non-impulsive sound. The NMFS disturbance guidelines are summarized in Table 1. For purposes of this section, underwater SPLs are reported as dB re 1 µPa.

Table 1: Marine Mammal Injury and Disturbance Thresholds for Underwater Sound

Marine Mammals Hearing Groups & Generalized Hearing Range[1]	Level A Harassment[2]		Level B Harassment[3]	
	Impulsive Sound	Non-Impulsive Sound	Impulsive Sound	Non-Impulsive Sound
Low-Frequency Cetaceans 7 Hz to 36 kHz	PK SPL 222 dB SEL_{24h} 183 dB	SEL_{24h} 197 dB	160 dB RMS	120 dB RMS
High-Frequency Cetaceans 150 Hz to 160 kHz	PK SPL 230 dB SEL_{24h} 193 dB	SEL_{24h} 201 dB	160 dB RMS	120 dB RMS
Very High-Frequency Cetaceans 200 Hz to 165 kHz	PK SPL 202 dB SEL_{24h} 159 dB	SEL_{24h} 181 dB	160 dB RMS	120 dB RMS
Phocid Pinnipeds (PW) 40 Hz to 90 kHz	PK SPL 223 dB SEL_{24h} 183 dB	SEL_{24h} 195 dB	160 dB RMS	120 dB RMS
Otariid Pinnipeds (OW) 60 Hz to 68 kHz	PK SPL 232 dB SEL_{24h} 203 dB	SEL_{24h} 199 dB	160 dB RMS	120 dB RMS

[1] Adoption of marine mammal hearing group terminology as defined by Southall et al. 2019.
[2] NMFS (2024) Level A thresholds indicating the onset of auditory injury; peak sound pressure level = PK SPL; Decibel = dB; cumulative sound exposure level over 24-hours = SEL_{24h}.
[3] NMFS (2024) Level B thresholds indicating the onset of temporary threshold shift; root-mean-square sound pressure level = RMS SPL.

2.7.2. Level A and B Harassment Zones

Distances to the harassment thresholds vary by functional hearing group, pile size, duration of installation, and pile-installation method. Table 2 provides distances to NMFS Level A underwater thresholds. Table 3 provides distances to NMFS Level B underwater thresholds.

Table 2: Modeled Distances in Meters and Ensonified Areas to NMFS Level A Thresholds

Activity / Method	Low- Frequency Cetacean		High-Frequency Cetacean		Very High-Frequency Cetacean		PW Pinniped	
	Isopleth (m)	AOE (km^2)	Isopleth (m)	AOE (km^2)	Isopleth (m)	AOE (km^2)	Isopleth (m)	AOE (km^2)
Impact Pile Driving								
ML MOF Wall; MOF Combi Wall; Coffer Cell - 24-inch AZ Sheet Pile	6,061	115	773	2	9,380	276	5,385	91
MOF RoRo Quads -24-inch Steel Pipe	998	3	127	0.051	1,545	7	887	2
MOF RoRo Quads; PLF - 48-inch Steel Pipe	1,120	4	143	0.064	1,733	9	995	3
PLF - 60-inch CISS Pile	3,408	36	435	0.594	5,274	87	3,028	29
Vibratory Pile Driving								
Mainline MOF Wall; MOF Combi Wall; Coffer Cell - 24-inch AZ Sheet Pile	30	0.003	12	0.0004	25	0.002	39.0	0.005
MOF Coffer Cell Template - 24-inch Bearing Pile	11	0.000	4	0.0001	9	0.000	13.9	0.001
MOF Combi Wall - 66-inch Steel Shell Pile	16	0.001	6	0.0001	13	0.001	20.1	0.001

Notes:
AOE = Area of Ensonification
CISS = Cast-in-shell steel
RoRo = Roll-on/roll-off

Table 3: Modeled Distances and Ensonified Areas to NMFS Level B Thresholds

Activity / Method	RMS Isopleth (m)	Ensonified Area (km^2)
Impact Pile Driving		
Mainline MOF Wall; MOF Combi Wall; MOF Coffer Cell; MOF Walls - 24-inch AZ Sheet Pile	1,000	3.14
MOF RoRo Quads -24-inch Steel Pipe	1,000	3.14
MOF RoRo Quads; PLF - 48-inch Steel Pipe	1,359	5.81
PLF - 60-inch CISS Pile	2,154	14.58
Vibratory Pile Driving		
Mainline MOF Wall; MOF Combi Wall; Coffer Cell - 24-inch AZ Sheet Pile	4,642	67.68
MOF Coffer Cell Template - 24-inch Bearing Pile	3,981	49.79
MOF Combi Wall - 66-inch Steel Shell Pile	6,310	125.07
Anchor Handling		
Anchor Handling Location 1	1,896	8.17
Anchor Handling Location 2	2,855	20.67
Anchor Handling Location 3	2,446	16.50
Anchor Handling Location 4	2,349	15.16
Anchor Handling Location 5	2,195	5.01

2.7.3. In-Water Activity Mitigation Measures

The majority of construction and associated activities are planned for the open water season (April-October). In summary:

1. Pre-activity Monitoring: PSOs would begin observing for marine mammals 30 minutes before soft-start or in-water pile installation.
    a. If a marine mammal is sighted within the Level A harassment zones, a soft start would not begin until the PSO has determined that the animal has exited the zone or has not been re-sighted for 30 minutes.
    b. If a marine mammal is sighted within the Level B harassment zone after the 30-minute monitoring period but before soft start, the Contractor would either begin soft start with documentation of take, or delay the soft start to avoid take. Soft start or pile driving would not start if a marine mammal is within the Level A harassment zone.
2. Soft Start: A soft start technique would be used at the beginning of each pile installation to allow marine mammals to exit the area before pile driving reaches full energy.
    a. For impact pile driving, an initial set of three strikes from the hammer at about 40 percent energy is followed by a 30-second waiting period, and then two subsequent three-strike sets. Impact pile driving at full power may commence, provided marine mammals remain absent from the monitoring zone.

3. Shutdown Procedures: The PSOs would continuously monitor the Level A and Level B harassment zones during pile installation and would have direct contact with the designated Construction PM to coordinate shutdowns, as necessary.

    a. If a marine mammal appears likely to enter the Level B harassment zone, the PSO would notify the Construction PM, who would either immediately shut down pile driving (using safe shutdown procedures) before the marine mammal enters the zone, avoiding a Level B take, or document the marine mammal as a Level B take upon entry into the zone. PSOs would document the reason to shut down or not shut down.

       If the decision is made to continue pile installation while a marine mammal is within the Level B harassment zone, that pile segment may be completed, unless the animal approaches and is likely to enter the Level A harassment zone. At that point, the Construction PM would immediately shut down pile driving operations (using safe shutdown procedures). Pile installation would be shut down to avoid take for marine mammal species for which take is not authorized.

    b. Following a lapse of pile driving for more than 30 minutes, the PSO would authorize soft start procedures after confirming that marine mammals have not been observed in the Level B harassment zone for at least 30 minutes immediately prior to resumption of operations.

    c. Following a shutdown of less than 30 minutes due to a marine mammal sighting in the Level B harassment zone, pile installation may commence when the PSO confirms that the marine mammal was observed exiting the zone or has not been observed in the zone for 30 minutes (for cetaceans) or 15 minutes (for pinnipeds).

4. Shutdown and Harassment Zones for Pile Driving (Table 4):

    For impact pile driving operations, the Applicant is proposing:

    a. 3.3-kilometer shut down zone for humpback whales (low frequency cetacean) to prevent Level A take by injury.

    b. 250-meter shut down zone for killer whales (mid-frequency cetacean) to prevent Level A take by injury.

    c. 1.0-kilometer shut down zone for harbor porpoises (high frequency cetacean) and harbor seals (phocid) to prevent Level A take by injury. The distances to the Level A thresholds are controlled by the cumulative SEL_{24hr}, resulting in larger Level A shutdown zones. For example, impact pile driving during PLF construction was determined to have a 2.4 km Level A shutdown zone radius for high frequency cetaceans. However, harbor porpoise characteristics, including appearance, size, and behavior make it unfeasible to consistently detect the species at distances greater than one kilometer.

    d. 3.6-kilometer Level B harassment zone based on the calculated distance to the 160 dB threshold for pipe piles.

i. This zone would be used for potential Level B exposures for marine mammals other than beluga whales.

ii. This zone would be used as the shutdown zone for beluga whales.

For vibratory pile driving operations, the Applicant is proposing:

a. 5.6-kilometer Level B harassment zone based on the calculated distance to the 120 dB threshold for sheet piles.

   i. This zone would be used for potential Level B exposures for marine mammals other than beluga whales.

   ii. This zone would be used as the shutdown zone for beluga whales.

5. Anchor Handling:

   a. For safety reasons, it is not possible to stop anchor handling procedures once the activity has started, and there would be no shutdowns.

   b. The Applicant is proposing a 2.9-kilometer Level B harassment zone for anchor handling operations based on the calculated distance to the 120 dB threshold.

      i. This zone would be used for potential Level B exposures for all marine mammals.

6. Shutdown for Weather: Pile installation would only occur when the Level A harassment zone can be adequately monitored, or an assumed take may be allowed by NMFS by calculating the density of each species and the actual time of pile driving activity.

Table 4: Radii of Shutdown and Level B Zones for Pile Driving and Anchor Handling

Activity	Level A Shutdown Zone Radius (m)					Level B Zone Radius (m)
	Low-Frequency Cetaceans	Medium-Frequency Cetaceans	High-Frequency Cetaceans	Phocids	Otariids	All Marine Mammals
PLF impact pile driving: 48-inch pipe piles 60-inch pipe piles	3,200	250	2,400	1,100	200	3,600
Temporary MOF impact pile driving: 24-inch pipe piles 48-inch pipe piles	3,300	250	1,800	1,000	250	3,600
Temporary MOF vibratory pile driving: Sheet piles All sizes pipe piles	300	250	250	250	--	5,600
Mainline MOF vibratory pile driving: Sheet piles	300	250	250	250	--	3,200
Mainline MOF impact pile driving: Sheet piles	1,200	250	1,000	650	300	800
Anchor Handling: Locations 1-4	--	--	--	--	--	2,900

If the entire Level B harassment zone is not visible, the Applicant would determine if in-water pile installation would continue or shut down. Conditions such as low light, darkness, high sea state, fog, ice, rain, glare, or other conditions may prevent effective marine mammal monitoring of the entire Level B harassment zone. In some cases, NMFS may allow for an "assumed take" when the Level B zone is not visible so that work can continue. If the number of takes is not approaching the allowable number, the Applicant may elect to continue work during that period to complete the work needed for that day. Conversely, if the number of takes is approaching the allowable number, the Applicant may elect to stop work during that period. Pile installation would not be reinitiated until the entire Level B harassment zone is visible or a decision is made to continue work and assumed level of take. If shutdown occurs for 30 minutes or more, startup procedures would be implemented prior to resumption of pile installation. This includes the 30-minute monitoring period to clear the zone and soft start procedures. The PSOs would document instances when shutdown is due to environmental conditions.

To avoid the potential for collision with a marine mammal during in-water work involving use of vessels (e.g., work boats, and skiffs), if a marine mammal approaches within 165 feet (50 meters) of the vessel, operations would cease and vessels would reduce speed to the minimum level required to maintain steerage and safe working conditions. Vessel operators would be instructed on basic marine mammal identification and avoidance measures as appropriate for their positions.

The Field Lead PSO and the Construction PM would maintain a count of Level B takes that occur for each species. If the maximum authorized number of Level B takes is reached or exceeded for the authorized period, in-water pile installation would be shut down immediately using safe shutdown procedures. In addition, NMFS would be notified immediately and a revised plan would be developed before in-water pile installation is resumed. To assist PSOs and construction crews, a protocol for the specific steps that should be used to communicate, decide, execute, and document a shutdown and re-start would be developed at the pre-field training session based on the issued ITR, final monitoring zones, and communication preferences. This protocol would be displayed and made available to appropriate personnel in hard copy or electronically.

2.7.4. Vessel Transit Mitigation Measures

Project vessels operating in Cook Inlet during Project construction activities would avoid approaching marine mammals within 300 feet (91 meters). Operators would observe direction of travel of marine mammals and attempt to maintain a distance of 300 feet (91 meters) or greater between the animal and the vessel by working to alter vessel course or velocity.

The vessel operator would avoid placing the vessel between members of a group of marine mammals in a way that may cause separation of individuals in the group from other individuals in that group. A group is defined as being three or more whales observed within 900 feet (274 meters) of one-another and displaying behaviors of directed or coordinated activity (e.g., migration or group feeding).

If the vessel approaches within 1.6 kilometers (1 mile) of one or more whales, the vessel operator would take reasonable precautions to avoid potential interaction with the whales by taking one or more of the following actions, as appropriate:

- Steering to the rear of whale(s) to avoid causing changes in their direction of travel.
- Maintaining vessel speed of 10 knots (19 kilometers per hour[km/hr]) or less when transiting to minimize the likelihood of lethal vessel strikes.
- Reducing vessel speed to less than 5 knots (9 km/hr) within 900 feet (274 meters) of the whale(s).

Project vessels would remain a minimum of 2.8 kilometers (1.5 nautical miles) seaward of the mean lower low water (MLLW) line between the Little Susitna River and -150.80 degrees west longitude to minimize the impacts of vessel sound and avoid strikes on Cook Inlet beluga whales between June 1 and September 7. The Susitna Delta Exclusion Zone is defined by:

- A 16-kilometer (10-mile) buffer of the Beluga River thalweg seaward of the MLLW line;
- A 16-kilometer (10-mile) buffer of the Little Susitna River thalweg seaward of the MLLW line;
- A 16-kilometer (10-mile) seaward buffer of the MLLW line between the Beluga River and Little Susitna River.

The buffer extends landward along the thalweg to include intertidal waters within rivers and streams up to their mean high water. The seaward boundary has been simplified so that it is defined by lines connecting readily discernable landmarks

2.7.5. Sound Source Verification

AGDC would conduct a sound source verification (SSV) study in accordance with the SSV Plan at the beginning of the pile driving program to characterize the sound levels associated with different pile and hammer types, as well as establish the marine mammal monitoring and mitigation zones. During the SSV study, a noise attenuation device, such as a bubble curtain, would be used to reduce source sound levels of pile driving. A minimum of two piles of each type and size would be measured for SSV. The following data would be collected during acoustic monitoring and reported:

- Hydrophone equipment and methods: recording device, sampling rate, distance from the pile where recordings were made; depth of recording device(s);
- Type of pile being driven and method of driving during recordings; and
- Mean, median, and maximum sound levels (dB re: 1µPa): cumulative sound exposure level (SEL_{cum}), peak sound pressure level (SPL_{peak}), root mean square sound pressure level (SPL_{rms}), and single-strike sound exposure level (SELs-s).

The results of the SSV study would be submitted to NMFS within 72 hours of completion of the test, along with any proposed changes to the monitoring and mitigation program based on the results of the SSV.

3. REPORTING

The results of the monitoring program, including estimates of takes, would be presented in weekly, monthly, and technical reports (90-day and final). The reports would summarize project operations, monitoring effort, species and numbers of marine mammals sighted, exposures, and implementation of mitigation measures. The technical reports (90-day and final, Section 3.3) would address the requirements established by NMFS in the ITR, and would be provided to the agencies and the Applicant. Unless specified in the ITR, weekly and monthly reports would be submitted to the Applicant only.

3.1. Weekly Reports

Each weekly report would contain the following information:

- Monitoring effort (date, start time, end time);
- Summary of environmental conditions (sea state, visibility, glare, etc.);
- Marine mammal sightings (species, number of individuals);
- Age classification (when discernible);
- Behaviors and potential reactions (correlated with project activities or monitoring zones);
- Marine mammal takes by species;
- In-water activities before and during marine mammal sightings; and
- Project shutdowns (date, duration, reason for shutdown).

3.2. Monthly Reports

A monthly report would be submitted to provide a summary of weekly report information and identify any trends or ongoing issues.

3.3. Technical Reports: 90-Day Monitoring and Final Reports

The results of the marine mammal monitoring program, including estimates of "take by harassment", would be presented in a technical report within 90 days of completing in-water work during each of the first four seasons (90-day reports) and a comprehensive summary report within 90 days (final report). Reports would address the requirements established by NMFS and include:

- Summaries of monitoring effort – total hours and distribution of marine mammals throughout the study period accounting for sea state, visibility, and other factors affecting detectability of marine mammals;
- Analyses of the effects of various factors influencing detectability of marine mammals, such as sea state, number of observers, and fog/glare;
- Species composition, occurrence, and distribution of marine mammal sightings, including date, group size, and age classification (when discernable);

- Analyses of the effects of the Alaska LNG Project:
    - Sighting rates of marine mammals during periods with and without project activities (and other variables that could affect detectability);
    - Initial sighting distances versus project activity;
    - Closest point of approach versus project activity;
    - Observed behaviors and types of movements versus project activity;
    - Numbers of sightings/individuals seen versus project activity;
    - Distribution around the action area versus project activity;
    - Summary of implemented mitigation measures; and
    - Estimates of “take by harassment”.
- If applicable, a summary of injured or dead marine mammals discovered.

3.4. Notification of Injured or Dead Marine Mammals

In the event that the Applicant discovers an injured or dead marine mammal and the Field Lead PSO determines that the cause of the injury or death is unknown, the Field Lead PSO would immediately report the incident to the same list of authorities with the same information described above. Pile installation may continue while NMFS reviews the circumstances of the incident. NMFS would work with the Applicant to determine whether modifications to the activities are appropriate.

In the unanticipated event that pile installation clearly causes the take of a marine mammal for which authorization has not been granted, such as a serious injury or mortality, the Construction PM would immediately cease pile installation and the Applicant would report the incident to:

- Chief of the Permits and Conservation Division;
- Office of Protected Resources;
- NMFS and its designees; and
- Alaska Regional Stranding Coordinators.

The report would include :

- Date, time, and location (latitude/longitude) of the incident;
- Detailed description of the incident;
- Description of equipment;
- Status of sound source use in the 24 hours preceding the incident;
- Environmental conditions (wind speed and direction, wave height, cloud cover, and visibility);
- Description of marine mammal observations in the 24 hours preceding the incident;

- Species identification, description, and fate of animal(s) involved; and
- Photographs or video footage of animals or equipment (if available).

Pile installation would not resume until NMFS is able to review the circumstances of the prohibited take. NMFS would work with the Applicant to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. The Alaska LNG Project would not resume activities until notified by NMFS as appropriate via letter, email, or telephone.

4. REFERENCES

Fairweather Science, LLC. 2020. 2019 Hilcorp Alaska Lower Cook Inlet Seismic Survey Marine Mammal Monitoring and Mitigation Report. Prepared for Hilcorp Alaska, LLC, 3800 Centerpoint Drive, Suite 1400, Anchorage, Alaska 99503 Submitted to National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, 1315 East West Highway, Silver Spring, MD 20910, and; United States Fish and Wildlife Service, 1011 East Tudor Road, #200, Anchorage, Alaska 99503. Prepared by Fairweather Science, 301 Calista Court, Anchorage, AK 99518. January 2020.

Lomac-MacNair, K.S., L.S. Kendall, and S. Wisdom. 2013. Marine Mammal Monitoring and Mitigation, 90-Day Report, May 6- September 30, 2012, Alaska Apache Corporation 3D Seismic Program, Cook Inlet, Alaska. Prepared by SAExploration 8240 Sandlewood Pl. Suite 102 Anchorage, AK and Fairweather Science 9525 King Street, Anchorage, AK. Prepared for Apache Alaska Corporation and National Marine Fisheries Service. 87 p.

National Marine Fisheries Service (NMFS). 2016. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-55, p. 178.

NMFS. 2018. 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0). Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-59, p. 178.

NMFS. 2024. Update to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 3.0): Underwater and In Air Criteria for Onset of Auditory Injury and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-71, 182 p. October.

Sitkiewicz, S., Hetrick. W., Leonard, K., and Wisdom, S. 2018. 2018 Harvest Alaska Cook Inlet Pipeline Project Monitoring Program Marine Mammal Monitoring and Mitigation Report. Prepared for Harvest Alaska, LLC, 3800 Centerpoint Drive, Suite 1400, Anchorage, Alaska 99503 Submitted to National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, 1315 East West Highway, Silver Spring, MD 20910. Prepared by Fairweather Science, 301 Calista Court, Anchorage, AK 99518. November 26, 2018.

APPENDIX A

Marine Mammal Effort, Sighting, and Mitigation Data Fields

Table A-1: Effort Data Fields

Data Field	Definition and Values
Date	Day, month, year of the record
Time	Time of observation
Observation Site	Location where observations are being conducted
Observer	Observer first and last name
Effort	Level of effort (watch start, continuous watch, watch end, off watch)
Tide	Predicted hourly data information gathered from National Oceanic and Atmospheric Administration would be available on-site and reported in the 90-Day Technical Report
Activity	Current operational activity (type of pile installation and number of piles driven)
Duration	Start and stop times of startup and shutdown processes
Beaufort Sea State	Sea surface conditions (0 to 12)
Glare	Severity (none, light, moderate, severe) and location (clockface)
Visibility	Distance visible for marine mammal detection
Air temp	Degrees Celsius
Ice coverage	Type (no ice present, new, brash, or pancake ice and floes) and amount (0-100%) of ice cover
Precipitation	Precipitation type (rain, light rain, drizzle, snow, fog)
Cloud Cover	Cloud percent (0-100%)
Light	Light, twilight, dark
Sightability	Overall evaluation of environmental conditions as related to detectability of a marine mammal (excellent, good, fair, poor)
Notes	Additional comments not otherwise captured

Table A-2: Sighting Data Fields

Data Field	Definition and/or Values
Date	Day, month, year of this record
Initial Time	Time of initial sighting
Final Time	Time which sighting was last observed
Latitude	Sighting latitude
Longitude	Sighting longitude
Observer	Observer first and last name
Sighting ID	Unique sighting ID number for each sighting
Species	Beluga Whale, California Sea Lion, Dall's Porpoise, Gray Whale, Harbor Porpoise, Harbor Seal, Humpback Whale, Killer Whale, Minke Whale, Other, Pacific White-sided Dolphin, Sea Otter, Stellar Sea Lion, Unid Dolphin or Porpoise, Unid Marine Mammal, Unid Pinniped
Group Size	Number of individuals observed
Juveniles	Number of juveniles present (if discernible)
Number Calves/Pup/Neonate	Number Calves/Pup/Neonates present (if discernible)
Sighting Cue	Feature first observed (head, fluke, dorsal fin, body, splash, blow, birds, other)
Optics Type	Naked eye, binoculars, spotting scope
Reticle	Reticle value from binoculars
Distance	Distance to sighting (km)
Closest Point of Approach (CPA)	Closest distance animal observed
Where At	From the perspective of a clock face, the location of the sighing relative to the observer
Where To	From the perspective of a clock face, the direction the animal is heading
Behavior 1	Primary behavior (Avoiding Predation, Blowing, Bowriding, Breaching, Bubbling, Calving, Dead, Diving, Feeding Observed, Feeding Suspected, Fluking, Haulout, Lobtail, Looking, Mating, Mating Suspected, Milling, Other, Resting, Side Scanning, Sinking, Snorkeling, Socializing, Spyhopping, Startling, Surface Active, Swimming, Tail Slapping, Tail Waving, Travelling, Unknown, Vocalizing)
Behavior 2	Secondary behavior (Avoiding Predation, Blowing, Bowriding, Breaching, Bubbling, Calving, Dead, Diving, Feeding Observed, Feeding Suspected, Fluking, Haulout, Lobtail, Looking, Mating, Mating Suspected, Milling, Other, Resting, Side Scanning, Sinking, Snorkeling, Socializing, Spyhopping, Startling, Surface Active, Swimming, Tail Slapping, Tail Waving, Travelling, Unknown, Vocalizing)
Reaction	Potential reaction to project activities (none, avoidance, approach, change direction, change speed, dive, splash, unknown)
Pace	Pace of movement (moderate, none, slow, unknown, vigorous)
Activity	Current operational activity (type of pile installation and number of piles driven)

Table A-2: Sighting Data Fields Continued

Data Field	Definition and/or Values
Mitigation	Mitigation action taken
Group Formation* (beluga only)	Circular, Echelon, Linear, No Formation, Parallel
Group Spread in body length (beluga only)	1, 2, 3, 4, 5
Group Size	Total number of animals in group
Notes	Additional comments not otherwise captured

Table A-3: Mitigation Data Fields

Data Field	Definition and Values
Date	Day, month, year of this record
Soft Start Time Start	Time soft start begins
Soft Start Time End	Time soft start ends
Shutdown Request Time	Time shutdown requested by PSO
Shutdown Implemented Time	Time shutdown implemented
Shutdown/Non-Shutdown	Decision made by Construction PM and reason
Level B Zone Entry	Time which sighting entered Level B exposure zone
Level B Zone Exit	Time which sighting exited Level B exposure zone
Level A Zone Entry	Time which sighting entered Level A exposure zone
Level A Zone Exit	Time which sighting exited Level A exposure zone
Clearing Start Time	Time PSO started clearing the harassment zones for initiation of pile driving
Clearing Completed Time	Time PSO determined the area was clear and contacted the Construction PM