UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion

Port of Alaska's Petroleum and Cement Terminal, Anchorage, Alaska

NMFS Consultation Number: AKRO-2018-01332

Action Agencies: National Marine Fisheries Service (NMFS), Office of Protected Resources, Permits and Conservation Division; U.S. Army Corps of Engineers (USACE)

Affected Species and Determinations:

ESA-Listed Species	Status	Is the Action Likely to Adversely Affect Species?	Is the Action Likely to Adversely Affect Critical Habitat?	Is the Action Likely To Jeopardize the Species?	Is the Action Likely To Destroy or Adversely Modify Critical Habitat?
Steller Sea Lion, Western DPS (*Eumetopias jubatus)*	Endangered	Yes	No	No	No
Humpback Whale, Western North Pacific DPS (*Megaptera novaeangliae*)	Endangered	Yes	N/A	No	N/A
Humpback Whale, Mexico DPS (*Megaptera novaeangliae*)	Threatened	Yes	N/A	No	N/A
Cook Inlet Beluga Whale (*Delphinapterus leucas)*	Endangered	Yes	Yes	No	No

Consultation Conducted By: National Marine Fisheries Service, Alaska Region

Issued By: for James W. Balsiger, Ph.D.
Regional Administrator

Date: March 23, 2020

Accessibility of this Document

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TERMS AND ABBREVIATIONS

µPa	Micro Pascal
2D	Two-Dimensional
3D	Three-Dimensional
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ADOT&PF	Alaska Department of Transportation and Public Facilities
AKBMP	Alaska Beluga Monitoring Partnership
AKR	Alaska Region
APU	Alaska Pacific University
ARRC	Alaska Railroad Corporation
AWTF	Anchorage Wastewater Treatment Facility
BA	Biological Assessment
BIA	Biologically Important Areas
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
CI	Confidence Interval
CIPL	Cook Inlet Pipeline Cross-Inlet Extension
CO_2	Carbon dioxide
CV	Coefficient of Variation
CWA	Clean Water Act
dB re 1µPa	Decibel referenced 1 microPascal
DPH	Detection Positive Hours
DPS	Distinct Population Segment
EMALL	ExxonMobil Alaska LNG
EPA	Environmental Protection Agency
ESCA	Endangered Species Conservation Act
ESA	Endangered Species Act
FR	Federal Register
ft	Feet
G&G	Geological and Geophysical
Hz	Hertz
ID	Identification
IHA	Incidental Harassment Authorization
IPCC	Intergovernmental Panel on Climate Change

ITA	Incidental Take Authorization
ITS	Incidental Take Statement
IWC	International Whaling Commission
JBER	Joint Base Elmendorf-Richardson
kHz	Kilohertz
KLU	Kitchen Lights Unit
km	Kilometers
LNG	Liquefied natural gas
MHHW	Mean Higher High Water
mi	Mile
MLLW	Mean Lower Low Water
MMPA	Marine Mammal Protection Act
MTR	Marine Terminal Redevelopment
µPa	Micro Pascal
NEPA	National Environmental Policy Act
NES	North Extension Stabilization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NRC	National Research Council
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
Opinion	Biological Opinion
OSK	Offshore Systems Kenai
Pa	Pascals
PAH	Polycyclic aromatic hydrocarbons
PAM	Passive Acoustic Monitoring
PAMP	Port of Anchorage Modernization Program
PBF	Physical or Biological Feature
PCB	Polychlorinated biphenyls
PCE	Primary Constituent Element
PCoD	Population Consequences of Disturbance
PCT	Petroleum and Cement Terminal
PDO	Pacific Decadal Oscillation
PHMSA	Pipeline and Hazardous Materials Safety Administration
PK	Peak sound level

POA	Port of Alaska
PTS	Permanent Threshold Shift
RMS	Root Mean Square
RPA	Reasonable and Prudent Alternative
s	Second
SEL	Sound Exposure Level
SPL	Sound pressure level
SUDEX	Susitna Delta Exclusion Zone
TL	Transmission Loss
TPP	Test Pile Program
TTS	Temporary Threshold Shift
UME	Unusual Mortality Event
UMHW	Ultra High Molecular Weight Polyethylene
USACE	U.S. Army Corps of Engineers
USFWS	United States Fish and Wildlife Services
VGP	Vessel General Permit
WFA	Weighting Factor Adjustment
WMS	Public Works

1. INTRODUCTION

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. § 1536(a)(2)) requires each Federal agency to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a Federal agency's action "may affect" a protected species, that agency is required to consult with the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 CFR § 402.14(a)). Federal agencies may fulfill this general requirement informally if they conclude that an action may affect, but "is not likely to adversely affect" endangered species, threatened species, or designated critical habitat, and NMFS or the USFWS concurs with that conclusion (50 CFR § 402.14(b)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS and/or USFWS provide an opinion stating how the Federal agency's action is likely to affect ESA-listed species and their critical habitat. If incidental take is reasonably certain to occur, section 7(b)(4) requires the consulting agency to provide an incidental take statement (ITS) that specifies the impact of any incidental taking, specifies those reasonable and prudent measures necessary or appropriate to minimize such impact, and sets forth terms and conditions to implement those measures.

In this document, the action agencies are NMFS Office of Protected Resources, Permits and Conservation Division (hereafter referred to as "the Permits Division") and U.S. Army Corps of Engineers (USACE). The Permits Division plans to issue two incidental harassment authorizations (IHA) pursuant to section 101(a)(5)(D) of the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. § 1361 et seq.), to the Port of Alaska (POA) for harassment of marine mammals incidental to the proposed action. The USACE plans to issue a permit for the proposed action (POA-2003-00502). The consulting agency for this proposal is NMFS's Alaska Region. This document represents NMFS's biological opinion (opinion) on the effects of this proposal on endangered and threatened species and designated critical habitat.

The opinion and ITS were prepared by NMFS Alaska Region in accordance with section 7(b) of the ESA (16 U.S.C. § 1536(b)), and implementing regulations at 50 CFR part 402.

The opinion and ITS are in compliance with the Data Quality Act (44 U.S.C. § 3504(d)(1)) and underwent pre-dissemination review.

This opinion is based on information provided in the Incidental Harassment Authorization (IHA) Application (POA 2019), the proposed IHA (84 FR 72154, December 30, 2019), and the Biological Assessment (BA). Other sources of information relied upon include updated project descriptions provided by the POA, email and telephone conservations between NMFS Alaska Region and NMFS Permits Division staff, and other sources of information. A complete record of this consultation is on file at NMFS's Anchorage, Alaska office.

This opinion considers the effects from the construction of the Petroleum and Cement Terminal

(PCT) at the POA in Knik Arm. These actions have the potential to affect endangered Cook Inlet beluga whales (*Delphinapterus leucas*), endangered Western North Pacific distinct population segment (DPS) humpback whales (*Megaptera novaeangliae*), threatened Mexico DPS humpback whales, endangered Western DPS Steller sea lions (*Eumetopias jubatus*), and designated critical habitat for Cook Inlet beluga whales. There is no designated critical habitat for Steller sea lions within the action area. Take would occur by harassment incidental to impact and vibratory pile driving.

1.1 Background

The Port of Alaska – the applicant for this proposed action – is Alaska's largest seaport and provides 90 percent of the consumer goods for about 85 percent of all of Alaska. It includes three cargo terminals, two petroleum terminals, one dry barge berth, two railway spurs, and a small craft floating dock, plus 220 acres of land facility, located in Anchorage. About 450 ships or tug/barges call at the POA each year.

Operations began at the POA in 1961 with a single berth. Since then, the POA has expanded to a terminal with five berths that moves more than four million tons of material across its docks each year (USACE 2009). The Port of Alaska Modernization Program (PAMP) includes multiple construction projects in the coming years to enable continued operations at the POA, update facilities for operational efficiency, accommodate modern shipping operations, and improve seismic resiliency[1]. This opinion considers the first Phase of the PAMP, the PCT project, which is a stand-alone project with independent utility apart from the future Phases of the PAMP. (Figure 1). The future Phases will depend upon funding that is not yet secured. The PAMP website[8] describes the funding requests to the State of Alaska, and alternative sources of funding such as taxes or cargo tariffs.

After completion of the PCT, the POA plans to replace Terminals 1 and 2 and stabilize the North Extension Stabilization (NES) Step 1 project as part of Phase 2 of the PAMP. Terminals 1 and 2 are the existing container and general cargo terminals, and are the only deep water marine cargo terminals in Anchorage. POA cargo services supply 87 percent of Alaska's population. Preliminary plans for these terminal replacements are currently in a state of reevaluation due to early estimates of high costs and current lack of funding. The schedule for replacement of Terminals 1 and 2 is currently uncertain.

The initial replacement plan that is currently under reevaluation for Phase 2 of the PAMP included demolition of the two existing marine terminals, a new upland expansion, and construction of two new marine terminals in the approximate center of the POA. Each terminal would include a pile-supported platform, pile-supported access trestles, a mooring system, and a fender system. Terminal 1 would support a lift-on/lift-off ship-to-shore rail mounted gantry crane system for the transfer of cargo. Vessels at Terminal 2 would utilize a roll-on/roll-off cargo transfer system. Terminal 2 would also include a single mooring dolphin. Excavation and placement of fill and armor rock would take place adjacent to Terminals 1 and 2 to extend the

[1] http://www.portofalaska.com/modernization-project/

shoreline seaward. Reevaluation of this concept is currently underway and a final design solution is expected to be identified in late 2020.

Other future phases of the PAMP include replacing Petroleum Oil and Lubricants Terminal 2 as part of Phase 3, and further stabilization of NES Step 2 and demolition of Terminal 3 as part of Phases 4 and 5. It should be noted that the NES Step 1 and 2 Projects will remove existing filled areas and convert them to open marine waters, resulting in beneficial impacts on the marine environment. Similar to Phase 2 of the PAMP, Phases 3 through 5 are currently being reevaluated and the schedules for construction are uncertain.

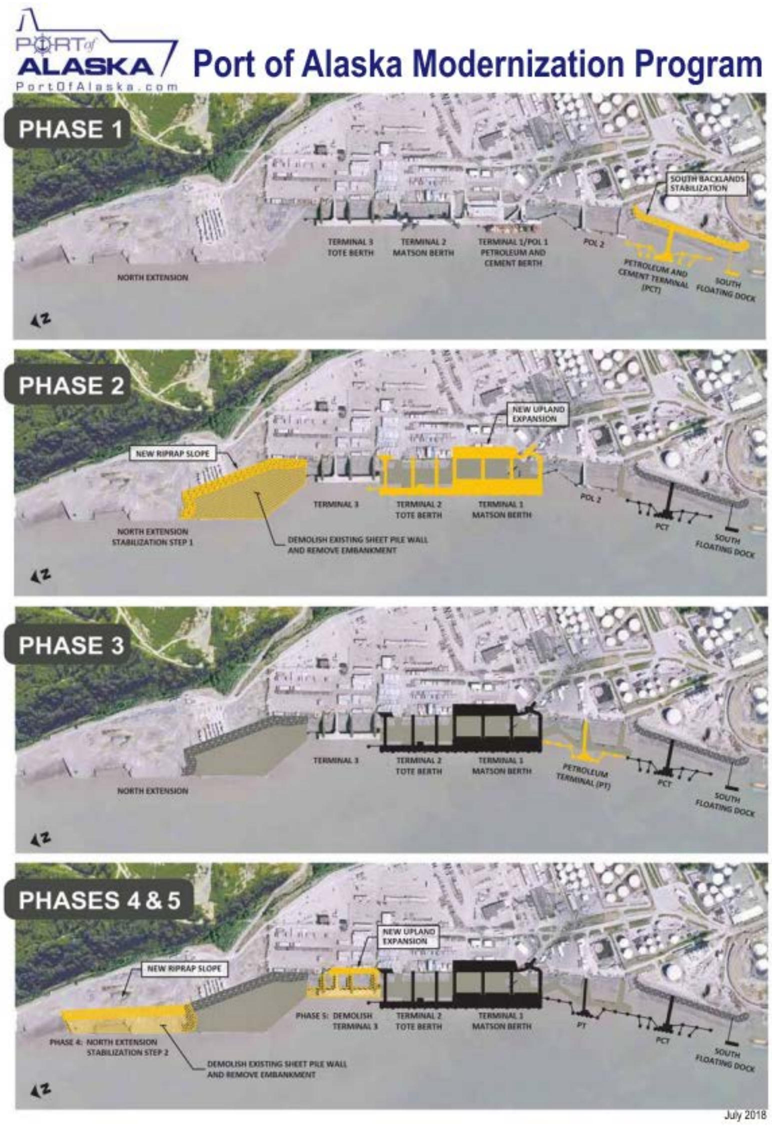

Figure 1. Phases 1-5 of the Port of Alaska Modernization Program (PAMP)[2].

[2] http://www.portofalaska.com/modernization-project/

1.2 Consultation History

- **November 28, 2018 –** NMFS Permits Division received a request from the POA for an IHA to take marine mammals incidental to pile driving associated with the construction of the PCT.
- **June 19, 2019** - the POA submitted a subsequent request because the project would now take two construction seasons (April – November) to complete.
- **August 9, 2019 –** the POA submitted a revised IHA application that outlined the specific construction activities for each year that was not outlined in the previous version.
- **August 28, 2019 –** although NMFS Permits Division disagreed with some of the analysis in the application, NMFS Permits Division deemed the IHA application adequate and complete because it contained all the information necessary for them to conduct their MMPA analysis. For more information on changes to the analysis see the Notice of the Proposed Incidental Harassment Authorization (84 FR 72154).
- **October 15, 2019 –** the POA submitted a revised IHA application.
- **October 17, 2019 –** the POA submitted a copy of the draft biological assessment to NMFS Permits Division.
- **November 18, 2019 –** NMFS Permits Division requested, and NMFS AKR initiated, ESA section 7 consultation.
- **February 18, 2020 –** USACE requested initiation of ESA section 7 formal consultation on the PCT project.

2. DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

2.1 Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas. 50 C.F.R. § 402.02. The proposed action is the PCT project. The following description of the proposed action derives primarily from the Incidental Harassment Authorization (IHA) Application (POA 2019a), the proposed IHA (84 FR 72154, December 30, 2019), and the Biological Assessment (HDR 2020)[3].

2.1.1 Proposed Activities

The PCT will be a new pile-supported structure located along the southernmost shoreline of the POA (Figure 2 and Figure 3), and construction will occur during two phases, Phase 1 and Phase

[3] The POA and USACE have divided the PCT project into 2 phases. The PCT project is the first phase of the PAMP, which is a standalone project with independent utility.

2, over two construction seasons in 2020 and 2021. The POA's boundaries currently occupy an area of approximately 129 acres. Other commercial and industrial activities related to secured maritime operations are located near the POA on Alaska Railroad Corporation (ARRC) property immediately south of the POA, on approximately 111 acres. The PCT terminal footprint spans approximately 0.87 acres and is approximately 0.74 kilometer (0.46 mile) north of Ship Creek, a location of concentrated marine mammal activity during seasonal runs of several salmon species. The PCT project will involve new construction of a loading platform, access trestle, and dolphins (catwalks will connect the dolphins); and installation of utilities (electricity, water, and communication), petroleum, and cement lines linking the terminal and shore. Ships mooring to the PCT will utilize both breasting dolphins and mooring dolphins to secure vessels to the loading platform. To meet required structural demands, 144-inch-diameter monopile dolphins are planned for both the breasting and mooring dolphins. Breasting dolphins are designed to assist in the berthing of vessels by absorbing some of the lateral load during vessel impact. Breasting dolphins also protect dock platforms from impacts by vessels. Mooring dolphins, as their name implies, are used for mooring only and provide a place for a vessel to be secured by lines (ropes). Use of mooring dolphins helps control transverse and longitudinal movements of berthed vessels.

In addition to these permanent structures, temporary work including temporary pile installation will be required to accommodate construction. During Phase 1, a temporary construction access trestle will be installed immediately adjacent and parallel to the permanent access trestle, and then subsequently removed when the permanent access trestle and loading platform construction are completed. During both Phase 1 and Phase 2, temporary template piles and mooring piles will also need to be installed. Various work boats and barges will be utilized to support construction and will be moored at or in the immediate vicinity of the PCT project.

In-water pile driving and removal is anticipated to take approximately 202 days to complete (127 days for Phase 1 and 75 days for Phase 2) during two construction seasons from April 1, 2020 through March 31, 2022, with construction occurring primarily from April through November of each year.

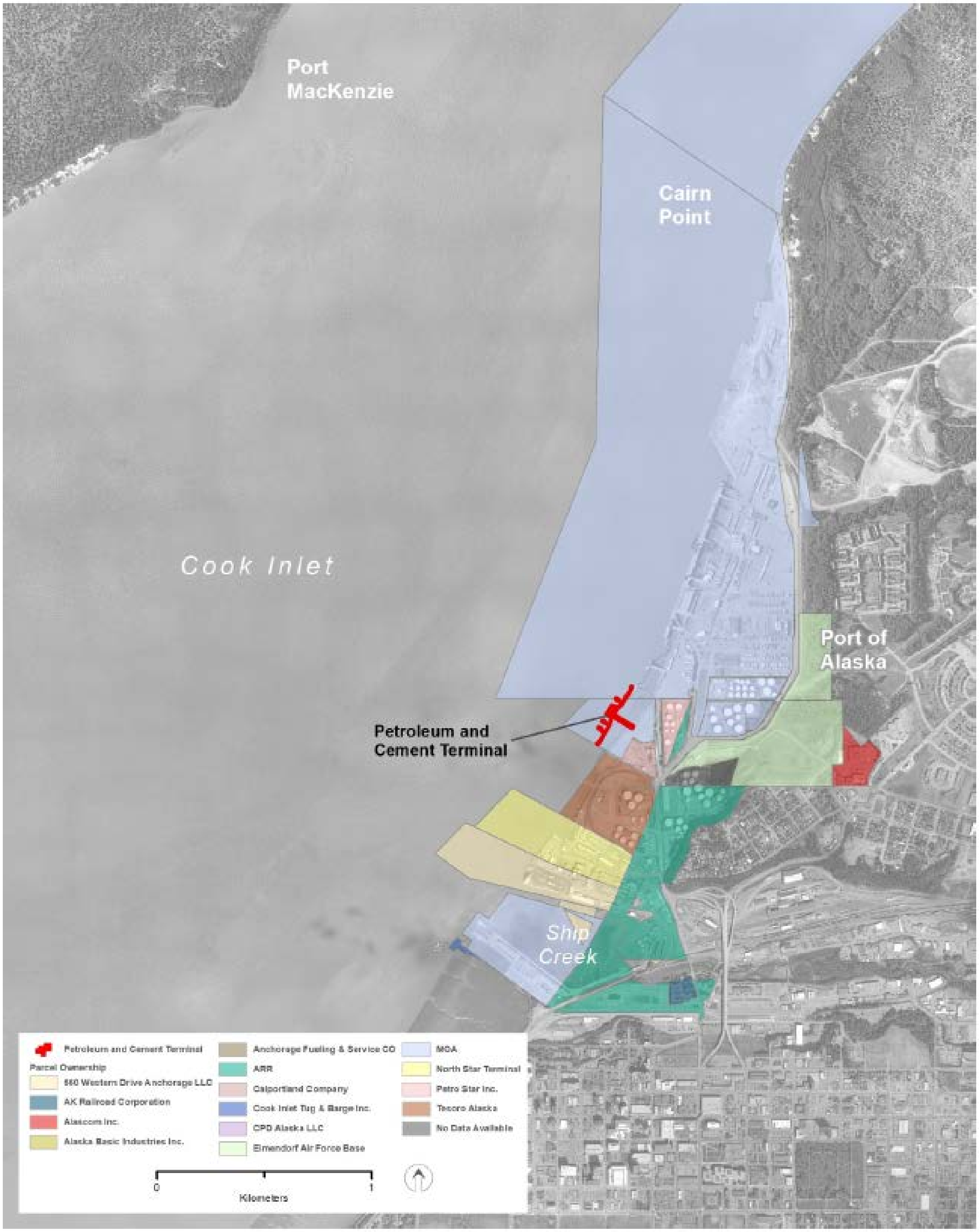

Figure 2. Location of the PCT project in Knik Arm

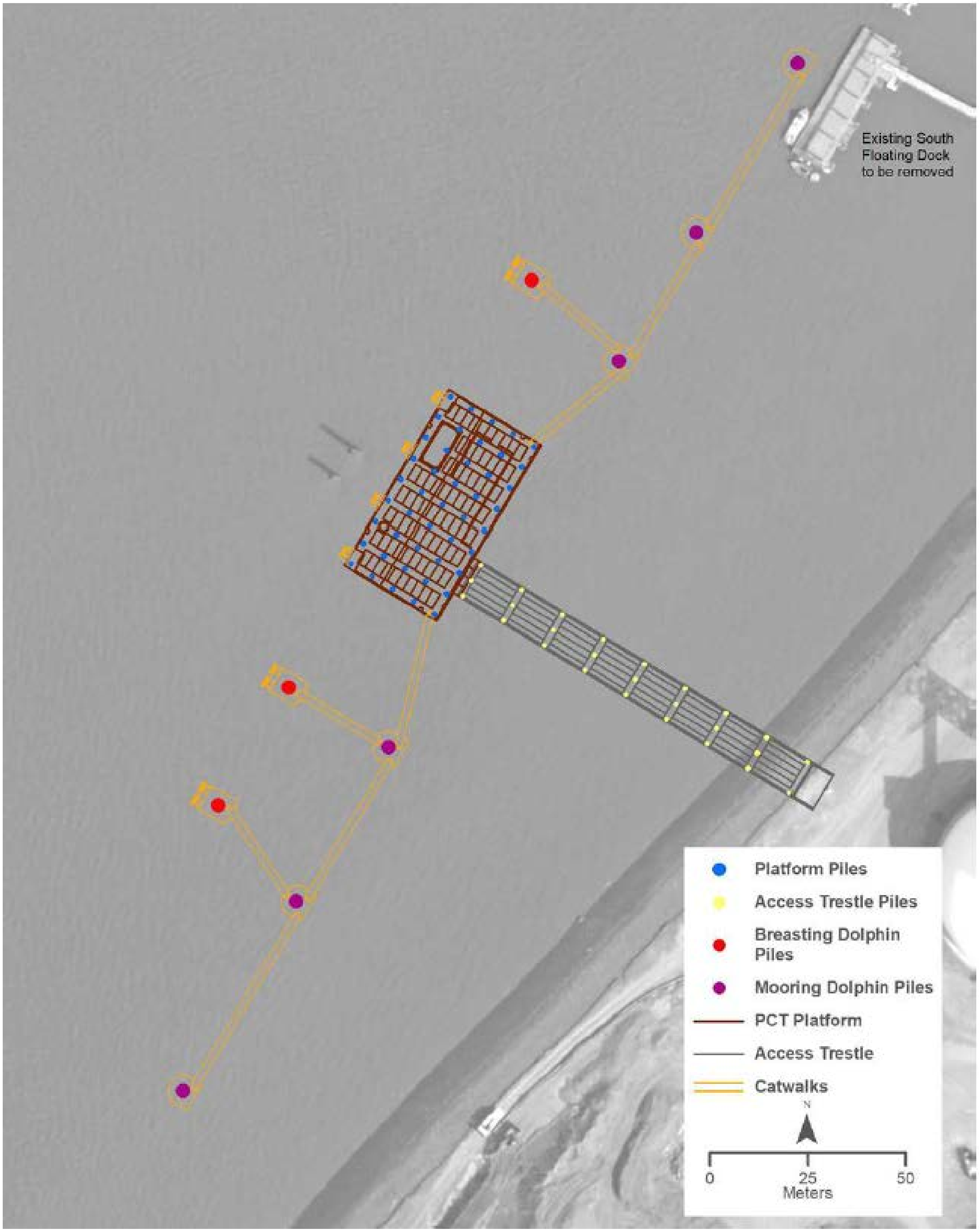

Figure 3. Project Footprint and Pile Locations of the PCT project

Pile installation will occur in both dry conditions and in water depths of up to 80 feet at the outer face of the loading platform, depending on tidal stage; diurnal tide range is approximately 29 feet (Figure 4). Figure 4 shows three test piles that were installed in 2016 and then removed in 2019. These test piles were located just water-ward of the face of the PCT loading platform. Note that the temporary fill pad shown in photo is part of 2018 construction work to stabilize near-shore soils and was removed following the 2018 construction season. The PCT will be constructed between these three test piles and the shore; for illustrative purposes, the distance from the water-ward edge of the PCT loading platform (general location of previous test piles) is approximately 30m from mean lower low water (MLLW) and 115m from mean higher high water (MHHW).

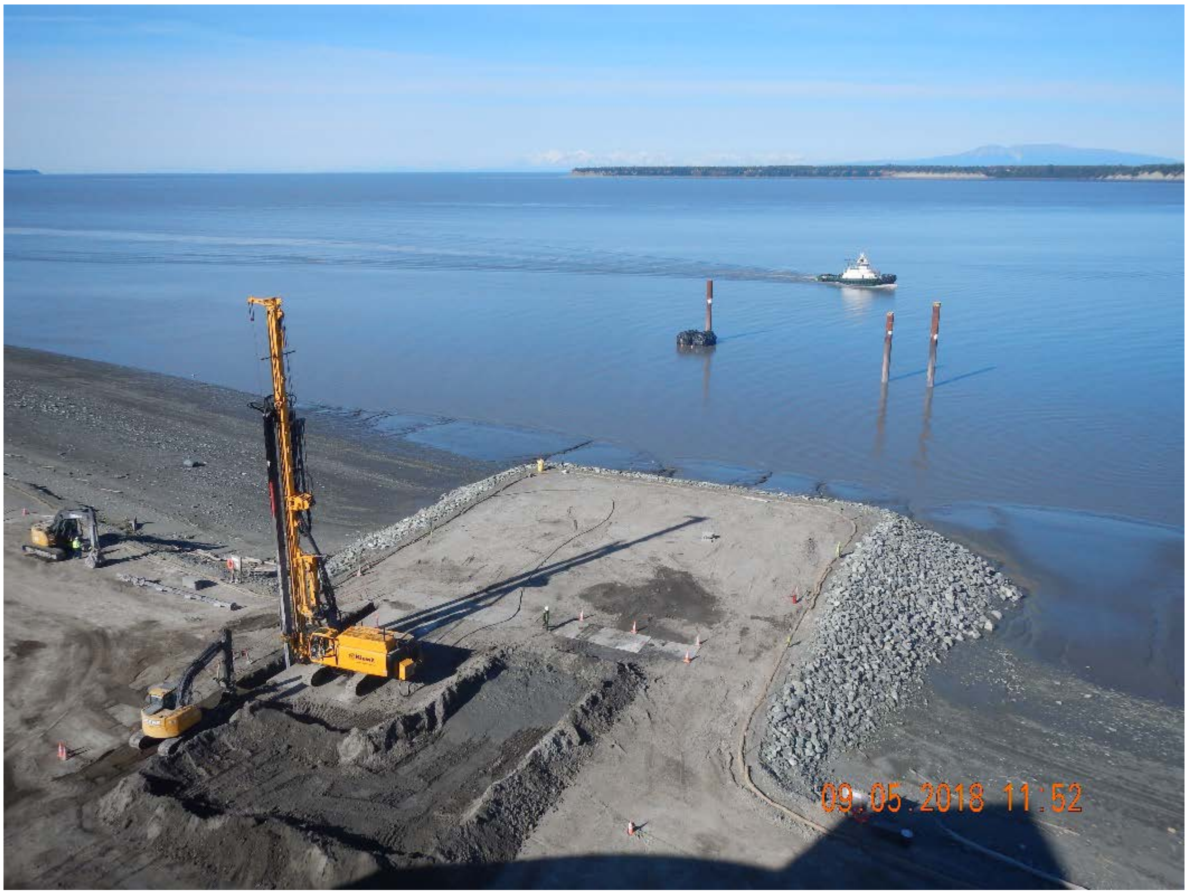

Figure 4. Location of PCT installation site at low tide.

2.1.1.1 PCT Phase 1 Details

PCT Phase 1 construction includes installing a temporary work trestle, the use of templates (temporary) to install permanent piles associated with the access trestle and loading platform, temporary piles to secure the derrick barge during construction, and temporary dolphins to moor vessels during construction. Phase 1 construction mobilization is scheduled to commence the first week of April 2020, with in-water pile driving initiating mid-April. Construction demobilization is planned to occur in November 2020 with the expectation to remove the final temporary piles by the first week of November. The temporary piles must be removed because they are not designed to withstand winter conditions, including ice. Between April and

November, piles will be installed and removed during daylight hours only. Construction of Phase 1 is estimated to occur over 127 days of in-water construction and involve an estimated 359 total hours of pile installation and removal. Table 1 and Table 2 summarizes the number of piles needed for each component and estimated effort required for pile installation and removal. Mooring anchor systems and vessel support details are provided in the *Other Activities – Both Phase 1 & 2* section (Section 2.1.1.3).

During the PCT project, an air bubble curtain noise attenuation system (bubble curtain) will be used during installation and removal of plumb (vertical) piles of all sizes, as feasible. There are no battered piles (installed at an angle) in Phase 1. If battered piles are installed in Phase 2, a bubble curtain will not be used due to the geometry of the template. For more information see the *Bubble Curtain* section below.

Table 1. Summary of PCT Phase 1 project components and activities

Type of Activity	Location	Pile Size and Type	Pile Total Amount or Number
Temporary Components and Construction Support			
Construction work trestle – Temporary pile installation	In-water	24-inch steel pipe	34 piles
	In-water	36-inch steel pipe	26 piles
Access trestle templates - Temporary pile installation	In-water	24-inch steel pipe	20 piles
Loading Platform template – Temporary pile installation	In-water	24-inch steel pipe	18 piles
Derrick barge - temporary[a]	In-water	36-inch steel pipe	4 piles
Construction vessel moorings– temporary[a]	In-water	24-inch steel pipe	3 dolphins, each with 3 piles (9 piles total)
Mooring anchor systems[ab]	In-water	20,000 pound Danforth anchors	2 mooring systems
Vessel support[b]	In water	Barges and tugs	16 flat deck barges, 2 derrick barges, and 3-4 tugs
Permanent Components			
Loading platform - Permanent pile installation	In water	48-inch steel pipe	45 piles
Access Trestle - Permanent pile installation	In water	48-inch steel pipe	26 piles
Installation of concrete decking on loading platform and main trestle	Above water	Pre-cast panels	About 120 panels
Installation of Utility, Petroleum, and Cement Lines	Above water, on-dock	Pipelines, various sizes and types	300–600 linear feet each

[a] This work will be deconstructed at the end of the season in Phase 1 because the temporary piles cannot withstand conditions over the winter (e.g., ice), and re-constructed and removed again in Phase 2.
[b] Mooring anchor systems and vessel support will be needed in both Phase 1 and 2.

Table 2. PCT Phase 1 Construction Pile Details and Estimated Effort Required for Pile Installation and Removal

Pipe Pile Diameter	Feature	Number of Piles	Total Number of Piles	Average Embedded Depth (feet)	Vibratory Duration or Number of Piles	Impact Strikes Per Pile	Estimated Total Number of Hours	Production Rate Piles per Day (Range)	Days of Installation and Removal
Phase 1									
48-inch	Loading Platform (Permanent)	45	71	100	30 minutes	2,300 (plus 50 restrikes each for 4 piles)[a]	73	1.5	30
	Access Trestle (Permanent)	26		130	10% of piles (7 piles)[b]	3,000 (plus 50 restrikes each for 3 piles)[a]	56	(1-3)	17
36-inch	Construction Work Trestle (Temporary)	26	30	115	75 minutes	50 restrikes each for 10 piles	33	3	9 installation
								(2-4)	9 removal
	Derrick Barge (Temporary)	4		40	75 minutes	NA	5	4	1 installation
									1 removal
24-inch	Construction Work Trestle (Temporary)	34	81	140	75 minutes	50 restrikes each for10 piles	65	3	9 installation
								(2-4)	9 removal
	Construction Access Trestle and Loading Platform Templates (Temporary)	38		105	75 minutes	NA	90	3	12 installation
								(2-4)	12 removal
	Construction Vessel	9		50	30 minutes	NA	3	3	3 installation

Pipe Pile Diameter	Feature	Number of Piles	Total Number of Piles	Average Embedded Depth (feet)	Vibratory Duration or Number of Piles	Impact Strikes Per Pile	Estimated Total Number of Hours	Production Rate Piles per Day (Range)	Days of Installation and Removal
	Moorings (Temporary)								3 removal
Phase 1 Construction Totals			**182 piles**				**359**		**127**

[a] A subset of the 48-in piles will require a short duration of re-strike pile driving to prove pile axial capacity (i.e., ensuring that the pile can withstand the planned weight/load without failure or settling).

[b] The Port expects that 30 minutes of vibratory hammer application per pile may be necessary on approximately 10 percent of loading platform and access trestle piles, or approximately 7 piles.

Construction Sequencing – Phase 1

Construction of the PCT in Phase 1 will be accomplished through two concurrent headings or work approaches; a land-side crawler crane/hammer will be used to construct the temporary and permanent access trestle from the shoreline out, and one marine-side derrick barge with a crane/hammer will be used to construct the loading platform. The crawler crane will initially advance the temporary work trestle out from the shoreline with a top-down or leap-frog type construction method, and then the crawler crane will work off of the temporary work trestle to construct the permanent trestle all the way out to the loading platform (Figure 5).

Figure 5. Illustration of a Typical Temporary Construction Work Trestle

Bubble Curtain

During the PCT project, an air bubble curtain noise attenuation system (bubble curtain) will be used during installation and removal of piles of all sizes, as feasible. The bubble curtain attenuates, or reduces, sound by creating a curtain of bubbles that breaks the propagation of sound waves. This ultimately reduces sound exposure to marine mammals. If battered piles (piles installed at an angle) are used in Phase 2, a bubble curtain will not be used due to the geometry of the template. It may not be possible to use a bubble curtain on piles installed or removed in shallow water or piles installed or removed “in the dry” (e.g., at times when the tide is low and the installation location is dewatered Figure 4). The tides at the POA have a mean range of about 8.0 meters (26 feet) (NOAA 2019), and low water levels will prevent proper deployment and function of the bubble curtain system. When water is present at the pile driving site, but is too shallow for deployment of a bubble curtain, the harassment zones for unattenuated impact pile installation will be monitored, see *Acoustic Thresholds* section in Chapter 6.

A confined bubble curtain was tested during the Port of Anchorage Modernization Program (PAMP) 2016 Test Pile Program (TPP), and was found to be an effective method of reducing in-water pile driving sound for 48-inch vertical steel pipe piles. It is assumed for the PCT project that a well-designed and robust bubble curtain system will achieve a mean reduction of 7 dB (Navy 2015) for both impact pile installation and vibratory pile installation and removal. Although there are differences between the application of the bubble curtain in Phase 1 and Phase 2 (e.g., the use of the casing system), the 7dB reduction is the same for both Phases. A sound source verification (SSV) study will measure sound source levels and capture reductions from the application of the bubble curtain.

A bubble curtain reduces the propagation of noise through the water by inhibiting transmission of noise through the air bubble-water interfaces. As a pile is installed or removed, air is released into the bubble curtain system through a series of vertically distributed bubble rings made from pipes that surround the pile. A bubble curtain system can also be designed to surround a set of piles. A series of compressors provides a continuous supply of compressed air, which is distributed among the layered bubble rings. Air is released from small holes in the bubble rings to create a curtain of air bubbles surrounding the pile. The curtain of air bubbles floating to the surface inhibits the transmission of pile installation noise into the surrounding water column. As the bubbles float to the surface and expand, new bubbles are released from the layers of rings, providing a range of bubble sizes at every depth that effectively attenuate different sound frequencies. Additionally, sound is known to propagate through the sediment and into the water column. However, with the casing system (described below), penetrating several feet into the sediment, this design may reduce transmission of sound through the sediment.

For piles driven in locations where tidal waters may exceed 3 meters in depth during pile driving operations, the POA proposes to use a bubble curtain to attenuate in-water noise resulting from impact and vibratory pile driving.

For Phase 1 PCT construction, the construction contractor has provided a detailed work plan regarding temporary pile requirements and suitable bubble curtain applications, as discussed below. For Phase 2 PCT construction, the construction contractor is not scheduled to be selected until approximately the third quarter of 2020; therefore, a similar level of detail and specificity is not currently available.

The bubble curtain air flows and annular space will conform to the guidance outlined in the National Marine Fisheries Service and U.S. Fish and Wildlife Service, Washington Fish and Wildlife Office document dated October 31, 2006 titled “Impact Pile Driving Sound Attenuation Specification” (USFWS 2006). Attenuation for temporary piles will conform to the methods described below.

In Phase 1, the 24-inch diameter temporary piles will have a 48-inch diameter confinement casing, and the 36-inch diameter temporary piling will have a 60-inch diameter confinement casing. Multiple confinement casings with bubble curtain hardware will be deployed when multiple pile driving operations are occurring concurrently.

Temporary piles and the confinement casing, with installed bubble curtain hardware, will be lofted together with the piles in a concentric arrangement, and allowed to drop onto the seafloor.

The weight of the configuration will embed the arrangement into the seafloor. The specific depth of penetration from self-weight varies depending on water depth, substrate, weight of pile, tidal stage resistance, and other physical factors present, but the contractor has estimated a minimum of a couple or few feet penetration into the substrate. The lowest bubble ring will be within one to two feet of the seafloor. There will be an arrangement of spacers that center the piling within the confinement casing. These spacers will be padded to prevent metal-to-metal contact between the confinement casing and the pile. Figure 6 illustrates this concentric arrangement.

Once the bubble curtain is operational, the temporary pile will be driven with a combination of vibratory and impact methods within the confinement casing; after pile driving, the confinement casing will be lifted off of the temporary pile. For removal of temporary piling, the confinement casing, with installed bubble curtain, will be re-deployed over the pile. Once the bubble curtain is operational, the temporary pile will be extracted using vibratory methods within the confinement casing, and the temporary piling casing will be removed together with the temporary pile. A vibratory hammer will not be required to remove the casing itself.

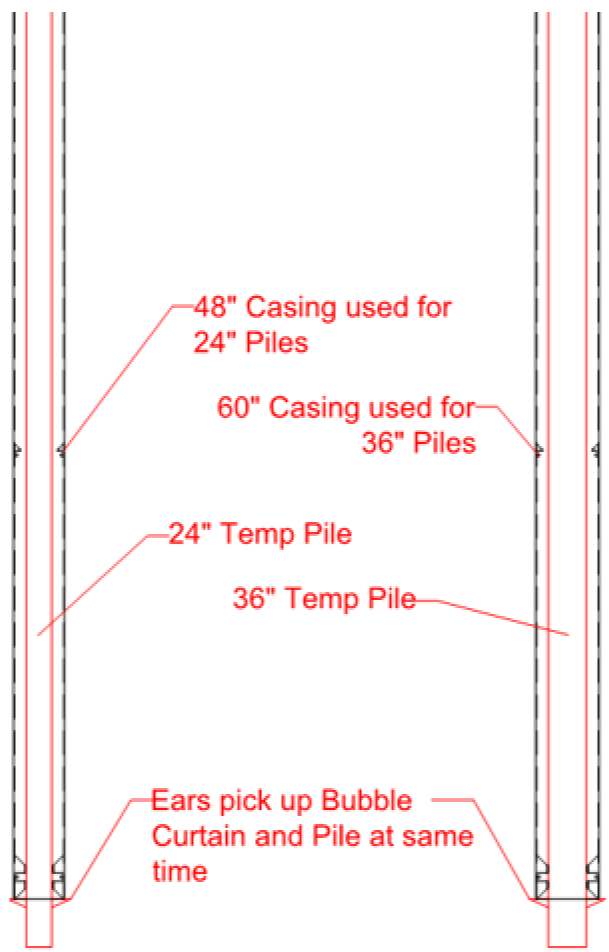

Figure 6. Diagram of temporary pile and confinement system, demonstrating concentric arrangement that can be lifted and dropped onto the seafloor together.

The 48-in piles are much heavier and longer than the 24- and 36-inch piles; therefore, the method of lofting the 48-in piles and concentric confinement casing together is not feasible. The 48-in piles in Phase 1 will be fitted with a 72-inch diameter confinement casing. Multiple confinement casings with bubble curtain hardware will be deployed when multiple piles will be driven concurrently. The confinement casing with installed bubble curtain hardware will be lofted through a template, shown in Figure 7, to the sea floor and then will be driven to a nominal depth of 10 feet using vibratory methods.

Vibratory hammer use is planned for not more than 3 minutes per confinement casing; with a total project impact of 215 minutes, which is less than 4 hours total. This will produce a brief and intermittent duration of unattenuated vibratory sound for each of the permanent piles. Use of a vibratory hammer is necessary in order to stabilize the pile using the sea floor embedment and the template, so that the confinement casing can be released from the crane without endangering personnel or property. Once the confinement casing is in place, the permanent pile will be lofted through the casing and allowed to self-weight into the sea floor. The bubble curtain will be activated and then the permanent pile will be driven using impact methods (or vibratory method in case of pile driving difficulties or obstructions as discussed elsewhere in the work description). After driving to depth, the confinement casing will be lifted off of the pile. This will not require vibratory energy to remove because of the shallow embedment. Figure 8 illustrates the arrangement for installation of the permanent piles and confinement system.

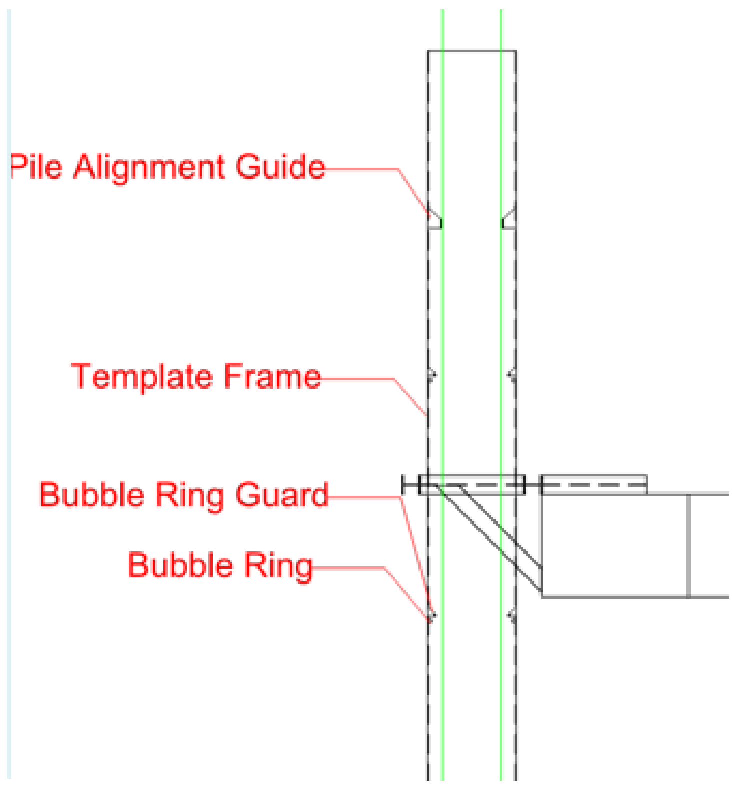

Figure 7. Template configuration used for installation of confined casing system used for permanent piles.

A subset of the 48-in piles will require a short duration of re-strike pile driving to prove pile axial capacity (i.e., ensuring that the pile can withstand the planned weight/load without failure or settling). This is planned for up to 7 piles. For these re-strike events, the confinement casing will be lowered over the permanent pile and allowed to self-weight into the sea floor sediments; the bubble curtain will be activated and then the pile re-struck with the impact hammer. Once the axial capacity is determined, the confinement casing will be lifted off of the pile. During restrikes, the confinement casing doesn't need to be vibratory hammered in because the permanent pile will provide a safe condition since the bubble curtain sleeve can be set onto the rigidity of the permanently installed 48" pile. The sleeve will not need to be free standing as in the case of initial installation.

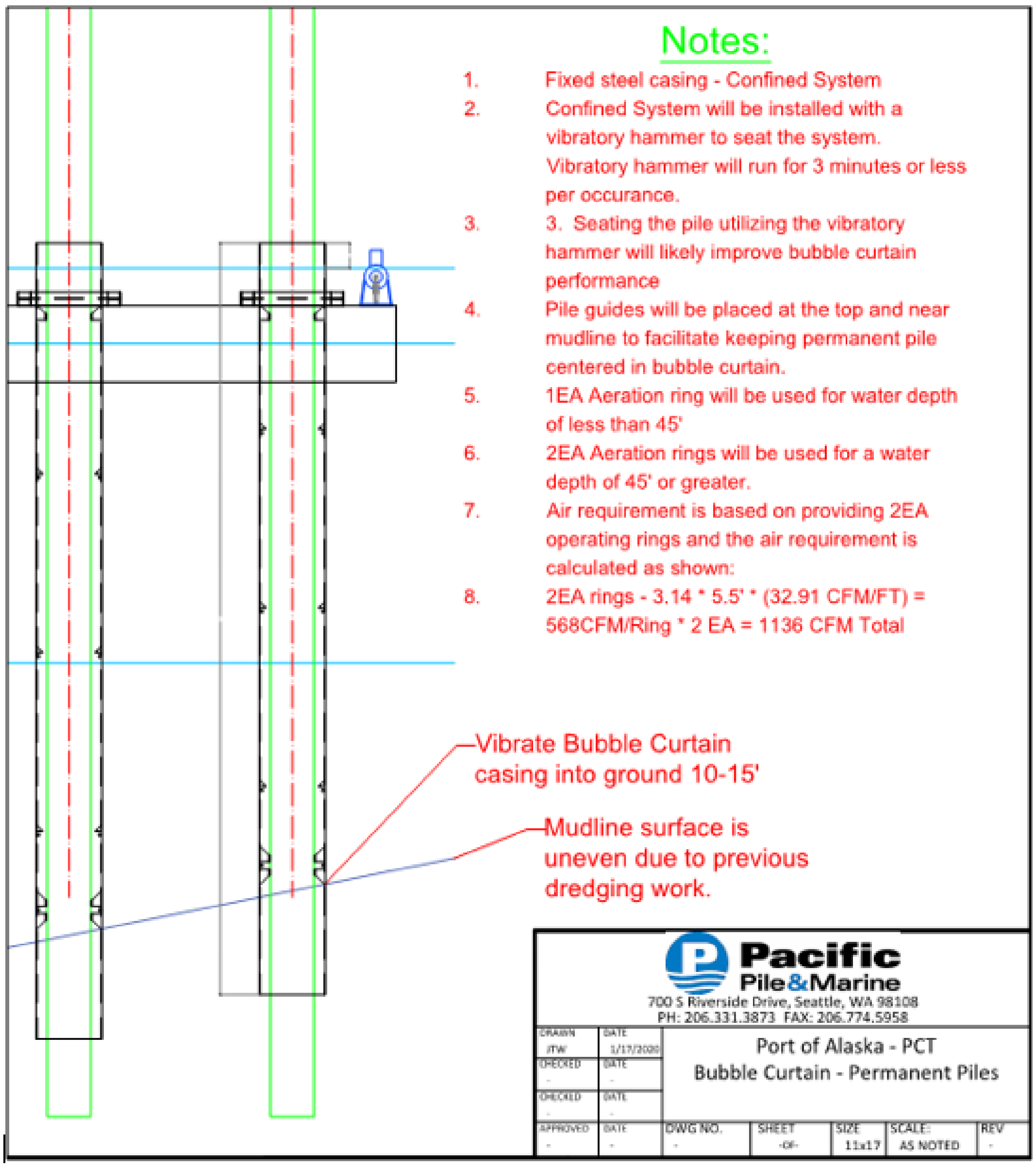

Figure 8. Diagram of pile and confinement system for the 48-in piles, showing arrangement requiring vibratory installation of confinement and separate advancement of pile.

Construction vessel moorings (Temporary) – Phase 1

Temporary mooring piles for construction vessels will be installed near the PCT during Phase 1 (and Phase 2). Working barges associated with the PCT project will use the temporary moorings during PCT construction. Each temporary dolphin will consist of 24-inch plumb piles installed with a vibratory hammer. Table 1 and Table 2 summarizes the number of piles needed for the temporary breasting dolphins, and estimates effort required for pile installation and removal. The temporary breasting dolphins will be removed at the end of the season in Phase 1, and re-constructed and removed again in Phase 2. Removal is expected to require the same number of days as installation due to the strong pile set up and resistance conditions related to Knik Arm substrates.

Derrick Barge Mooring (Temporary) – Phase 1

A temporary derrick barge mooring will be installed adjacent to the loading platform during Phase 1 (and near the dolphins during Phase 2) to secure the derrick barge during construction. The mooring will be comprised of 36-inch-diameter steel pipe piles and will be installed with a vibratory hammer to hold the barge in position. Table 1 and Table 2 summarizes the number of piles needed for the temporary derrick barge mooring, and estimates effort required for pile installation and removal. The temporary derrick barge mooring will be deconstructed at the end of the season in Phase 1, and re-constructed and removed again in Phase 2. Removal is expected to require the same number of days as installation due to the strong pile set up and resistance conditions related to Knik Arm substrates.

Construction Work Trestle (Temporary) – Phase 1

A temporary construction work trestle is anticipated to be necessary to support construction of the access trestle during Phase 1 and will be located adjacent, parallel to, and north of the access trestle (Figure 5). Table 1 and Table 2 summarizes the number of piles needed for the construction work trestle, and estimates effort required for pile installation and removal. Temporary piles are required to be installed using a vibratory hammer due to specific construction requirements, accuracy, sequencing, and schedule. Removal is expected to require the same number of days as installation due to the strong pile set up and resistance conditions related to Knik Arm substrates.

Restrikes or proofing of temporary trestle piles are anticipated to be required. Proofing involves brief periods of restrikes while instrumentation is attached to the pile to confirm adequacy for handling construction equipment loads. Restrikes of piles will occur concurrent with other pile installation activities and will not add additional days of work to the project timeline.

Construction Access Trestle Template (Temporary) – Phase 1

A driving template supported by 4 24-inch piles will be required during Phase 1 for construction of each of the 9 bents (cross-ways support structures) of the access trestle (9 bents * 4 piles per driving template = 36 total temporary access trestle template piles). This template will also be used as a welding platform during splicing operations. Temporary construction template piles will be installed with a vibratory hammer due to accuracy requirements for setting the template.

Table 1 and Table 2 summarizes the number of piles needed for the access trestle template, and estimates effort required for pile installation and removal. Removal is expected to require the same number of days as installation due to the strong pile set up and resistance conditions related to Knik Arm substrates.

Loading Platform Template (Temporary) – Phase 1

A template will be required during Phase 1 for construction of the loading platform. The loading platform template piles are arranged in an array of nine bents with five piles per bent. The contractor intends to secure or register the piling and bubble curtain casing using a floating template that includes five locations through which to drive the permanent piles. Each end of the floating template will be secured with a temporary 24-inch pile. After the permanent loading platform plies are driven at one bent, the template will be removed and floated to the next bent to advance that line of piles. Average production rate and installation of temporary loading platform template piles will require the hours of activity over the number of days shown in Table 2. Removal is expected to require the same number of days as installation due to the strong pile set up and resistance conditions related to Knik Arm substrates.

Loading Platform and Access Trestle (Permanent) – Phase 1

Construction of the loading platform and access trestle will occur during Phase 1. Table 1 and Table 2 summarize the number of piles and estimate effort required for pile installation of the loading platform and access trestle. The access trestle is comprised of eight bents (clusters) of three piles each and one bent of two piles at the abutment.

Loading platform and access trestle 48-inch piles will be installed using an impact hammer. Loading platform and access trestle piles will be driven through the overburden sediment layer and into the bearing layer. It is estimated that one or two loading platform or trestle piles will be installed per day; three or more piles may be installed on some days. The Port expects an average installation rate of 1.5 piles per day. Vibratory hammer methods may be used to install loading platform and access trestle piles if necessary for constructability or safety reasons, or if a pile encounters an obstruction or constructability issue. The Port expects that 30 minutes of vibratory hammer application per pile may be necessary on approximately 10 percent of loading platform and access trestle piles, or approximately 7 piles.

Installation of Utility Lines and Pipelines

Utility lines will include water, electric, and communication lines. New pipelines will be installed to carry petroleum and cement. Utility, petroleum, and cement lines will extend between the PCT loading platform and the shore, and will connect with existing onshore infrastructure. The installed utility lines and pipelines will be supported by the access trestle and loading platform above marine waters. No pile installation or removal is associated with these auxiliary activities; therefore, no impacts on the aquatic environment, including elevated in-water noise, are anticipated from the installation of utility lines and pipelines.

2.1.1.2 PCT Phase 2 Details

PCT Phase 2 construction includes installation of 144-inch monopile dolphins, the use of temporary template piles for installation of the monopiles, temporary piles to secure the derrick barge during construction, and temporary dolphins to moor vessels during construction. Phase 2 construction mobilization is scheduled to commence in April 2021, with in-water pile driving initiating in May. Construction demobilization is planned to occur in November 2021 with the expectation to remove the final temporary piles in early November. The project is sequentially staged; therefore, it is unlikely pile installation would be evenly distributed throughout the construction season. However, there will be several days of no pile driving while the pile segments of the 144-inch piles are being spliced and out-of-water work is occurring. Construction of Phase 2 is estimated to occur over 75 days of in-water construction and involve an estimated 229 total hours of pile installation and removal. Table 3 and Table 4 summarizes the number of piles needed for each component and estimated effort required for pile installation and removal.

During the PCT project, an air bubble curtain noise attenuation system (bubble curtain) will be used during installation and removal of plumb (vertical) piles of all sizes, as feasible. If battered piles (piles installed at an angle) are installed in Phase 2 (see *Bubble Curtain* section below), a bubble curtain will not be used due to the geometry of the template. For more information see the *Bubble Curtain* section below.

Table 3. Summary of PCT Phase 2 Project Components and Activities

Type of Activity	Location	Pile Size and Type	Total Amount or Number
Temporary Components and Construction Support			
Dolphin templates - Temporary pile installation	In-water	36-inch steel pipe (plumb)	72 piles
Derrick barge - Temporary[a]	In-water	36-inch steel pipe (plumb)	4 piles
Construction vessel moorings – Temporary[a]	In-water	24-inch steel pipe (plumb) 24-inch steel pipe (battered)	3 dolphins, each with 1 plumb and 2 battered piles (9 piles total)
Mooring anchor systems[a,b]	In-water	20,000 pound Danforth anchors	2 mooring systems
Vessel support[b]	In water	Barges and tugs	16 flat deck barges, 2 derrick barges, and 3-4 tugs
Permanent Components			
Permanent pile installation (breasting and mooring dolphins)	In water	144-inch steel pipe (plumb)	9 piles
Catwalks	Above water	Prefabricated steel or aluminum trusses with open steel grating	9 units, totaling 990 feet

[a] This work will be deconstructed at the end of the season in Phase 1 (because the temporary piles cannot withstand winter conditions (e.g., ice)), and re-constructed and removed again in Phase 2.
[b] Mooring anchor systems and vessel support will be needed in both Phase 1 and 2.

Table 4. PCT Phase 2 Construction Pile Details and Estimated Effort Required for Pile Installation and Removal

Pipe Pile Diameter	Feature[a]	Number of Piles	Total Number of Piles	Average Embedded Depth (feet)	Vibratory Duration Per Pile (minutes)	Impact Strikes Per Pile	Estimated Total Number of Hours	Production Rate Piles per Day (Range)	Days of Installation and Removal
Phase 2									
24-inch	Dolphins for mooring construction vessels (Temporary)	3	9	50	30	NA	3	3	1 installation 1 removal
	Dolphins for mooring construction vessels, Battered (Temporary)	6		50	30	NA	9	3	2 installation 2 removal
36-inch	Construction Dolphin Template (Temporary)	72	76	115	75	NA	180	3 (2-4)	24 installation 24 removal
	Derrick barge (Temporary)	4		40	75	NA	5	4	1 installation 1 removal
144-inch	Mooring Dolphin (Permanent)	6	9	140	45 minutes total 10% of 9 piles (~1 pile)[b]	5,000 (1,500 first day, 3,500 second day)	21	0.5	13
	Breasting Dolphin (Permanent)	3		135			11	(0.3 on first day and 0.7 on second day)[c]	6
Phase 2 Construction Totals			**94 piles**				**229**		**75**

[a]Piles are plumb (vertical) unless battered is specified.

[b] The Port expects that 30 minutes of vibratory hammer application per pile may be necessary on approximately 10 percent of the mooring and breasting dolphin piles.

c About 60 minutes of impact installation (30 percent of the total effort) will be required the first day to install the first pile segment. It is anticipated that several days will be required to splice the second segment and prepare it for installation. The second day of impact installation will require about 140 minutes (70 percent of the effort).

Construction Sequencing – Phase 2

For Phase 2, construction will be accomplished from one marine-based derrick barge with a crane/hammer work station. Similar to Phase 1, the contractor will initially install four temporary 36- inch mooring piles to stabilize the derrick barge during the construction season. Also, temporary mooring dolphins will be constructed in the vicinity of the PCT to serve as mooring for construction vessels and barges containing construction materials, and will be removed at the end of the construction season. The derrick barge will host the crane and hammer used to install the mooring and breasting dolphins. Temporary template piles will then be installed to anchor the template that will guide the installation of the permanent dolphin piles at each of the dolphin locations. These temporary 36-inch template piles will be driven in a grid formation surrounding the location of each dolphin pile, with a steel framework bolted to the temporary piles to guide dolphin pile installation. The framework includes adjustable components and hydraulic guides that can be adjusted to maintain correct positioning of the dolphins once in place.

Following temporary pile installation with a vibratory hammer for the dolphin template, held in place with 36-inch piles, the crane will loft the first permanent pile length (approximately 100 feet) and ready it for lowering through the template framework. The crane will have a boom holding the top of the pile as well as a spotter arm lower on the pile to steady the pile for positioning. The pile will then be lowered through the template and readied for pile driving. Impact pile driving will be used to advance the pile to a prescribed depth, at which point pile driving activity will stop to allow field splicing of the second pile length.

Decking will be added to the temporary pile template framework to accommodate welders; no pile driving will be conducted during welding and testing of the two lengths of pile, as the crane will be holding the second pile length in place. Once the first and second lengths of pile are spliced, pile driving will be reinitiated until the tip is at the prescribed depth. Limited vibratory hammer application may be required on the mooring or breasting dolphin piles for safety or constructability reasons, or if a pile encounters an obstruction.

Following monopile installation, the superstructure will be installed on top of the monopile. A precast concrete mooring cap will be added to the monopile. The caps will be welded to the piles by an embedded steel ring in the precast cap. This activity will not require in-water work or hammer activity. The three breasting dolphins will have fenders installed, which will be attached to the mooring cap and will not require in-water or hammer work.

Once the first and second lengths of pile, ring and mooring cap, and fender, if applicable, are assembled at the first location, the temporary template piles will be removed using a vibratory hammer. The barge will then be repositioned to the next location, and the work activity will commence as described above.

One crane and hammer will be used for installation of dolphin piles and associated temporary template piles; multiple hammers will not be employed simultaneously. Templates will be re-used at each dolphin location. The crane will alternate between installing template piles, driving dolphin pile, removing template piles, and out-of-water work such as placement of decking, catwalks, and utility racks along the platform and trestle. All terminal utility work is out of the water, and includes installation of pipe racks and utilities along the platform and trestle.

Bubble Curtain

For Phase 2, the POA commits to application of a bubble curtain on all 144-inch diameter permanent dolphin piles and all temporary piles that are installed vertically or plumb. Due to the large size of the 144-inch dolphin piles, it is expected that an open bubble curtain system will be required. During Phase 1, the POA will confirm performance and operation of the enclosed bubble curtain system, along with receiving a detailed Work Plan from the Phase 2 construction contractor, before selecting the exact type of bubble curtain system that will be most operationally efficient and best attenuate noise emissions.

As mentioned above, although there are differences between the application of the bubble curtain in Phase 1 and Phase 2 (e.g., the use of the casing system), the 7dB reduction is the same for both Phases. A sound source verification (SSV) study will measure sound source levels and capture reductions from the application of the bubble curtain.

Construction vessel moorings (Temporary) – Phase 2

As in Phase 1, temporary mooring piles for construction vessels will be installed near the PCT during Phase 2. The design, materials, and construction will be the same as described above for Phase 1. Table 3 and Table 4 summarizes the number of piles needed for the dolphins and estimated effort required for pile installation and removal in Phase 2. All temporary plumb piles will employ a bubble curtain during all pile driving activity. If battered piles are installed in Phase 2, a bubble curtain will not be used due to the geometry of the template

Derrick Barge Mooring (Temporary) – Phase 2

As in Phase 1, a temporary derrick barge mooring will be installed. Design, materials, and construction will be the same as described above for Phase 1, however for Phase 2 this will be located near the dolphins to secure the derrick barge during construction. Table 3 and Table 4 summarize the number of piles needed for the derrick barge and estimated effort required for pile installation and removal in Phase 2. All temporary plumb piles will employ a bubble curtain during all pile driving activity.

Construction Dolphin Template for 144-in piles (Temporary) – Phase 2

Temporary construction piles will be needed to anchor the template that will guide the installation of 144-inch piles at each of the nine dolphin locations during Phase 2 (Figure 9). It is anticipated that temporary construction piles to support the dolphin template will be 36-inch-diameter steel pipe (Table 3 and Table 4). Eight temporary construction piles will be needed for each mooring and breasting dolphin. All piles will be aligned plumb (vertically) and installed and removed using a vibratory hammer due to accuracy requirements for setting the template. All temporary plumb piles will employ a bubble curtain during all pile driving activity. In addition to the time required to install and removal piles, additional time will be required for setup of the template structure, which will include welding, surveying the location, and other activities.

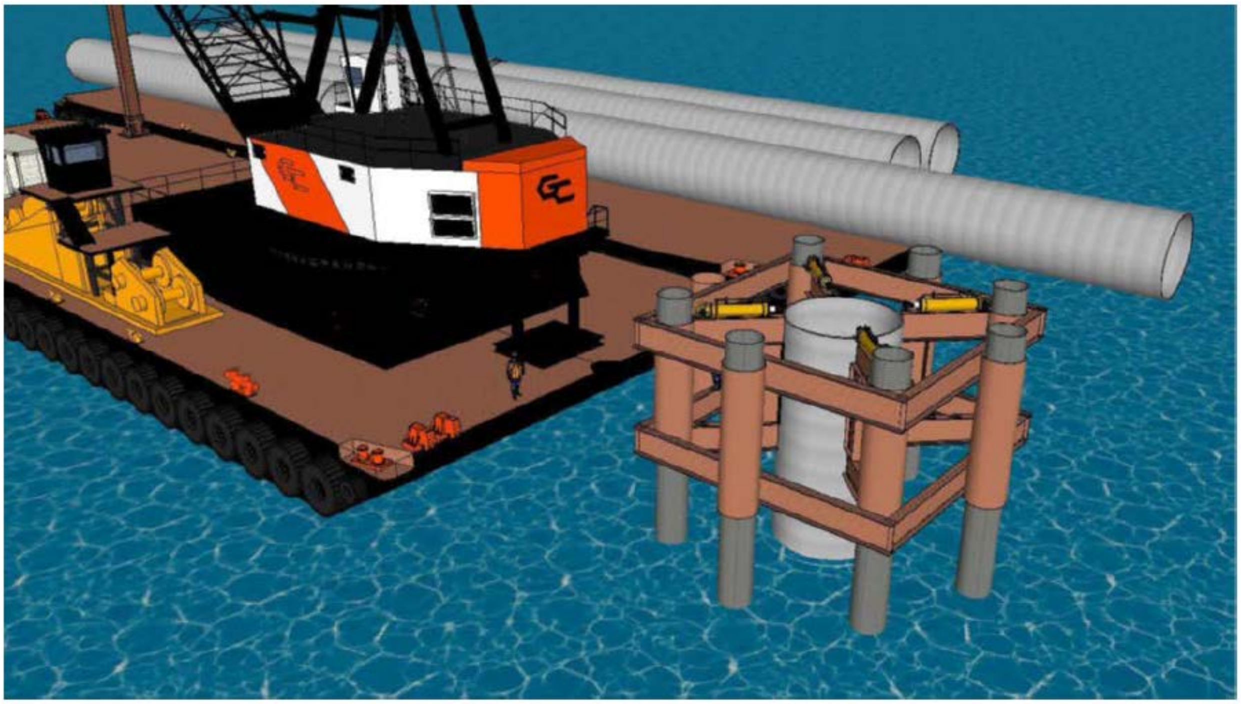

Figure 9. Illustration of a typical dolphin pile template.

Mooring Dolphins (Permanent) – Phase 2

Six permanent mooring dolphins will be constructed parallel to and landward of the loading platform face during Phase 2 (Figure 3). These dolphins will provide additional secure mooring points for ships docking at the terminal. Each mooring dolphin will be comprised of a single round, 144-inch-diameter steel pipe pile. Piles will be installed using an impact hammer. Details on the estimated effort and average embedded depth are provided in Table 4. About 60 minutes of impact installation (30 percent of the total effort) will be required the first day to install the first pile segment. It is anticipated that several days will be required to splice the second segment and prepare it for installation. The second day of impact installation will require about 140 minutes (70 percent of the effort). Vibratory hammer application may be used on the 144-inch mooring or breasting dolphin piles if necessary for safety reasons or if a pile encounters an obstruction, potentially adding an additional day of in-water pile installation (Table 4).

Breasting Dolphins (Permanent) – Phase 2

Three permanent breasting dolphins will be constructed parallel with the PCT loading platform face during Phase 2 (one dolphin north of the loading platform and two to the south; Figure 3). Each of the breasting dolphins will be comprised of a single round, 144-inch-diameter steel pipe pile, estimated effort and average embedded depth are provided in Table 4. Installation methods are the same as listed for permanent mooring dolphins.

2.1.1.3 Other Activities – PCT Phase 1 and 2

Construction Support Vessels

During both phases of construction of the PCT, the contractor is expected to mobilize cranes, tugs, and floating barges, including two 300-ton derrick barges, each with a mounted crane. Barges will be moved into location with tugboats. Approximately three to four tugboats and approximately six barges may be onsite at one time. Cranes will be used to conduct overwater work from barges, which are anticipated to remain on-site for the duration of the PCT construction period.

Temporary Mooring Anchor Systems

Two temporary mooring anchor systems will be installed and utilized throughout both phases of PCT construction. The anchor systems will provide mooring for construction barges at a location that is slightly removed from the immediate work area, which will minimize congestion and facilitate vessel movements. Each anchor system is comprised of an approximately 20,000-pound Danforth anchor connected to a chain and buoy. No pile installation or removal is associated with these structures. No in-water sound levels capable of causing harassment of marine mammals are anticipated from the installation and use of mooring anchor systems.

2.1.2 Mitigation Measures

The following mitigation measures are also outlined in the Permits Division's IHAs for Phase 1 and Phase 2.

Mitigation Measures

1. Pile driving will occur during daylight hours only.
2. For in-water construction, heavy machinery activities other than pile driving (e.g., use of barge-mounted excavators, or dredging), if a marine mammal comes within 10 m, POA must cease operations and reduce vessel speed to the minimum level required to maintain steerage and safe working conditions.
3. POA is required to conduct briefings for construction supervisors and crews, the monitoring team, and POA staff prior to the start of all pile driving activity, and when new personnel join the work, in order to explain responsibilities, communication procedures, the marine mammal monitoring protocol, and operational procedures.
4. POA is required to employ PSOs per the Marine Mammal Monitoring Plan and Monitoring Measures described in section 5 of the IHA.
5. Marine mammal monitoring must take place from 30 minutes prior to initiation of pile installation and removal through 30 minutes post-completion of pile driving. Pile driving may commence when observers have declared the shutdown zone clear of marine mammals or the beluga whale mitigation measures (#8) are satisfied. In the event of a delay or shutdown of activity resulting from marine mammals, animals must be allowed to leave on their own volition and their behavior must be monitored and documented.

6. On a given day, if PSO monitoring ceases but pile driving is scheduled to resume, PSOs must following pre-pile driving monitoring protocol as described in mitigation measure 5 above.
7. If a marine mammal is entering or is observed within an established shutdown zone (Table 5), pile driving must be halted or delayed. Pile driving may not commence or resume until either the animal has voluntarily left and been visually confirmed 100 m beyond the shutdown zone and on a path away from such zone or 15 minutes (non-beluga beluga whales) or 30 minutes (beluga whales) have passed without subsequent detections. NMFS may adjust the shutdown zones pending review and approval of an acoustic monitoring report (see Reporting section).

Table 5. Level B, Monitoring, and Shutdown Zones by Pile Size and Pile Driving Method.

<table>
<tr><th>Pile Size</th><th>Hammer Type</th><th>Attenuation</th><th>Level B and Monitoring Zone radius (m)</th><th>Non-Beluga Whales Shutdown Zone radius (m)</th><th>Beluga Whales Shutdown Zone radius (m)</th></tr>
<tr><td rowspan="2">144-in</td><td>Impact</td><td rowspan="2">Bubble Curtain</td><td>1,946</td><td rowspan="10">100</td><td>1,946</td></tr>
<tr><td>Vibratory</td><td>9,069</td><td>9,069</td></tr>
<tr><td rowspan="2">48-in</td><td>Impact</td><td rowspan="6">Bubble Curtain</td><td>824</td><td>824</td></tr>
<tr><td>Vibratory</td><td>2,247</td><td>2,247</td></tr>
<tr><td rowspan="2">36-in</td><td>Impact</td><td>296</td><td>296</td></tr>
<tr><td>Vibratory</td><td>1,699</td><td>1,699</td></tr>
<tr><td rowspan="4">24-in</td><td>Impact</td><td>261</td><td>261</td></tr>
<tr><td>Vibratory</td><td>846</td><td>846</td></tr>
<tr><td>Impact</td><td rowspan="2">Unattenuated</td><td>629</td><td>629</td></tr>
<tr><td>Vibratory</td><td>2,247</td><td>2,247</td></tr>
</table>

8. Cook Inlet Beluga Whales Pile Driving Delay/Shutdown Protocol
   i. Prior to the onset of pile driving or removal, should a beluga whale(s) be observed swimming toward or into lower Knik Arm, pile installation or removal must be delayed (Figure 10). Pile driving may not commence until either the animal has voluntarily traveled at least 100 m beyond the Level B harassment zone (Table 5) or has not been re-sighted within 30 minutes.
   ii. If pile installation or removal has commenced, and a beluga whale(s) is observed within or likely to enter the Level B harassment zone (Table 5), a PSO must call for a shutdown. Pile driving will shut down and will not re-commence until the beluga whale is out of and on a path away from the Level B harassment zone (Table 5) or until no beluga whale has been observed in the Level B harassment zone (Table 5) for 30 minutes immediately prior to resumption of pile driving.

iii. If vibratory hammer is required on a 144-in pile, it may not be possible to monitor the entire Level B harassment zone and this zone may extend beyond the pre-clearance zones. In this case, the pre-clearance zone remains applicable.

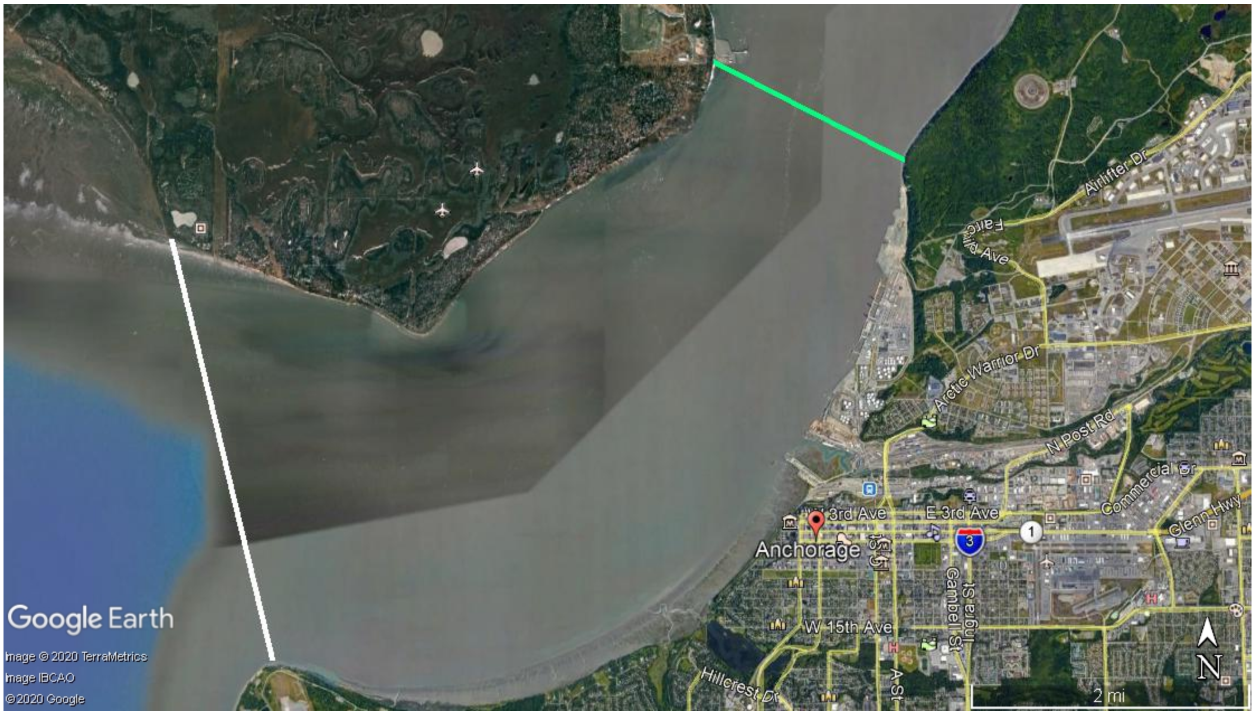

Figure 10. Boundaries of the Pre-pile driving Clearance Zone

9. If PSOs can no longer effectively monitor all waters within the Level B harassment zone (Table 5) for the presence of marine mammals due to environmental conditions (e.g., fog, rain, wind), pile driving may continue only until the current segment of pile is driven; no additional sections of pile or additional piles may be driven until conditions improve such that the Level B harassment zone can be effectively monitored.
10. POA must use soft start techniques when impact pile driving. Soft start requires contractors to provide an initial set of strikes at reduced energy, followed by a thirty-second waiting period, then two subsequent reduced energy strike sets. A soft start must be implemented at the start of each day’s impact pile driving, any time pile driving has been shutdown or delayed due the presence of a marine mammal, or at any time following cessation of impact pile driving for a period of thirty minutes or longer.
11. Phase 1 - POA is required to employ a confined bubble curtain in Phase 1 during all impact and vibratory driving and operate it in a manner consistent with the following performance standards:

    i. The confinement (i.e., solid, steel casing pile) shall extend from the substrate to a sufficient elevation above the maximum water level expected during pile installation such that when the air delivery system is adjusted properly, the bubble curtain does not act as a water pump (i.e., little or no water should be pumped out of the top of the confinement system).

ii. The confinement shall contain resilient pile guides that prevent the pile and the confinement from coming into contact with each other and do not transmit vibrations to the confinement sleeve and into the water column (e.g., spacers, air filled cushions).

iii. In water less than 15 meters deep, the system shall have a single aeration ring at the substrate level. In waters greater than 15 meters deep, the system shall have at least two rings, one at the substrate level and others at intermediate depths.

iv. The lowest layer of perforated aeration pipe shall be designed to ensure contact with the substrate without sinking into the substrate and shall accommodate sloped conditions.

v. Air holes shall be 1.6 mm (1/16-inch) in diameter and shall be spaced approximately 20 mm (3/4 inch) apart. Air holes with this size and spacing shall be placed in four adjacent rows along the pipe to provide uniform bubble flux.

vi. The system shall provide a bubble flux of 3.0 cubic meters per minute per linear meter of pipe in each layer (32.91 cubic feet per minute per linear foot of pipe in each layer). The total volume of air per layer is the product of the bubble flux and the circumference of the ring where V1 = 3.0 m3/min/m * Circ of the aeration ring in m or V1 = 32.91 ft3/min/ft * Circ of the aeration ring in ft.

vii. Meters shall be provided as follows:

1) Pressure meters shall be installed at all inlets to aeration pipelines and at points of lowest pressure in each branch of the aeration pipeline.

2) Flow meters shall be installed in the main line at each compressor and at each branch of the aeration pipelines at each inlet. In applications where the feed line from the compressor is continuous from the compressor to the aeration pipe inlet the flow meter at the compressor can be eliminated.

3) Flow meters shall be installed according to the manufactures recommendation based on either laminar flow or non-laminar flow.

12. Phase 2 - POA is required to employ a bubble curtain during all impact and vibratory driving of plumb piles and operate it in a manner consistent with the following performance standards:

i. The bubble curtain must distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column.

ii. The lowest bubble ring must be in contact with the mudline for the full circumference of the ring, and the weights attached to the bottom ring shall ensure 100 percent mudline contact. No parts of the ring or other objects shall prevent full mudline contact.

iii. Air flow to the bubblers must be balanced around the circumference of the pile.

13. If a barge is used to house the pile-driver, it shall be isolated from the noise-producing operations. This isolation shall be such that noise from the pile driving operation is not transmitted through the barge to the water column.
14. POA must not install 144-inch piles with a vibratory hammer in August.
15. POA must not install unattenuated plumb piles in water depths greater than 3 meters.
16. POA must not operate two vibratory hammers concurrently.
17. If a species for which take authorization has not been granted, or a species for which take authorization has been granted but the authorized takes are met, is observed approaching or within the monitoring zone (Table 5), pile driving and removal must shut down immediately using shut-down procedures. Pile driving must not resume until the animal has been confirmed to have left the area or the observation time period, as indicated in condition mitigation measure 5 above, has elapsed.
18. If the POA is conducting non-PCT related in-water work which require PSOs, the PCT PSOs must be in real-time contact with those PSOs, relaying all information regarding marine mammal sightings.
19. During PCT hydroacoustic monitoring, all in-water work (e.g., dredging, other in-water work at the POA, vessel transit) must be documented (e.g., type of activity, location relative to recordings, date/time) and reported.

Monitoring Measures

20. Marine mammal monitoring must be conducted in accordance with the Marine Mammal Monitoring Plan and the following measures:
    i. PSOs will be positioned at four stations during all pile driving to maximize marine mammal detection: one station will be at the PCT site, one at Ship Creek, one at Point Woronzof or nearby location, and one location north of the PCT site (e.g., northern end of POA, Port MacKenzie).
    ii. PSOs will work in three- to four-person teams at each outer (northern and southern) observation station. The station at the PCT site will have at least two PSOs. At least two PSOs will be on watch at any given time at each station. A third PSO will be available to record data at the southern and northern stations.
    iii. Each outer (southern and northern) station must be equipped with large-aperture binoculars (25X), hand-held binoculars (at least 7X), and range finders. A theodolite must be available at one station. The central station must be equipped with hand-held binoculars (at least 7X) and range finders.
21. Marine mammal monitoring during pile driving and removal must be conducted by NMFS-approved PSOs in a manner consistent with the Marine Mammal Monitoring Plan and the following:
    i. Independent PSOs (*i.e.*, not construction personnel) who have no other assigned tasks during monitoring periods must be used.

ii. A lead observer or monitoring coordinator must be designated. The lead observer must have prior experience working as a marine mammal observer during construction.

iii. POA must submit PSO CVs for approval by NMFS prior to the onset of pile driving.

iv. PSOs must be in constant real-time communication with each other and with construction crews to convey information about marine mammal sightings, locations, directions of movement, and communicate calls for pile driving shutdowns or delays.

v. A PSO must observe for no more than 4 hours at a time and no more than 12 hours per day.

22. PSOs must have the following additional qualifications:

    i. Ability to conduct field observations and collect data according to assigned protocols.

    ii. Experience or training in the field identification of marine mammals, including the identification of behaviors.

    iii. Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations.

    iv. Ability to observe and record environmental and marine mammal sighting data, including but not limited to the number and species of marine mammals observed; dates and times when in-water construction activities were conducted; dates, times, and reason for implementation of mitigation (or why mitigation was not implemented when required); and marine mammal behavior.

    v. Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary.

23. Acoustic monitoring must be conducted in accordance with the POA's Hydroacoustic Monitoring Plan.

Reporting

The POA is required to:

24. Submit interim weekly and monthly marine mammal monitoring reports, including data sheets, during the PCT construction season. These reports must include a summary of marine mammal species and behavioral observations, pile driving shutdowns or delays, and pile work completed.

25. Alert NMFS when the number of Cook Inlet beluga whale takes reaches 80 percent of those authorized per year. Weekly marine mammal monitoring reports will assist with the tracking of take numbers.

26. Submit an interim sound source verification report within 10 calendar days of each acoustic monitoring session (acoustic monitoring will occur intermittently throughout the season). This interim report must, at minimum, include:

    i. Hydrophone equipment and methods: recording device, sampling rate, distance from the pile where recordings were made; depth of recording device(s).

    ii. Type of pile being driven and method of driving during recordings.

    iii. Mean, median, and peak sound source levels (dB re: 1µPa): cumulative sound exposure level (SELcum), peak sound pressure level (SPLpeak), root mean square sound pressure level (SPLrms), and single-strike sound exposure level (SELs-s).

    iv. Number of strikes per pile or vibratory hammer duration measured, pulse duration, and one-third octave band spectrum and/or power spectral density.

    v. Estimated distances to the Level A harassment and Level B harassment isopleths for each type of pile measured.

27. Submit a draft final report on all marine mammal monitoring conducted under the IHA within 90 calendar days of the completion of monitoring. A final report shall be prepared and submitted within 30 days following resolution of comments on the draft report from NMFS. This report must contain the informational elements described in the Marine Mammal Monitoring Plan, including, but not limited to:

    i. Dates and times (begin and end) of all marine mammal monitoring.

    ii. Construction activities occurring during each daily observation period, including how many and what type of piles were driven or removed and by what method (*i.e.*, impact or vibratory).

    iii. Weather parameters and water conditions during each monitoring period (*e.g.*, wind speed, percent cover, visibility, sea state).

    iv. The number of marine mammals observed, by species, relative to the pile location and if pile driving or removal was occurring at time of sighting.

    v. Age and sex class, if possible, of all marine mammals observed.

    vi. PSO locations during marine mammal monitoring.

    vii. Distances and bearings of each marine mammal observed to the pile being driven or removed for each sighting (if pile driving or removal was occurring at time of sighting).

    viii. Description of any marine mammal behavior patterns during observation, including direction of travel.

    ix. Number of individuals of each species (differentiated by month as appropriate) detected within the monitoring zone, and estimates of number of marine mammals taken, by species (a correction factor may be applied to total take numbers, as appropriate).

x. Detailed information about any implementation of any mitigation triggered (e.g., shutdowns and delays), a description of specific actions that ensued, and resulting behavior of the animal, if any.

xi. Description of attempts to distinguish between the number of individual animals taken and the number of incidences of take, such as ability to track groups or individuals.

28. Submit a draft report of all acoustic monitoring within 90 days following the last acoustic monitoring effort of the season. A final report shall be prepared and submitted within thirty days following resolution of comments on the draft report from NMFS. Both the draft and final report must, at minimum, include:

    i. Hydrophone equipment and methods: recording device, sampling rate, distance from the pile where recordings were made; depth of recording device(s).

    ii. Type of pile being driven and method of driving during recordings.

    iii. Mean, median, and peak sound source levels (dB re: 1µPa): cumulative sound exposure level (SELcum), peak sound pressure level (SPLpeak), root mean square sound pressure level (SPLrms), and single-strike sound exposure level (SELs-s).

    iv. Number of strikes per pile measured, pulse duration, and one-third octave band spectrum and/or power spectral density.

    v. Estimated distances to the Level A harassment and Level B harassment isopleths for each type of pile measured.

29. Reporting injured or dead marine mammals:

    i. In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner not authorized in this opinion or the IHA, such as serious injury, or mortality, POA must immediately cease the specified activities and report the incident to the NMFS Office of Protected Resources (301-427-8401) and Alaska Region Stranding Hotline (1-877-925-7773). The report must include the following information:

        1. Time and date of the incident;
        2. Description of the incident;
        3. Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);
        4. Description of all marine mammal observations and active sound source use in the 24 hours preceding the incident;
        5. Species identification or description of the animal(s) involved;
        6. Fate of the animal(s); and
        7. Photographs or video footage of the animal(s).

Activities must not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with POA to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. POA may not resume their activities until notified by NMFS.

ii. In the event POA discovers an injured or dead marine mammal, and the lead observer determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.*, in less than a moderate state of decomposition), POA must immediately report the incident to the NMFS Office of Protected Resources and the NMFS AKR Stranding Hotline (877-925-7773). The report must include the same information identified in mitigation measure 29(i) of this opinion and 6(f) of the IHA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with POA to determine whether additional mitigation measures or modifications to the activities are appropriate.

iii. In the event that POA discovers an injured or dead marine mammal, and the lead observer determines that the injury or death is not associated with or related to the specified activities (*e.g*., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), POA must report the incident to the NMFS Office of Protected Resources, and the Alaska Region Stranding Hotline (877-925-7773) within 24 hours of the discovery.

Summary of Agency Contact Information

Table 6. Summary of agency contact information.

Reason for Contact	**Contact Information**
Alaska Regional Office (AKR) - ESA Consultation Questions, Reports & Data Submittal	Greg Balogh: greg.balogh@noaa.gov, 907-271-3023 Bonnie Easley-Appleyard: bonnie.easley-appleyard@noaa.gov; 907-271-5172
Office of Protected Resources (OPR) – ITR/MMPA Questions, Report & Data Submittal	Jolie Harrison (Jolie.Harrison@noaa.gov) Jaclyn Daly (jaclyn.daly@noaa.gov)
Stranded, Injured, or Dead Marine Mammal	Stranding Hotline (24/7 coverage) 877-925-7773
Note: In the event that this contact information becomes obsolete please call NMFS Anchorage Main Office 907-271-5006	

2.2 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR § 402.02). For this reason, the action area is typically larger than the project area and extends out to a point where no measurable effects from the proposed action occur.

NMFS defines the action area for this project as the area within which project-related noise levels are ≥122.2 dB_{rms} re 1µPa or approaching ambient noise levels (i.e., the point where no measurable effect from the project would occur; see Section 6.2.1).[4] To define the action area, we considered the maximum diameter and type of piles, the pile-driving methods (i.e., with and without bubble curtains), and empirical measurements of noise. Received sound levels associated with vibratory pile driving of 144-in diameter piles (with a bubble curtain) are anticipated to decline to 122.2 dB_{rms} re 1µPa within 9,069 meters of the source (Figure 11), see the *Acoustic Threshold* section for more information on the factors included in this calculation.

Figure 11. POA PCT project action area (outlined in red).

[4] We express noise as the sound force per unit micropascals (µPa), where 1 pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter. Sound pressure level is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in acoustics is 1 µPa, and the units for underwater sound pressure levels are decibels (dB) expressed in root mean square (rms), which is the square root of the arithmetic average of the squared instantaneous pressure values.

3. APPROACH TO THE ASSESSMENT

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. The jeopardy analysis considers both survival and recovery of the species. The adverse modification analysis considers the impacts to the conservation value of the designated critical habitat.

To jeopardize the continued existence of a listed species means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR § 402.02). As NMFS explained when it promulgated this definition, NMFS considers the likely impacts to a species' survival as well as likely impacts to its recovery. Further, it is possible that in certain, exceptional circumstances, injury to recovery alone may result in a jeopardy biological opinion (51 FR 19926, 19934; June 3, 1986).

Under NMFS's regulations, the destruction or adverse modification of critical habitat means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species (50 CFR § 402.02).

The designation(s) of critical habitat for Cook Inlet beluga whales use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (81 FR 7414; February 11, 2016) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

We use the following approach to determine whether the proposed action described in Section 2 of this opinion is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify those aspects (or stressors) of the proposed action that are likely to have effects on listed species or critical habitat. As part of this step, we identify the action area – the spatial and temporal extent of these effects.
- Identify the rangewide status of the species and critical habitat likely to be adversely affected by the proposed action. This section describes the current status of each listed species and its critical habitat relative to the conditions needed for recovery. We determine the rangewide status of critical habitat by examining the condition of its PBFs - which were identified when the critical habitat was designated. Species and critical habitat status are discussed in Section 4 of this opinion.
- Describe the environmental baseline including: past and present impacts of Federal, state, or private actions and other human activities *in the action area*; anticipated impacts of proposed Federal projects that have already undergone formal or early section 7

consultation, and the impacts of state or private actions that are contemporaneous with the consultation in process. The environmental baseline is discussed in Section 5 of this opinion.

- Analyze the effects of the proposed actions. Identify the listed species that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent our *exposure analyses*). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to stressors and the populations or subpopulations those individuals represent. NMFS also evaluates the proposed action's effects on critical habitat features. The effects of the action are described in Section 6 of this opinion with the exposure analysis described in Section 6.2 of this opinion.
- Once we identify which listed species are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those listed species are likely to respond given their exposure (these represent our *response analyses*). Response analysis is considered in Section 6.2 of this opinion.
- Describe any cumulative effects. Cumulative effects, as defined in NMFS's implementing regulations (50 CFR § 402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate section 7 consultation. Cumulative effects are considered in Section 7 of this opinion.
- Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat. In this step, NMFS adds the effects of the action (Section 6) to the environmental baseline (Section 5) and the cumulative effects (Section 7) to assess whether the action could reasonably be expected to: (1) appreciably reduce the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 4). Integration and synthesis with risk analyses occurs in Section 8 of this opinion.
- Reach jeopardy and adverse modification conclusions. Conclusions regarding jeopardy and the destruction or adverse modification of critical habitat are presented in Section 9. These conclusions flow from the logic and rationale presented in the Integration and Synthesis Section 8.
- If necessary, define a reasonable and prudent alternative to the proposed action. If, in completing the last step in the analysis, NMFS determines that the action under consultation is likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat, NMFS must identify a reasonable and prudent alternative (RPA) to the action.

4. RANGEWIDE STATUS OF THE SPECIES AND CRITICAL HABITAT

Three species (four DPSs) of marine mammals listed under the ESA under NMFS's jurisdiction may occur in the action area. The action area also includes designated critical habitat for Cook Inlet beluga whales. This opinion considers the effects of the proposed action on these species and designated critical habitat (Table 7). The nearest designated critical habitat for the Steller sea lion is over 200 km from the action area.

Table 7. Listing status and critical habitat designation for marine mammals considered in this opinion.

Species	Status	Listing	Critical Habitat
Humpback Whale, Mexico DPS *(Megaptera novaeangliae)*	Threatened	NMFS 2016, 81 FR 62260	Not designated
Humpback Whale, Western North Pacific DPS *(Megaptera novaeangliae)*	Endangered	NMFS 2016, 81 FR 62260	Not designated
Cook Inlet beluga whale (*Delphinapterus leucas*)	Endangered	NMFS 2008, 73 FR 62919	NMFS 2011, 76 FR 20180
Steller Sea Lion, Western DPS *(Eumetopias jubatus)*	Endangered	NMFS 1997, 62 FR 24345	NMFS 1993, 58 FR 45269

4.1 Climate Change

One threat is or will be common to all of the species we discuss in this opinion: global climate change. Because of this commonality, we present this narrative here rather than in each of the species-specific narratives that follow.

The timeframe for the proposed action is April 2020 through November 2021, which is a relatively short duration. However, Alaska is experiencing rapid climate change with each new year and is experiencing further decreases in ice cover and extensions of the open-water season.

Since the 1950s the atmosphere and oceans have warmed, snow and sea ice have diminished, sea levels have risen, and concentrations of greenhouse gases have increased (IPCC 2014). There is little doubt that human influence has been the dominant cause of the observed warming since the mid-20th century (IPCC 2014). The impacts of climate change are especially pronounced at high latitudes. Average temperatures have increased across Alaska at more than twice the rate of the rest of the United States (EPA 2017). Average air temperatures across Alaska have been increasing, and the average annual temperature is now 3-4° warmer than during the early and mid-century (Thoman and Walsh 2019) (Figure 12). Winter temperatures have increased by 6°F (Chapin et al. 2014) and the snow season is shortening (Thoman and Walsh 2019) (Figure 13). Some of the most pronounced effects of climate change in Alaska include disappearing sea ice, shrinking glaciers, thawing permafrost, and changing ocean temperatures and chemistry (Chapin et al. 2014). Climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the foreseeable future (Houghton 2001, McCarthy et al. 2001).

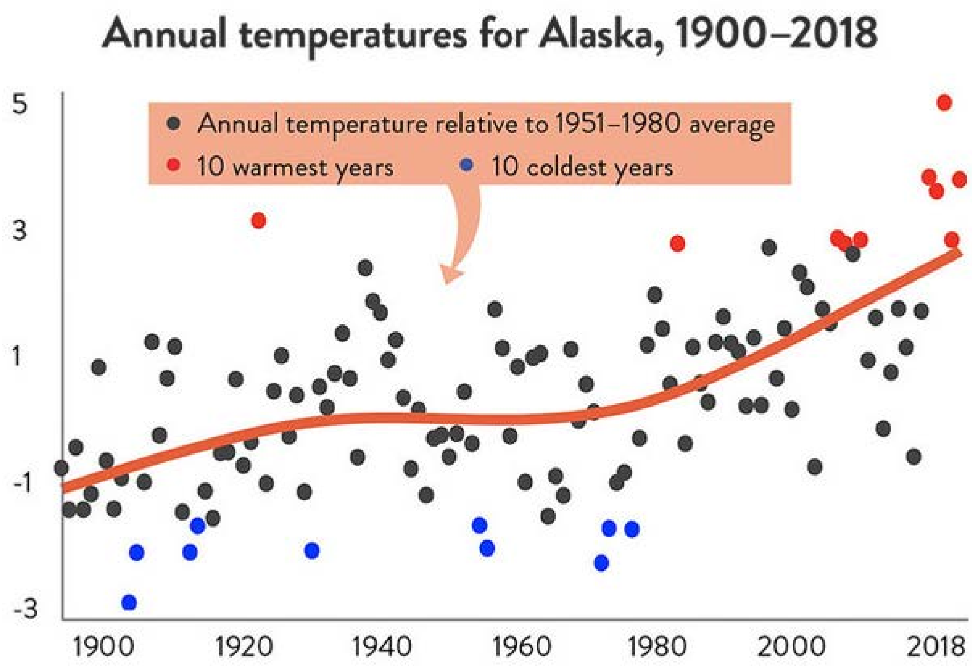

Figure 12. Alaska's ten coldest years on record (blue dots) all occurred before 1980. Meanwhile, nine of its ten warmest years on record have occurred since 1980. Graph by Rick Thoman, Alaska Center for Climate Assessment and Policy. Data source: NASA GISS & UAF/Brian Brettschneider.

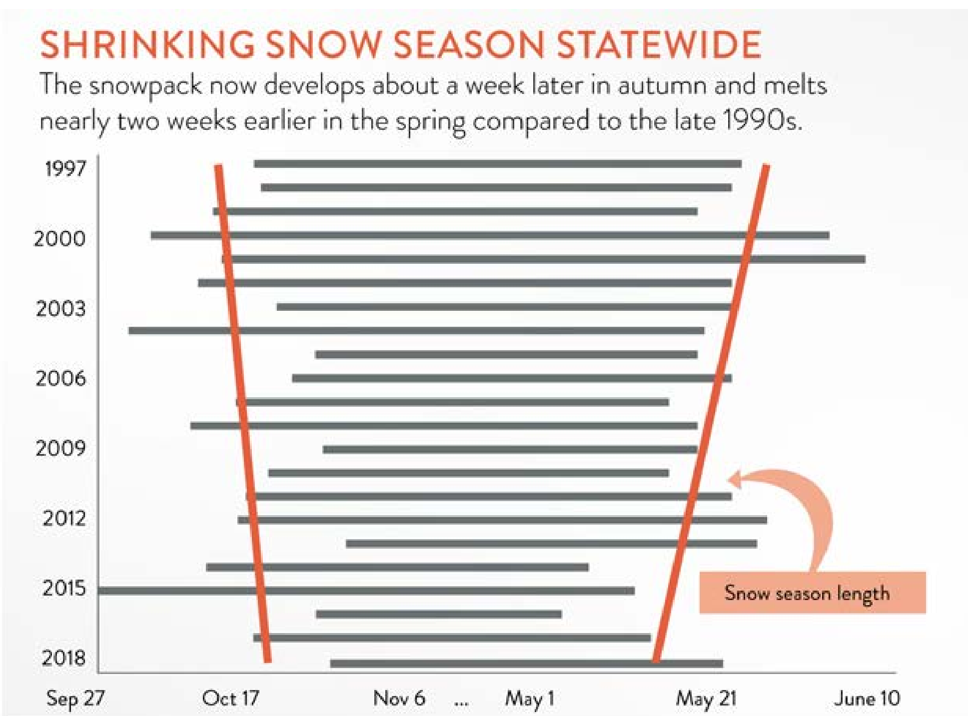

Figure 13. Length of the snow season (gray bars) in Alaska each year from 1997-2018. Orange slanting

bars show the trend: the date when the state becomes 50 percent snow covered is arriving a week later in October than it used it, and the spring "snow-off" date—when half the winter snow has melted—is arriving nearly two weeks earlier. Image by Rick Thoman, Alaska Center for Climate and Policy.

The impacts of these changes and their interactions on listed species in Alaska are hard to predict. A recent period of especially warm water in the North Pacific Ocean, referred to as “the blob,” is likely responsible for poor growth and survival of Pacific cod, an important prey species for endangered Steller sea lions. The 2018 Pacific cod stock assessment estimated that the female spawning biomass of Pacific cod is at its lowest point in the 41-year time series considered in the assessment. This assessment was conducted following three years of poor recruitment in 2014-2016 and increased natural mortality during the 2014-2016 Gulf of Alaska marine heat wave (NMFS 2018b). Biologists also attribute increases in bird die-offs, whale strandings, toxic algae blooms, and poor salmon survival to warmer water conditions (Bernton 2017). Additionally, marine mammals in the Gulf of Alaska were likely impacted by the low prey availability associated with warm ocean temperatures that occurred in the Gulf during 2014-2016 (Bond et al. 2015, Peterson et al. 2016, Sweeney et al. 2018).

The world’s oceans have absorbed approximately one-third of the anthropogenic CO_2 released, which has curtailed the increase in atmospheric CO_2 concentrations (Sabine et al. 2004). Despite the oceans’ role as large carbon sinks, in 2016, the mean monthly average CO_2 level exceeded 400 ppm and continues to rise (NOAA 2018). As the oceans absorb more CO_2, ocean acidification is occurring, which reduces the amount of calcium carbonate minerals in solution that many organisms use to form and maintain shells (Reisdorph and Mathis 2014). Shelled zooplankton such as pteropods are prey for many species of carnivorous zooplankton, fishes including salmon, mackerel, herring, and cod, and baleen whales (Orr et al. 2005). Under increasingly acidic conditions, pteropods may not be able to grow and maintain shells, and are often considered an indicator species for ecosystem health. It is uncertain if they may be able to adapt to changing ocean conditions (Fabry et al. 2009).

Additionally, as the ocean becomes more acidic, low frequency sounds (1 to 3 kHz and below) travel farther because the concentrations of certain ions that absorb acoustic waves decrease with decreasing pH (Brewer and Hester 2009).

4.2 Status of Listed Species Likely to be Adversely Affected by the Action

This opinion examines the status of each species that is likely to be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species’ likelihood of both survival and recovery. The species status section also helps to inform the description of the species’ current “reproduction, numbers, or distribution” as described in 50 CFR § 402.02. The opinion also examines the condition of critical habitat throughout the designated area, and discusses the current function of the essential PBFs that help to form that conservation value.

This section consists of narratives for each of the ESA-listed species that are likely to be adversely affected by the proposed action. In each narrative, we present a summary of information on the population structure and distribution of each species to provide a foundation for the exposure analyses that appear later in this opinion. Then we summarize information on the threats to the species and the species' status given those threats to provide points of reference for the jeopardy determinations we make later in this opinion. That is, we rely on a species' status and trend to determine whether or not an action's effects are likely to increase the species' probability of becoming extinct.

4.2.1 Cook Inlet DPS Beluga Whale

4.2.1.1 Population Structure and Status

Beluga whales inhabiting Cook Inlet are one of five distinct stocks found in Alaska (Muto et al. 2019). The best historical abundance estimate of the Cook Inlet beluga population was from a survey in 1979, which estimated a total population of 1,293 belugas (Calkins 1989). NMFS began conducting comprehensive, systematic aerial surveys of the Cook Inlet beluga population in 1993. These surveys documented a decline in abundance from 653 belugas in 1994 to 347 belugas in 1998 (Figure 14). In response to this nearly 50 percent decline, NMFS designated the Cook Inlet beluga population as depleted under the Marine Mammal Protection Act in 2000 (65 FR 34590; May 31, 2000). The lack of population growth since that time led NMFS to list the Cook Inlet beluga as endangered under the ESA on October 22, 2008 (73 FR 62919).

The best estimate of 2018 abundance for the Cook Inlet beluga whale population from the aerial survey data is 279 whales (95% probability interval 250 to 317; Shelden and Wade 2019). A comparison of the population estimates over time is presented in Figure 14. Over the most recent 10-year time period (2008-2018), the estimated trend in abundance is approximately -2.3 (-4.1-0.6) percent/year (Figure 14) (Shelden and Wade 2019). This is a steeper decline than the previously estimated decline of -0.5 percent/year (Shelden et al. 2017). The methods presented in Shelden and Wade (2019) were developed by incorporating additional data and an improved methodology for analyzing the results of aerial population surveys. NMFS used a new group size estimation method (Boyd et al. 2019) and new criteria to determine whether certain data from aerial surveys could be used reliably. Shelden and Wade (2019) report abundance estimates dating back to 2004 that have been adjusted using the new methodology.

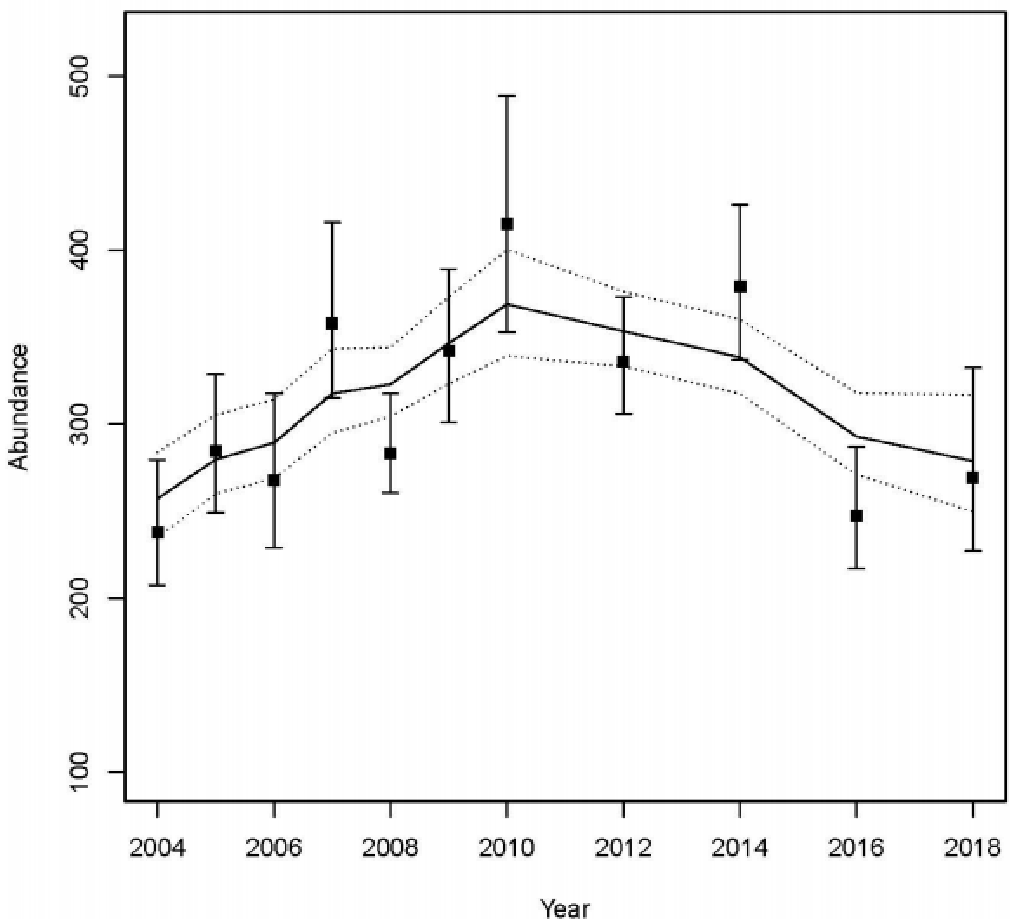

Figure 14. Cook Inlet beluga whale annual abundance estimates (squares) and 95% probability intervals (error bars) for the reanalyzed survey period 2004-2016 with results from 2018. The moving average is also plotted (solid line), with 95% probability intervals (dotted lines) (Shelden and Wade 2019).

The Cook Inlet Beluga Recovery Plan (NMFS 2016b) examined potential obstacles to the recovery of Cook Inlet belugas. It is unlikely that all threats listed in the recovery plan impact beluga recovery equally, so ideally each threat would be investigated and either dismissed as insignificant or prioritized for action according to defined criteria. Table 8 lists each threat and summarizes the Recovery Team's assessment of the major effect of the threat, its extent, frequency, trend, probability, magnitude, and rating of relative concern (among the threats identified) for Cook Inlet beluga recovery. Assessments were made based on the information and data gaps presented in the Background section of the recovery plan (NMFS 2016b).

Climate change, while considered a potential threat to beluga recovery, is not addressed as a separate threat in the recovery plan, but rather is discussed with respect to how it may affect each of the listed threats. Although climate change occurs naturally, the effects of greenhouse gas emissions are fundamentally changing global processes. The recovery plan does not attempt to identify the sources of such emissions or to assess the relative contribution of each potential source. Instead it focuses on the effects of a changing climate to belugas.

The Recovery Plan discusses the issue that there are inherent risks associated with small populations, such as loss of genetic or behavioral diversity. The effects of threats on small populations may be greater than on large populations due to these inherent risks. Small populations may be more susceptible to disease, inbreeding, predator pits, or catastrophic events than large populations. The Recovery Plan addresses ten principal threats to the Cook Inlet beluga population and considers how they may be exacerbated by these types of inherent risks due to small population size.

Section 4(a)(1) of the ESA and the associated regulations (50 CFR part 424) set forth the considerations for the listing status of a species: 1) the present or threatened destruction, modification, or curtailment of its habitat or range; 2) overutilization for commercial, recreational, scientific, or educational purposes; 3) disease or predation; 4) inadequacy of existing regulatory mechanisms; or 5) other natural or human-made factors affecting its continued existence. Table 8 summarizes ten threats identified in the recovery plan for Cook Inlet beluga whales, associated with the relevant ESA section 4(a)(1) factors (identified as Factors A–E).

Table 8. Summary of threats assessment for Cook Inlet belugas (NMFS 2016b).

Threat Type	ESA § 4(a)(1) factor	Major effect	Extent	Frequency	Trend	Probability	Magnitude	Relative concern
Catastrophic events (e.g., natural disasters; spills; mass strandings)	A, D, E	Mortality, compromised health, reduced fitness, reduced carrying capacity	Localized	Intermittent & Seasonal	Stable	Medium to High	Variable Potentially High	High
Cumulative effects	C ,D, E	Chronic stress; reduced resilience	Range wide	Continuous	Increasing	High	Unknown Potentially High	High
Noise	A, D, E	Compromised communication & echolocation, physiological damage, habitat degradation	Localized & Range wide	Continuous, Intermittent, & Seasonal	Increasing	High	Unknown Potentially High	High
Disease agents (e.g., pathogens; parasites; harmful algal blooms)	C	Compromised health, reduced reproduction	Range wide	Intermittent	Unknown	Medium to High	Variable	Medium
Habitat loss or degradation	A	Reduced carrying capacity, reduced reproduction	Localized & Range wide	Continuous & Seasonal	Increasing	High	Medium	Medium
Reduction in prey	A, D, E	Reduced fitness (reproduction and/or survival); reduced carrying capacity	Localized & Range wide	Continuous, Intermittent, & Seasonal	Unknown	Unknown	Unknown	Medium
Unauthorized take	A, E	Behavior modification, displacement, injury or mortality	Range wide, localized hotspots	Seasonal	Unknown	Medium	Variable	Medium
Pollution	A	Compromised health	Localized & Range wide	Continuous, Intermittent, & Seasonal	Increasing	High	Low	Low
Predation	C	Injury or mortality	Range wide	Intermittent	Stable	Medium	Low	Low
Subsistence hunting	B, D	Injury or mortality	Localized	Intermittent	Stable or Decreasing	Low	Low	Low

A detailed description of the Cook Inlet beluga whales' biology, habitat, and extinction risk factors may be found in the final listing rule for the species (73 FR 62919, October 22, 2008), the Conservation Plan (NMFS 2008a), and the Recovery Plan (NMFS 2016b). Additional information regarding Cook Inlet beluga whales can be found on the NMFS AKR web site at: http://alaskafisheries.noaa.gov/protectedresources/whales/beluga.htm.

4.2.1.2 Distribution

Cook Inlet beluga whales are geographically and genetically isolated from other beluga whale stocks in Alaska (Muto et al. 2019). Their distribution (Figure 15) overlaps with the entire action area. Although they remain year-round in Cook Inlet, they demonstrate seasonal movements within the inlet. In general, during the summer and fall, beluga whales occur in shallow coastal waters and are concentrated near the Susitna River mouth, Knik Arm, Turnagain Arm, and Chickaloon Bay (Shelden et al. 2015b, Castellote et al. 2016). During the winter, ice formation in the upper Inlet may restrict beluga's access to nearshore habitat (Ezer et al. 2013), and they are more dispersed in deeper waters in the mid-inlet to Kalgin Island, and in the shallow waters along the west shore of Cook Inlet to Kamishak Bay.

Information on Cook Inlet beluga distribution, including aerial surveys and acoustic monitoring, indicates that the species' range in Cook Inlet has contracted markedly since the 1990s (Figure 15) (Shelden et al. 2015b). This distributional shift and range contraction coincided with the decline in abundance (Moore et al. 2000, NMFS 2008a, Goetz et al. 2012). Beginning in 1993, aerial surveys have been conducted annually or biennially in June and August by NMFS Marine Mammal Laboratory (NMFS 2008a, Hobbs et al. 2012). Historic aerial surveys for beluga whales also were completed in the late 1970s and early 1980s (Harrison and Hall 1978, Murray and Fay 1979). Results indicate that prior to the 1990s belugas used areas throughout the upper, mid, and lower Inlet during the spring, summer, and fall (Huntington 2000, Rugh et al. 2000, NMFS 2008a, Rugh et al. 2010). While the surveys in the 1970s showed whales dispersing into the lower inlet by mid-summer, almost the entire population is now found only in northern Cook Inlet from late spring into the fall.

The Susitna Delta is a highly important area for Cook Inlet beluga whales, particularly in the summer-fall months. Groups of 200 to 300 individuals – almost the entire population – including adults, juveniles, and neonates, have been observed in recent years in the Susitna River Delta area (McGuire et al. 2014). Acoustic monitors at the Little Susitna River detected a peak from late May to early June, and a large peak from July through August (Figure 16) (Castellote et al. 2015). At the Beluga River, three peaks of occurrence were detected by the acoustic monitors: one from mid-February to early April, the strongest peak in June to mid-July, and the third peak in mid-November and December (Figure 17) (Castellote et al. 2016). These earlier peaks appear to coincide with eulachon runs in May and June (Vincent-Lang and Queral 1984), and salmon runs (particularly silver and chinook salmon) from June and July (Brenner et al. 2019). NMFS refers to this preferred summer-fall habitat near the Susitna Delta as the Susitna Delta Exclusion Zone and seeks to minimize human activity in this area of extreme importance to Cook Inlet beluga whale survival and recovery.

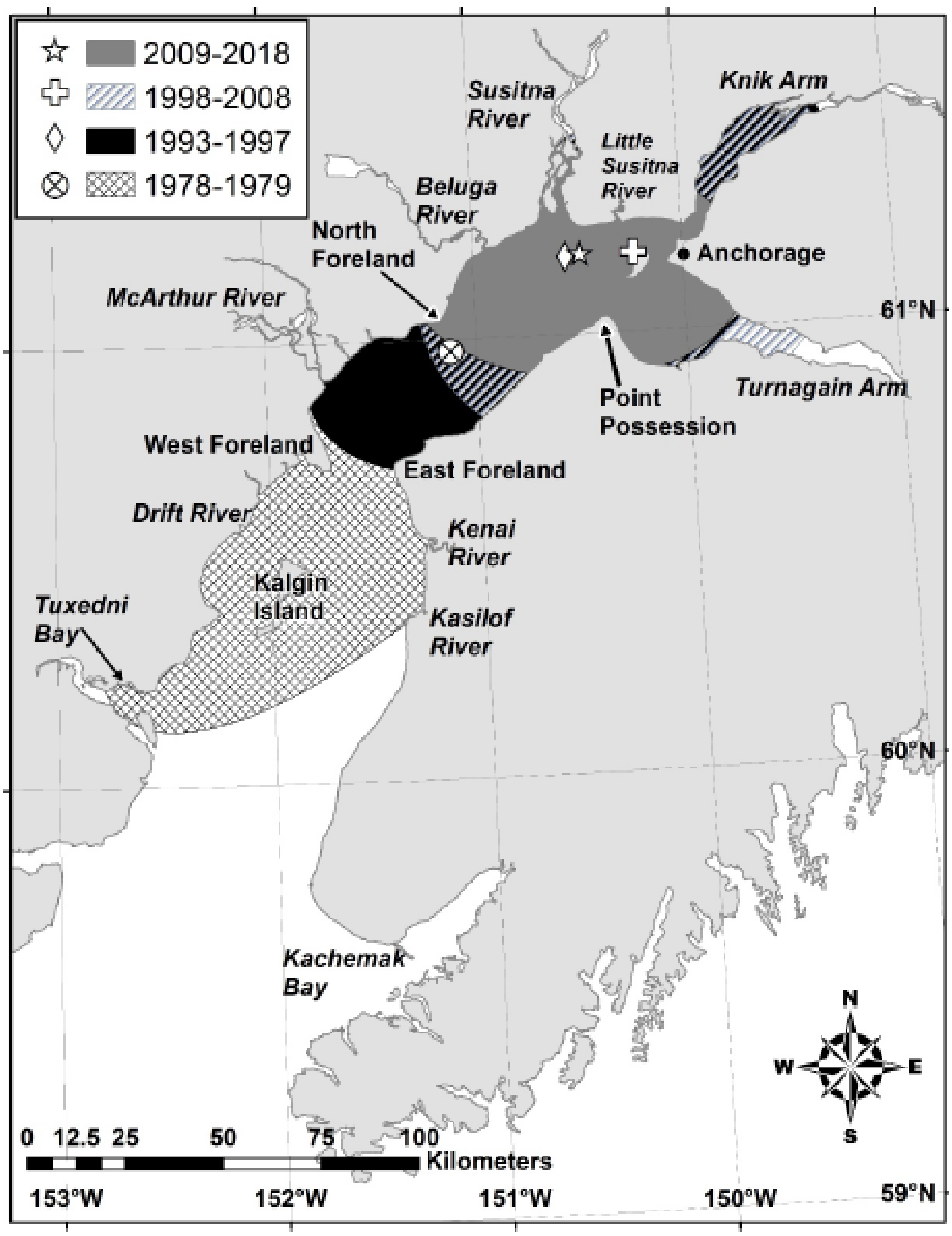

Figure 15. Summer range contraction over time as indicated by ADFG and NMFS aerial surveys. Adapted from Shelden and Wade (2019). The distribution of belugas around each central location (shaded regions next to symbols) for each period was calculated at 2 standard deviations (SD; capturing ca. 95% of the whales). The 95% core summer distribution contracted from 7,226 sq. km in 1978–79 to 2,110 sq. km in 2009–18 (29% of the 1978–79 range).

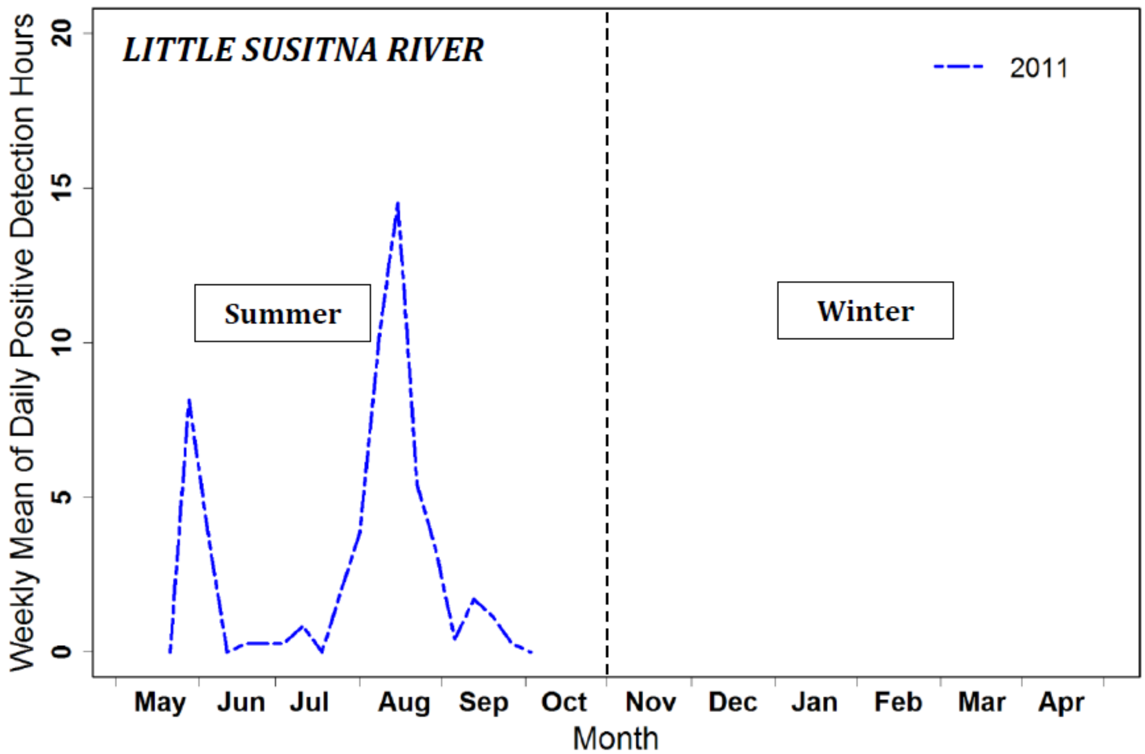

Figure 16. Weekly mean of daily beluga detection positive hours (DPH) by month at Little Susitna River, Cook Inlet, Alaska, 2011 (Figure 3D from Castellote et al. 2016).

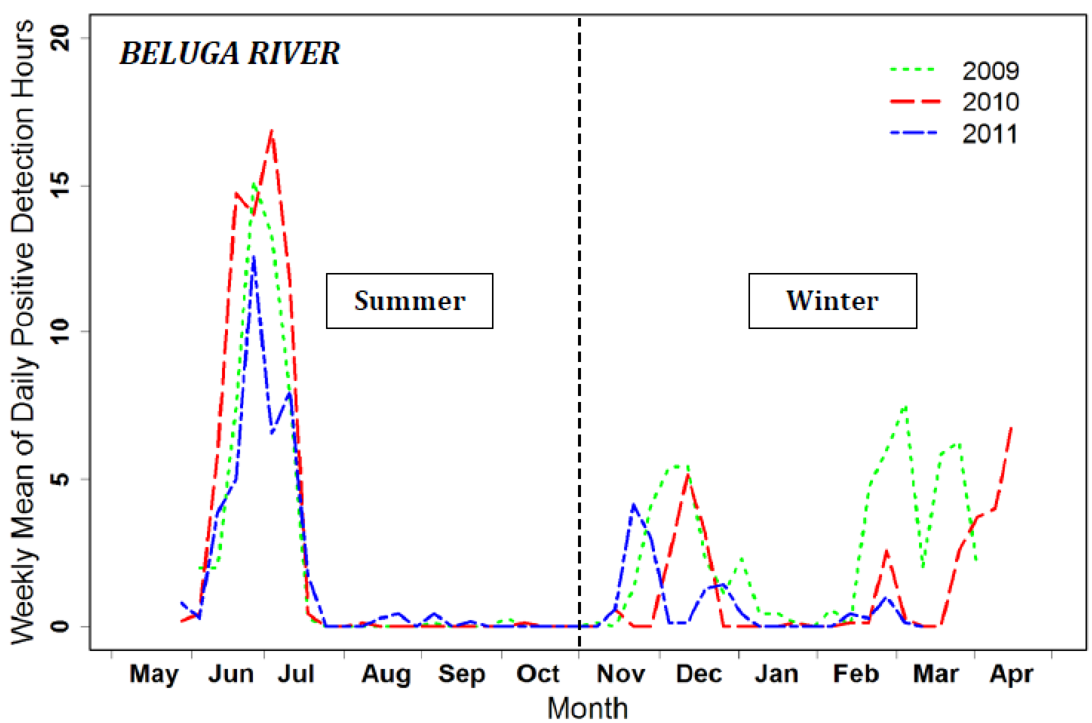

Figure 17. Weekly mean of daily beluga detection positive hours (DPH) by month at Beluga River, Cook Inlet, Alaska, 2009-2011 (Fig. 3E from Castellote et al. 2016).

While belugas are concentrated primarily in the upper inlet during the summer and fall months, the area around the East Forelands between Nikiski, Kenai, and Kalgin Island appears to provide important habitat in winter, early spring, and fall. Belugas were historically seen in and around the Kenai and Kasilof Rivers during June aerial surveys conducted by ADFG in the late 1970s and early 1980s and by NMFS starting in 1993 (Shelden et al. 2015b), and throughout the summer by other researchers, local observations, etc., but in recent years have been seen more typically in the spring and fall (Ovitz 2019). The Alaska Beluga Monitoring Partnership (AKBMP)[5] citizen science project recorded 386 sightings in the Kenai River (48 groups, with an average group size of 9 belugas) during 73 monitoring sessions between August and October 2019. While visual sightings indicate peaks in spring and fall, acoustic detections indicate that belugas may be present in the Kenai River throughout the winter (Figure 18) (Castellote et al. 2016; NMFS unpublished data). Combined, both the acoustic detections and visual sightings indicate that there appears to be a steep decline in beluga presence in the Kenai River area during the summer (June through August), despite the historic sightings of belugas throughout the summer in the area and the presence of salmon in the river, which are important beluga prey.

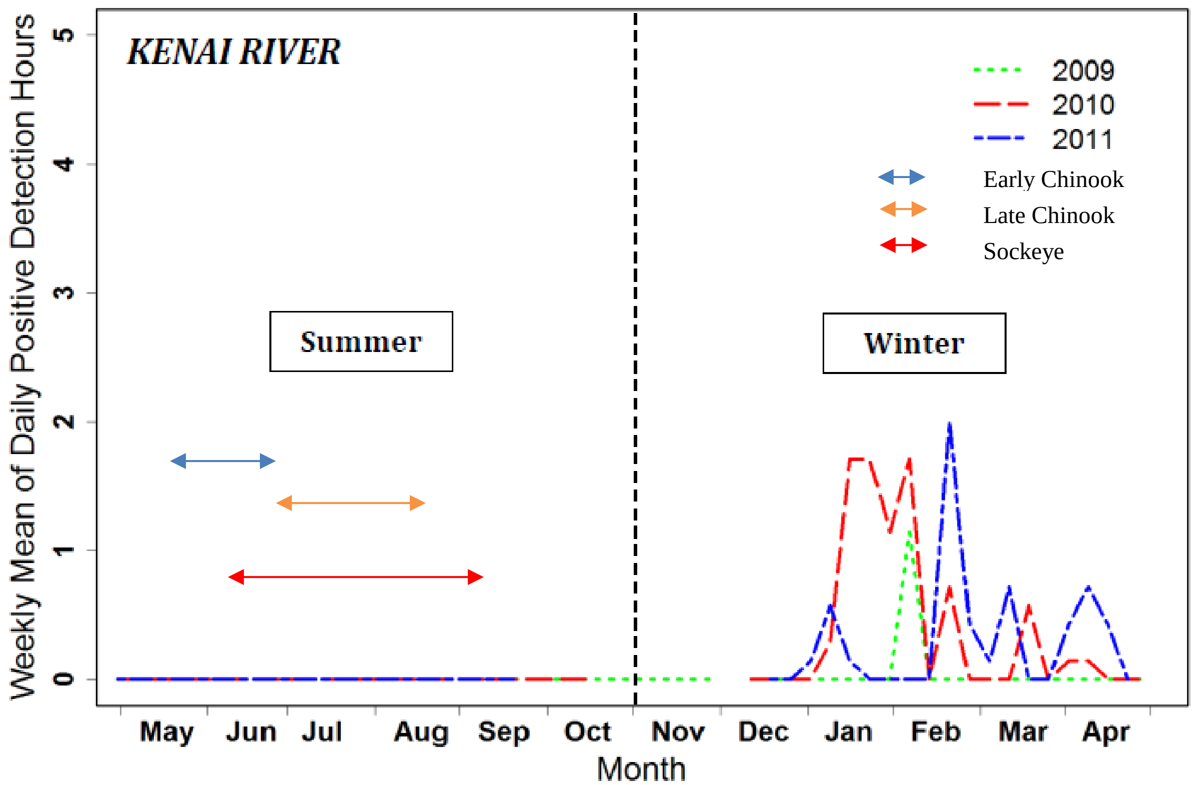

Figure 18. Acoustic detections of Cook Inlet beluga whales in the Kenai River from 2009 through 2011 compared to Chinook and Sockeye run timing. From Castellote et al. (2016) and fish run timing data at http://www.adfg.alaska.gov/sf/FishCounts/index.cfm?adfg=main.home (accessed March 2, 2020).

[5] https://akbmp.org/

NMFS's records of opportunistic sightings contain thirteen records of beluga sightings in the Kasilof River between 1978 and 2015, with half of those sightings since 2008 (Shelden et al. 2015b; NMFS unpublished data)). In 2018, NMFS conducted surveys of local residents regarding two reports of belugas in the Kasilof River in April; one of these reports was of a group of around 30 belugas (Ovitz 2019).

Belugas may be present in Tuxedni Bay throughout the year, with peaks in acoustic detections in January and especially in March (Figure 19) (Shelden et al. 2015b, Castellote et al. 2016). Belugas were also seen in March 2018 and 2019 in Tuxedni Bay during NMFS winter distribution aerial surveys (NMFS unpublished data).

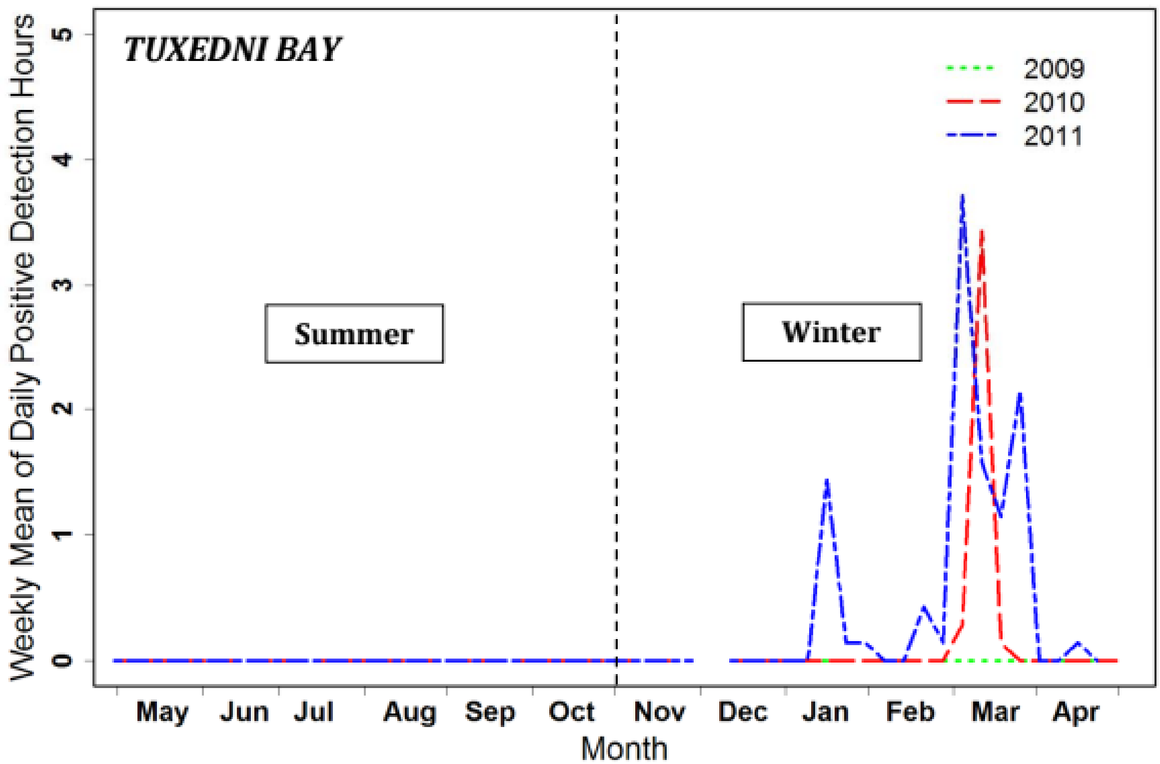

Figure 19. Detections of belugas in Tuxedni Bay using acoustic monitors from 2009-2011. (Figure 4G from Castellote et al 2015).

From December 2015 through January 2016, Tyonek Platform (located in upper Cook Inlet) personnel observed 200 to 300 Cook Inlet beluga whales, including calves, regularly. They appeared to be drifting by the platform on the afternoon tides, in the open water areas between ice sheets. One operator, working in Cook Inlet for 30 years, stated that he had never seen them in the winter before the 2015 to 2016 season (S. Callaway, pers. comm. 01/19/2016). Hilcorp reported 143 sightings of beluga whales from May through August while conducting pipeline work in upper Cook Inlet (Sitkiewicz et al. 2018).

Presence in Knik Arm/Port of Alaska

Multiple groups have conducted beluga studies in Knik Arm over the past 15 to 20 years both at and near the POA, including NMFS, LGL Alaska Research Associates Inc., the Cook Inlet Photo-ID Project, Alaska Pacific University, the POA (during various port construction and maintenance projects), and Joint Base Elmendorf-Richardson. We reviewed the various reports and published papers for information on beluga occurrence and movements in upper Cook Inlet to determine beluga presence in the action area.

Beluga whales can be found in Knik Arm year-round, but are more frequently observed in the summer and fall. Figure 20 through Figure 25 show acoustic detections of belugas at various mooring locations in Knik Arm from 2008-2013 (not all sites had a mooring each year) (Castellote et al. 2015). Figure 26 also shows the seasonal distribution of belugas sighted during construction and scientific monitoring programs at the POA from 2008-2011 (Cornick 2012).

The Alaska Beluga Monitoring Partnership (AKBMP)[6] citizen science project monitored for belugas at the Ship Creek Small Boat Ramp between August 15 - Oct 31 (68 days with monitoring sessions) and recorded 75 individual beluga sightings, including 23 groups, with sightings that ranged from 1-12 whales (average group size of 3).

McGuire and Stephens (2017) and McGuire and Stephens (2016) reported that during boat- and land-based photo-identification (ID) surveys, large concentrations of belugas were present in Knik Arm from mid-August through mid-September. During this period, their movements in the area were typically characterized by traveling to upper Knik Arm with the high tide, and following the low tide back down to Eagle Bay and the Port. Beluga whales observed in Knik Arm during the autumn were most frequently sighted on the western side of the arm (Funk et al. 2005).

Aerial surveys, funded and flown by NMFS and BOEM, to look at the winter distribution of belugas were conducted in late March and early November of 2018, and late March, late September/early October and early November of 2019. Knik Arm was surveyed during each survey. Belugas were only seen in Knik Arm during the early November 2019 survey in Eagle Bay. However, belugas were present in Knik Arm in September and October of 2018 and 2019 as observed during beluga biopsy and photogrammetry research activities (Verena Gill, NMFS personal obs).

[6] https://akbmp.org/

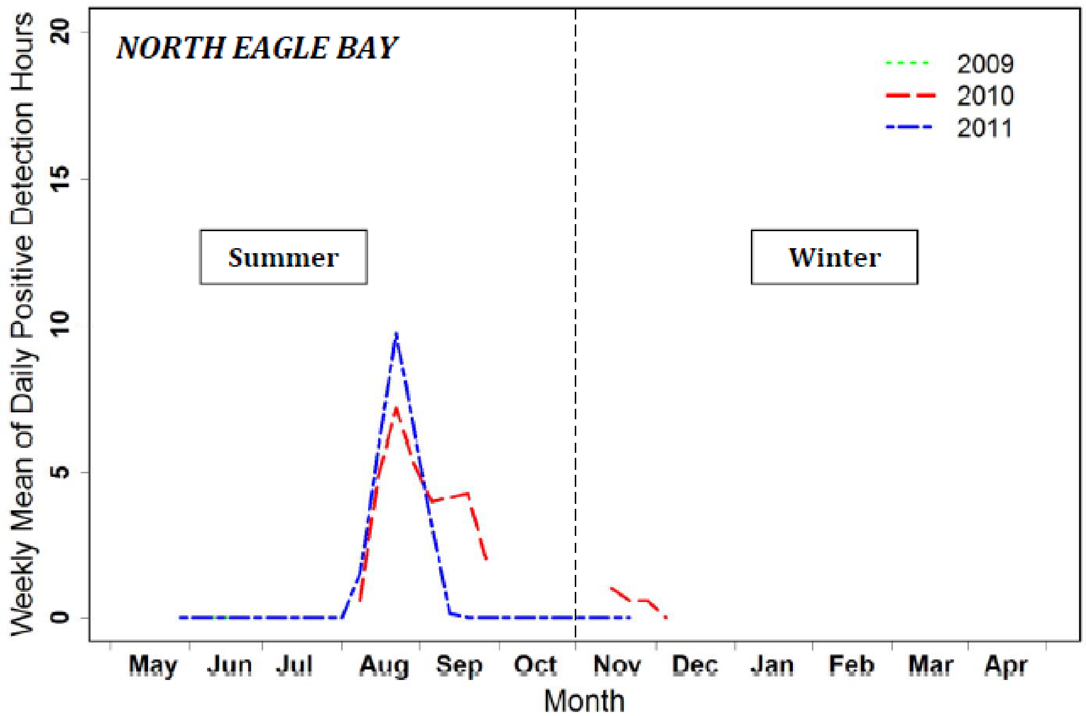

Figure 20. Weekly mean of daily beluga detection positive hours (DPH) by month at North Eagle Bay, Cook Inlet, Alaska, 2009-2011 (Castellote et al. 2015).

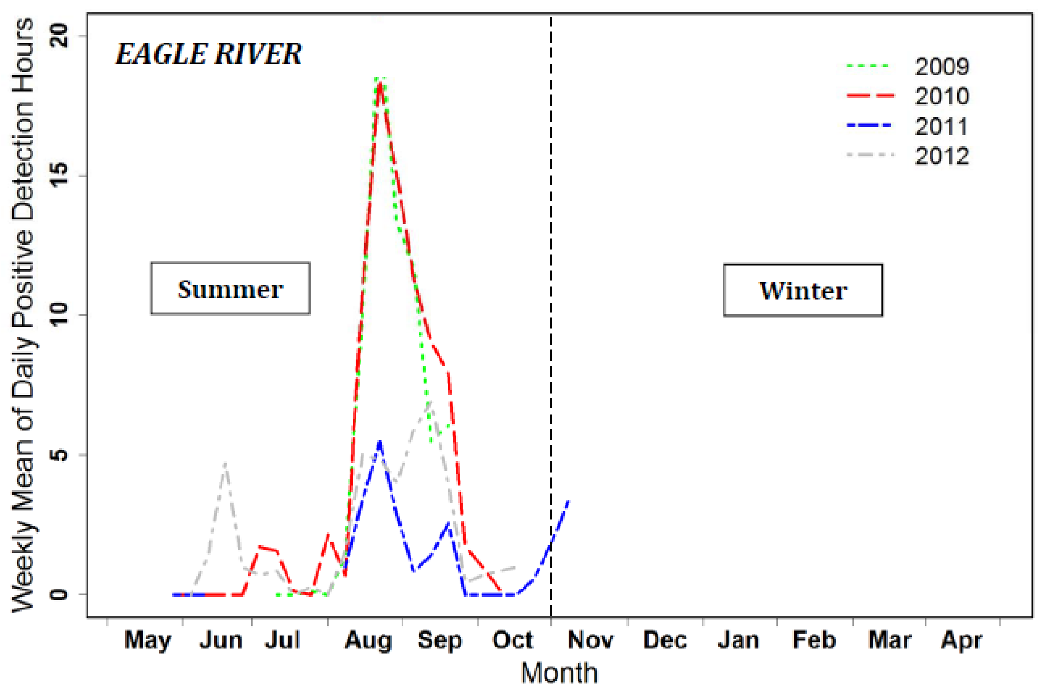

Figure 21. Weekly mean of daily beluga detection positive hours (DPH) by month at Eagle River, Cook Inlet, Alaska, 2009-2012 (Castellote et al. 2015).

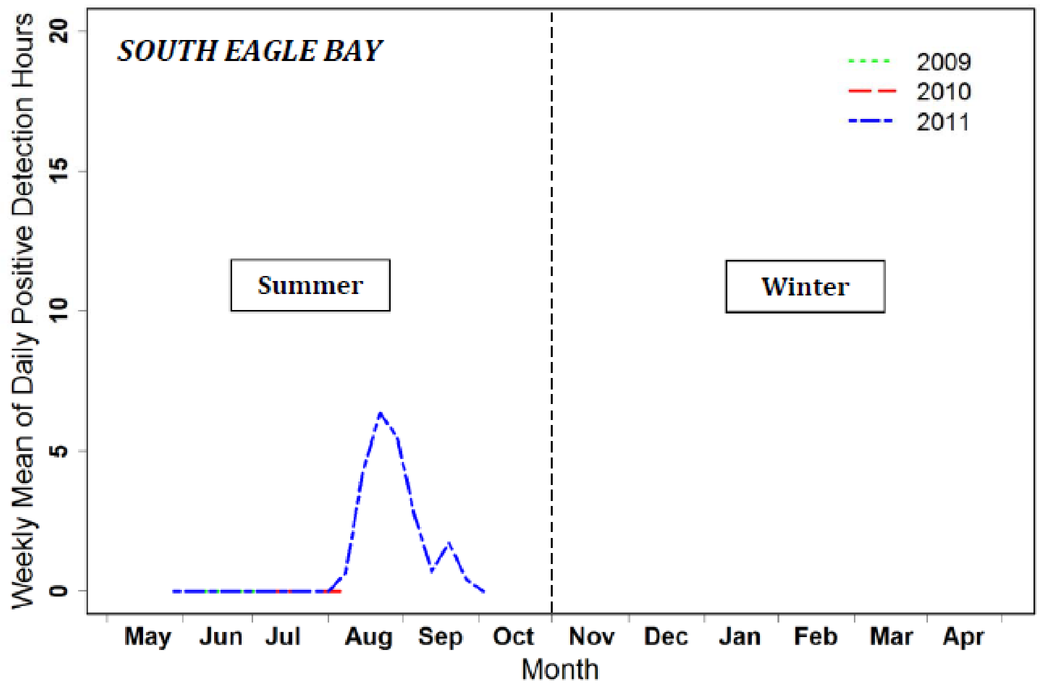

Figure 22. Weekly mean of daily beluga detection positive hours (DPH) by month at South Eagle Bay, Cook Inlet, Alaska, 2009-2011 (Castellote et al. 2015).

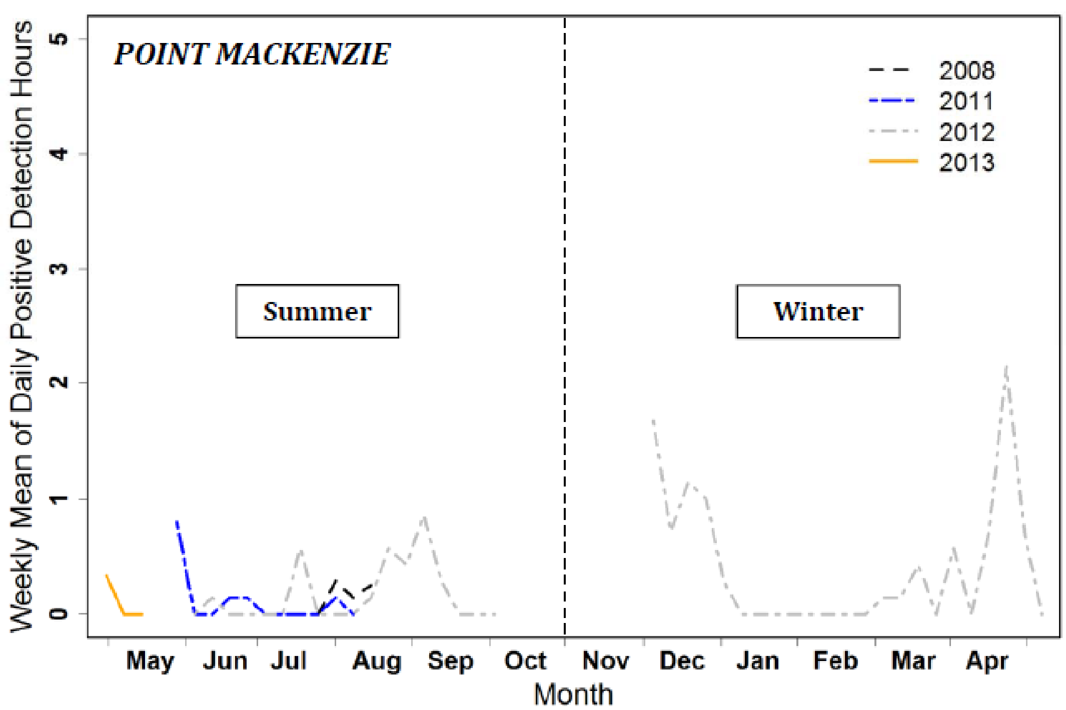

Figure 23. Weekly mean of daily beluga detection positive hours (DPH) by month at Point MacKenzie, Cook Inlet, Alaska, 2008-2013 (Castellote et al. 2015).

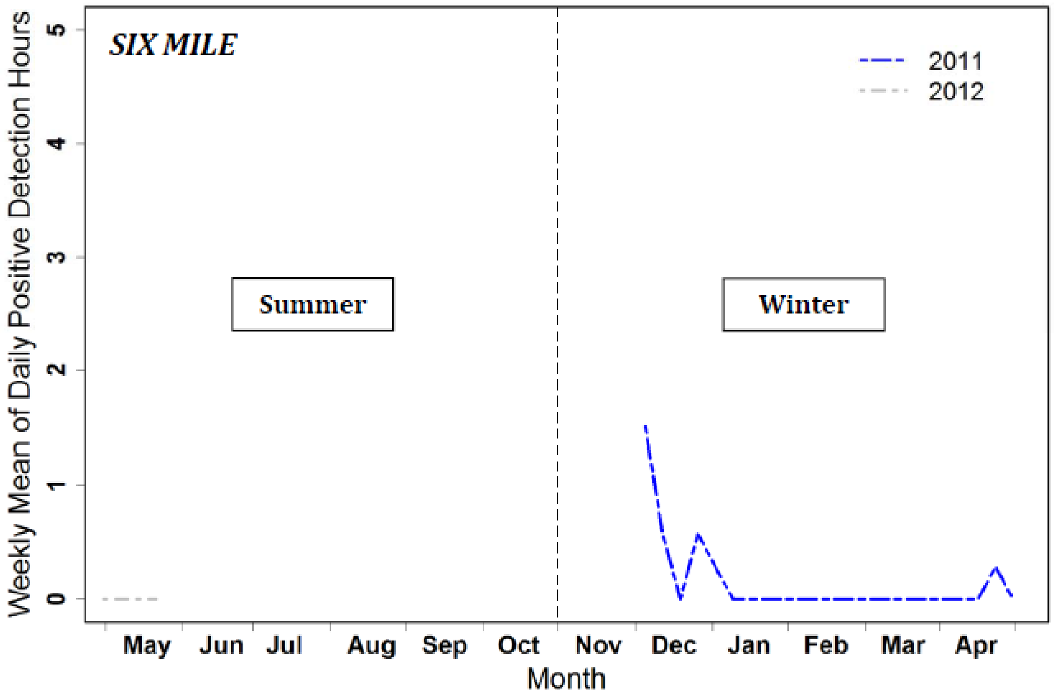

Figure 24. Weekly mean of daily beluga detection positive hours (DPH) by month at Six Mile, Cook Inlet, Alaska, 2011-2012 (Castellote et al. 2015).

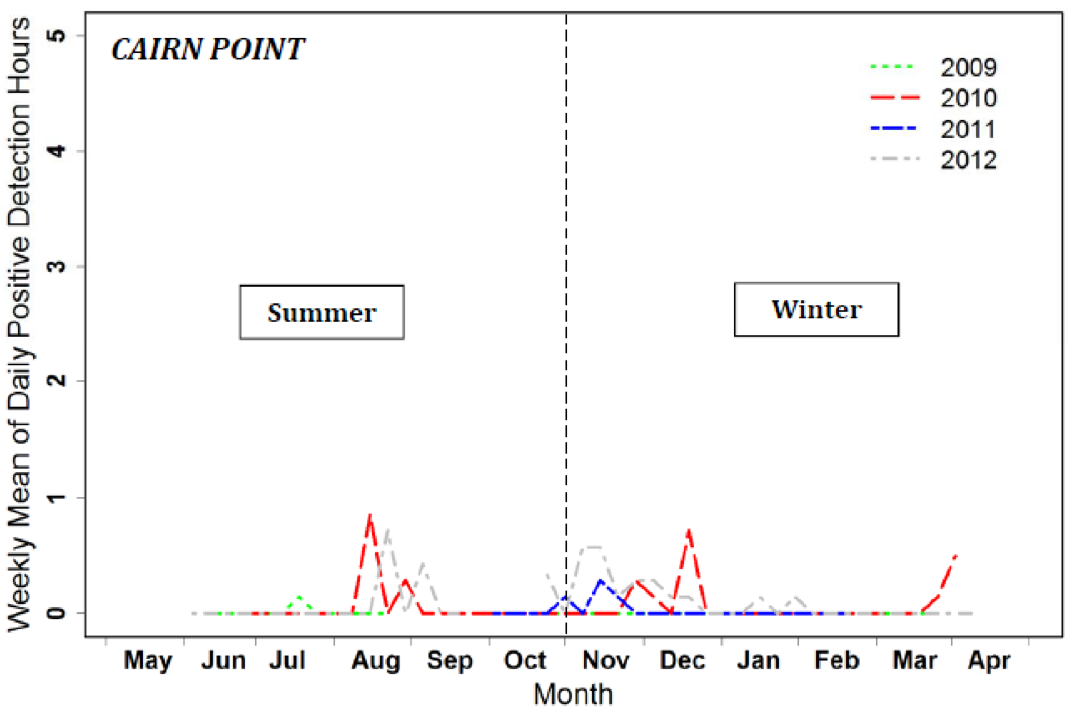

Figure 25. Weekly mean of daily beluga detection positive hours (DPH) by month at Cairn Point, Cook Inlet, Alaska, 2009-2012.

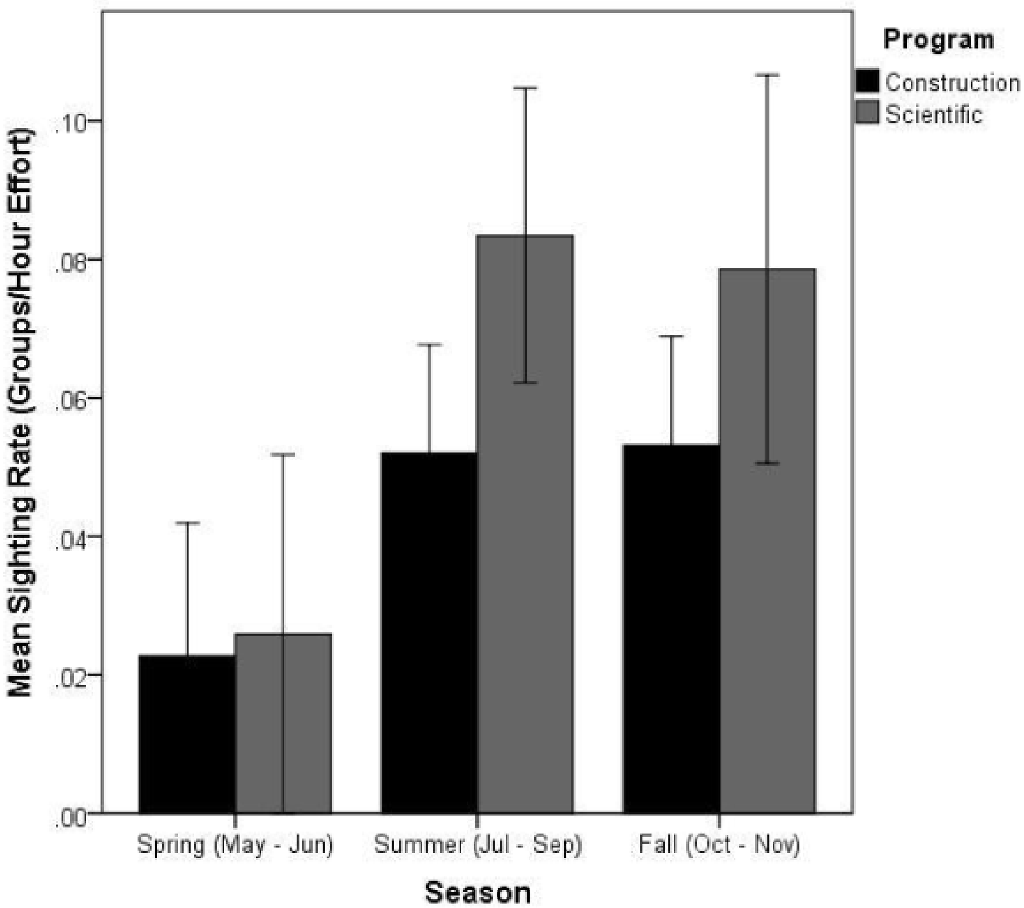

Figure 26. Beluga whale sighting rates (number of beluga whale groups sighted per hour of effort) across seasons for Construction and Scientific MMM Programs. Error bars represent one standard error of the mean (Cornick 2012).

McGuire and Stephens (2016) conducted land- and vessel-based surveys in Knik Arm from August to October 2014. During this period, 11 observations of 1-120 whales were made (Table 15), with the maximum group size of 120 being more than twice the maximum group size reported for Turnagain Arm (McGuire and Stephens 2016). Calves and neonates were present in 9 of the 11 groups observed in Knik Arm (Figure 27). While the primary behaviors observed were traveling and milling, a feeding event was confirmed in Eagle Bay (Table 10).

Table 9. From McGuire and Stephens (2016; Table 3). Number, composition, and size of groups sighted during vessel- and land-based surveys in Knik Arm in 2014. Group numbers were assigned by day. (Neonates are separate from calf total. Unknown = beluga of unknown color and size.)

Date	Survey Type	Beluga Group #	# White	# Gray	# Calves	# Neonates	# Unknown	Group Size
Aug 15	land	1	26	34	10	*	0	70
Aug 18	land	1	47	59	14	*	0	120
Aug 19	land	1	49	43	14	*	0	106
Aug 19	land	2	1	0	1	0	0	2
Aug 20	land	1	39	36	16	*	0	91
Aug 23	vessel	1	15	10	5	3	0	33
Aug 23	vessel	2	4	1	1	1	0	7
Aug 23	vessel	3	3	1	0	0	0	4
Aug 30	vessel	1	1	0	0	0	0	1
Aug 30	vessel	2	8	12	3	1	0	24
Sept 9	land	1	20	31	8	5	0	64
Annual Total		**11**	**213**	**227**	**72**	**10**	**0**	**522**

*neonates present but not counted separately from calves

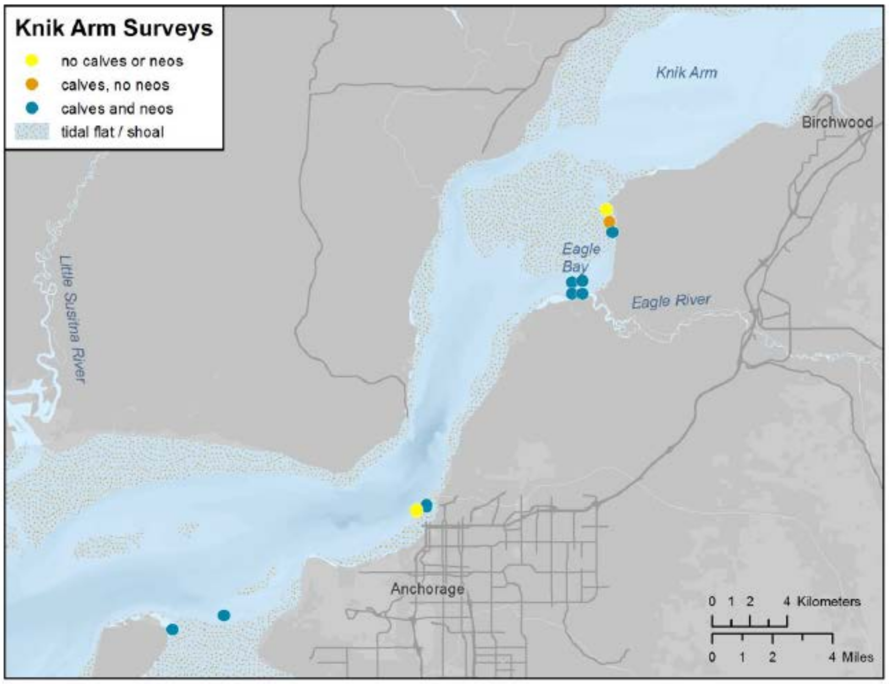

Figure 27. From McGuire and Stephens (2016; Fig. 7): Location of groups with and without calves and neonates encountered during land- and vessel-based photo-id surveys of Knik Arm, Upper Cook Inlet, Alaska in 2014.

Table 10. From McGuire and Stephens (2016; Table 7). Summary of primary and secondary activities of beluga groups encountered in 2014 during photo-id surveys in Knik Arm, Upper Cook Inlet, Alaska.

Date	Group Size	Primary Group Activities Noted	Secondary Group Activities Noted	Events and Additional Comments
Aug 15	70	milling	traveling	shallow diving
Aug 18	120	milling	traveling/diving/ feeding suspected	feeding confirmed - one instance of fish in mouth of beluga
Aug 19	106	milling	traveling	shallow diving
Aug 19	2	traveling	none	
Aug 20	91	milling	traveling	socializing along sandbar middle of Eagle Bay
Aug 23	33	traveling	milling	travel along shore within a few meters of inter-tidal bulldozing along Port of Anchorge; at small boat ramp whales dive to avoid small duck-hunting motorized skiff that approaced them, whales submerge 2 minutes then reappear in same location after skiff leaves
Aug 23	7	milling	none	
Aug 23	4	milling	traveling	
Aug 30	1	traveling	none	
Aug 30	24	traveling	none	
Sept 9	64	traveling	milling	diving

Belugas are more likely to be present in Eagle Bay during low tides (Funk et al. 2005, McGuire et al. 2008, Joint Base Elmendorf-Richardson 2010, McGuire et al. 2018). Additionally, during scientific and construction monitoring at the Port, Cornick et al. (2011) reported that belugas were present at all tidal stages near the Port (lower Knik Arm), however there were more belugas present during low slack tide than any other tide stage (Figure 28).

McGuire and Stephens (2017) noted that belugas will travel between Knik Arm and Turnagain Arm using both the channel between Fire Island and Anchorage and the longer route along the western shore passing the Susitna Delta.

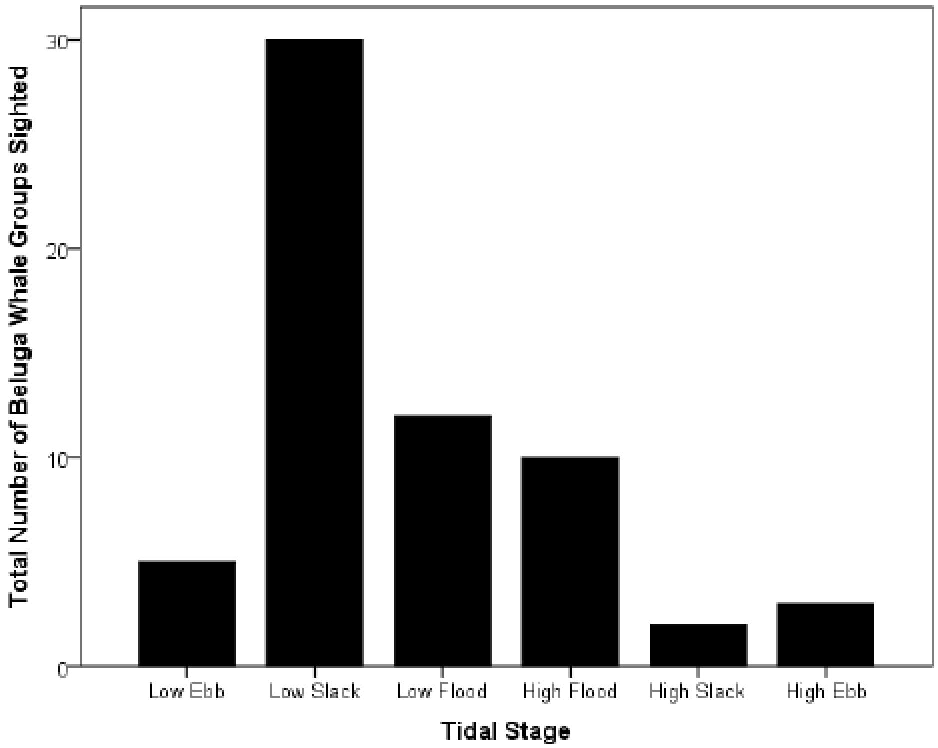

Figure 28. Beluga whale sightings by tidal stage. The stages are defined as hours before (-) or after (+) low tide; each stage is two hours in duration (Cornick et al. 2011).

The Alaska Beluga Monitoring Partnership (AKBMP)[7] citizen science project recorded 75 sightings (23 groups) at the Ship Creek small boat launch (with group sizes ranging from 1-12 belugas, average size 3) from August 15 through October 31, 2019 (68 days with monitoring sessions), however, this is likely an underestimate of beluga presence in Knik Arm, since the AKBMP monitoring sessions were scheduled around high tide when belugas are less likely to be present in the area.

Dredging occurred at the POA from May – September 2019. No belugas were observed during either May or July. During June, belugas were seen only between 21-29 June, with the groups ranging in size from 2 to 18 belugas and an average of about 7 whales (POA 2019b). When dredging re-commenced in August, belugas were observed on nearly every day, with group sizes most often 3-15 whales, however some groups were as large as 85 animals. Dredging continued until September 17, however the last sighting of belugas during dredging was on September 10.

The USACE also conducted dredging at the POA between April and October 2018. During their operations, 24 belugas were observed in June, 12 in July, 75 in August, and 5 each in September and October (USACE 2019).

[7] https://akbmp.org/

Construction and independent scientific marine mammal monitoring programs occurred previously at the POA from 2005 to 2011. Table 11 summarizes monitoring effort and belugas documented during scientific and construction monitoring.

Table 11. Beluga Whales Observed in the POA Area during Monitoring Programs

Year	Dates of Monitoring Effort	Monitoring Effort		Total Number of Groups[a] Sighted	Total Number of Beluga Whales	Monitoring Type
		# of Days	# of Hours			
2005	August 2–Nov. 28	51	374	21	157	Scientific Monitoring
2006	April 26–Nov. 3	95	564	25	82	Scientific Monitoring
2007	Oct. 9–Nov. 20	28	139	14	61	Scientific Monitoring
2008	June 24–Nov. 14	86	612	74	283	Scientific Monitoring
	July 24–Dec. 2	108	607[b]	59	431	Construction Monitoring
2009	May 4–Nov. 18	86	783	54	166	Scientific Monitoring
	March 28–Dec. 14	214	3,322[b]	NA	1,221	Construction Monitoring
2010	June 29–Nov. 19	87	600	42	115	Scientific Monitoring
	July 21–Nov. 20	106	862[b]	103	731	Construction Monitoring
2011	June 28–Nov. 15	104	1,202	62	290	Scientific Monitoring
	July 17–Sept. 27	16	NA	5	48	Construction Monitoring
2016	May 3–June 21	19	85.3	9	10	Construction Monitoring

[a] For this monitoring program, the POA defined a group as one or more individuals.

[b] Intermittent in-water pile-driving hours.

Source: Cornick and Seagars 2016; Cornick et al. 2010, 2011; Cornick and Pinney 2011; Cornick and Saxon-Kendall 2008, 2009; ICRC 2009a, 2010a, 2011a, 2012; Markowitz and McGuire 2007; Prevel-Ramos et al. 2006

NA = not available; the information was not provided in the report. The 2009 construction monitoring report does not indicate the total number of sightings, only the total number of beluga whales observed.

Based on data from Goetz et al. (2012), beluga whale densities within the action area for the PCT project ranged from 0.042 to 0.236 beluga whales/km^2. The higher densities north of the POA are expected as beluga whales tend to concentrate in Eagle Bay to forage, whereas in the lower Knik Arm, where the POA is located, habitat use is more commonly associated with traveling (Figure 29) (McGuire and Stephens 2017). However, the Goetz density data for this specific project may not be fully applicable because the density data is based on June aerial surveys while the PCT project is occurring from April through November, the data is over seven years old, and there are multiple years of monitoring data collected by the POA that may be more informative of actual beluga presence at the POA.

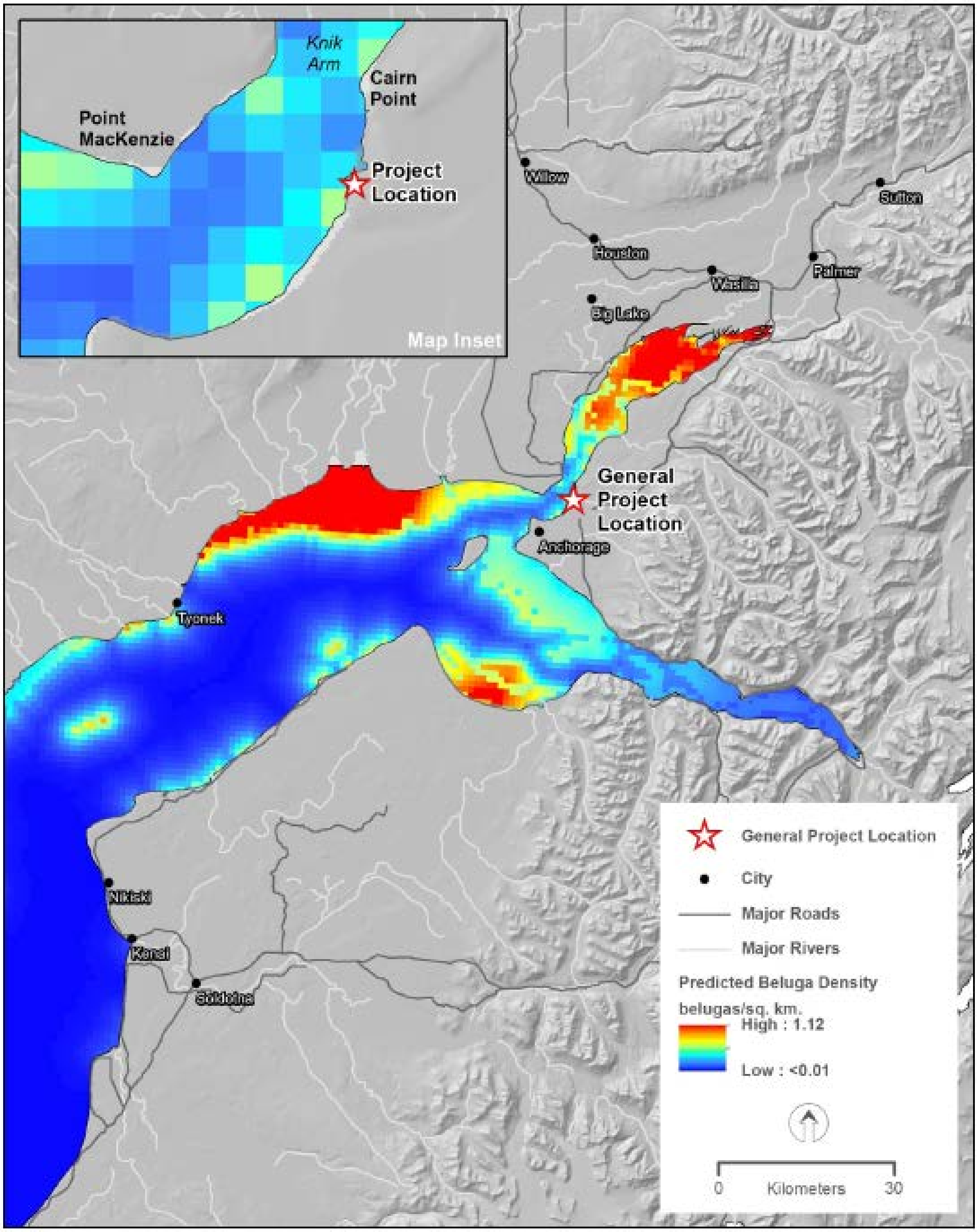

Figure 29. Predicted beluga whale densities within Upper Cook Inlet during summer (Goetz et al. (2012).

NMFS determined that for the PCT project, using data from the previous POA scientific monitoring that covered similar months of work (April – November) over multiple years would best capture the presence of belugas in the vicinity of the POA. To capture beluga whale distribution and abundance during the proposed PCT project, we undertook a multi-step analysis consisting of an evaluation of long-term, seasonal sighting data, the amount of documented take from previous POA projects, and group size. In lieu of density data, NMFS applied sighting rate data presented in Kendall and Cornick (2015) to estimate hourly sighting rates per month (April through November) (Table 12).

Table 12. Beluga sightings rate from April-November (Kendall and Cornick 2015).

Monitoring Data[a]			
Month	**Effort Hours**	**Number of whales observed**	**Average whale/hr**
April	12	2	0.17
May	156	40	0.26
June	280	8	0.03
July	360	2	0.01
August	426	269	0.63
September	447	169	0.38
October	433	22	0.05
November	215	175	0.82
Total	**2,317**	**685**	**0.30**

a Kendall and Cornick 2015

b Assumes equal work distribution/month except in April and November when the POA has indicated they would be conducting only 2 weeks of pile driving due to time needed for mobilization and demobilization.

4.2.1.3 Behavior and Group Size

Beluga whales are extremely social and often interact in close, dense groups. McGuire and Stephens (2017) observed increasing maximum group size of Cook Inlet beluga whales since 2012, and as mentioned above, groups of 200 or more individuals (maximum group size of 313 whales – almost the entire population) were seen during in the Susitna River Delta area. Group sizes during the summer and fall were largest in July (57) and smallest in October (13.9), with the largest groups seen during mid-July and early August in the Susitna River Delta, while the smallest group sizes were in the Kenai River Delta.

Most calving in Cook Inlet is assumed to occur from mid-May to mid-July (Calkins 1989; NMFS unpublished data). Young beluga whales are nursed for two years and may continue to associate with their mothers for a considerable time thereafter (Colbeck et al. 2013).

Neonates have been photographed in Cook Inlet as early as mid-July and as late as October, during a field season that generally runs May through October. The only documented observation of a beluga whale birth occurred on July 20, 2015 in the Susitna River Delta, which corroborates the importance of the Susitna River Delta as a Cook Inlet beluga whale calving ground (McGuire and Stephens 2017, Shelden et al. 2019). Shelden et al. (2019) predicted birth dates of stranded neonates, fetuses, and calves of the year and suggested that calving could occur through the entire ice-free period from April through November. The predicted peak range of conception dates for the stranded animals was March through May, however, conception dates have been exhibited over a seven month period, including two fetuses with predicted conception dates in December and January. Probable mating behavior of belugas was observed in April and

May of 2014, in Trading Bay (Lomac-MacNair et al. 2016).

4.2.1.4 Feeding and Prey Selection

Cook Inlet beluga whales have diverse diets (Quakenbush et al. 2015, Nelson et al. 2018), foraging on fish and benthos, often at river mouths. Belugas seasonally shift their distribution within Cook Inlet in relation to the timing of fish runs and seasonal changes in ice and currents (NMFS 2016b). Generally, belugas spend the ice-free months in the upper Inlet, often concentrated in discrete areas such as the Susitna River Delta (McGuire and Stephens 2017), then expand their distribution south and into more offshore waters in winter (Hobbs et al. 2005). In early spring, belugas travel up to Twenty Mile River and Placer Creek in Turnagain Arm, indicating the importance of eulachon as a spring food source. Funk et al. (2005) confirmed early spring (March to May) and fall (August to October) use of Knik Arm.

In August-October, the increase in sightings (McGuire and Stephens 2016, McGuire et al. 2018) and acoustic detections (Castellote et al. 2016) of belugas in Turnagain Arm and Knik Arm coincides with the coho salmon run (NMFS 2016b). Later in the fall, many belugas disperse south, though few whales are observed in the lower inlet. In winter, belugas occur in the upper inlet as well as the lower inlet (Shelden et al. 2015b). Acoustic results suggest that some belugas may enter Knik Arm in December, January, March, and April, but their numbers do not markedly increase until May (Castellote et al. 2016).

A recent study using stable isotopes on historical and recent beluga bone samples suggests that the diets of Cook Inlet belugas have shifted over time (i.e., since the 1980s) to a diet influenced more by freshwater prey (Nelson et al. 2018). The cause of this dietary shift is unknown, but appears to have begun before the documented population decline.

4.2.1.5 Hearing, Vocalizations, and Other Sensory Capabilities

Like other odontocete, or toothed, cetaceans, beluga whales produce sounds for two overlapping functions: communication and echolocation. For their social interactions, belugas emit communication calls with an average frequency range of about 0.2 to 7.0 kHz (well within the human hearing range) (Garland et al. 2015), and the variety of audible whistles, squeals, clucks, mews, chirps, trills, and bell-like tones they produce have led to their nickname of “canaries of the sea” (Castellote et al. 2014). Belugas and other odontocetes make sounds across some of the widest frequency bands that have been measured in any animal group.

At the higher frequency end of their hearing range, belugas use echolocation signals (biosonar) with peak frequencies at 40-120 kHz (Au 2000) to navigate and hunt in dark or turbid waters, where vision is limited. Beluga whales are one of five non-human mammal species for which there is convincing evidence of frequency modulated vocal learning (Payne and Payne 1985, Tyack 1999, Stoeger et al. 2012).

Even among odontocetes, beluga whales are known to be among the most adept users of sound. It is possible that the beluga whale’s unfused vertebrae, and thus the highly movable head, have allowed adaptations for their sophisticated directional hearing. Multiple studies have examined hearing sensitivity of belugas in captivity (Awbrey et al. 1988, Johnson et al. 1989, Klishin et al.

2000, Ridgway et al. 2001, Finneran et al. 2002a, Finneran et al. 2002b, Finneran et al. 2005, Mooney et al. 2008), however, the results are difficult to compare across studies due to varying research designs, complicating factors such as ototoxic antibiotics (e.g., Finneran et al. 2005), and small sample sizes. In the first report of hearing ranges of belugas in the wild, Castellote et al. (2014) reported a wide range of sensitive hearing from 20-110 kHz, with minimum detection levels around 50 dB (Figure 30). In general, these results were similar to the ranges reported in the captive studies, however, the levels and frequency range indicate that the belugas in the Castellote et al. (2014) study have sensitive hearing when compared to previous beluga studies and other odontocetes (Houser and Finneran 2006, Houser et al. 2018).

Most of these studies measured beluga hearing in very quiet conditions. However, in Cook Inlet, tidal currents regularly produce ambient sound levels well above 100 dB (Lammers et al. 2013). Belugas’ signal intensity can change with location and background noise levels (Au et al. 1985).

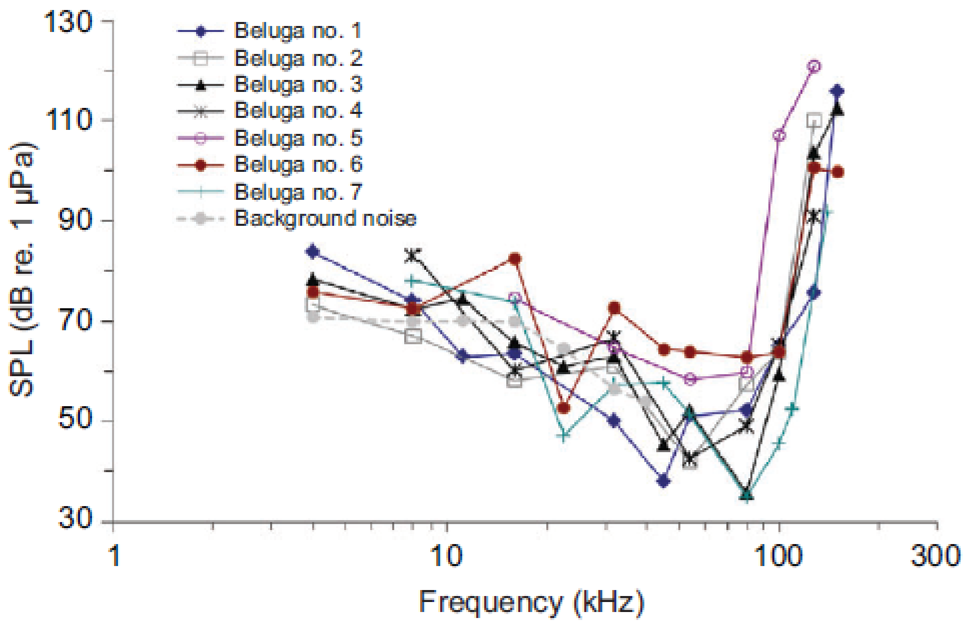

Figure 30. Audiograms of seven wild beluga whales. Human diver audiogram and Bristol Bay background noise for comparison (from Castellote et al. 2014).

4.2.1.6 Cook Inlet Beluga Whale Critical Habitat

NMFS designated critical habitat for the Cook Inlet beluga whales on April 11, 2011 (Figure 31; 76 FR 20180). Critical habitat includes two areas: Area 1 and Area 2 that together encompass 7,800 km^2 (3,013 mi^2) of marine and estuarine habitat in Cook Inlet (76 FR 20180). For national security reasons, critical habitat excludes all property and waters of Joint Base Elmendorf-Richardson (JBER) and waters adjacent to the Port of Alaska. Portions of critical habitat Area 1 and Area 2 exist within the action area (Figure 32).

Critical habitat Area 1 consists of 1,909 km^2 (738 mi^2) of Cook Inlet, north of Threemile Creek and Point Possession (76 FR 20180). Area 1 contains shallow tidal flats or mudflats and mouths of rivers that provide important areas for foraging, calving, molting, and escape from predation. High concentrations of beluga whales are often observed in these areas from spring through fall. Additionally, anthropogenic threats have the greatest potential to adversely impact beluga whales in critical habitat Area 1 (76 FR 20180).

Critical habitat Area 2 consists of 5,891 km^2 (2,275 mi^2) south of critical habitat Area 1 and includes nearshore areas along western Cook Inlet and Kachemak Bay. Critical habitat Area 2 is known fall and winter foraging and transit habitat for beluga whales as well as spring and summer habitat for smaller concentrations of beluga whales (76 FR 20180).

The Cook Inlet Beluga Whale Critical Habitat Final Rule (76 FR 20180) included designation of five Primary Constituent Elements (PCEs, referred to in this opinion as PBFs). These five PBFs were deemed essential to the conservation of the Cook Inlet beluga whale (50 CFR § 226.220(c)). The PBFs are:

1. *Intertidal and subtidal waters of Cook Inlet with depths <30 feet (MLLW) and within five miles of high and medium flow anadromous fish streams.*
2. *Primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole.*
3. *Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.*
4. *Unrestricted passage within or between the critical habitat areas.*
5. *Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.*

Although belugas may have abandoned critical habitat off of the Kenai River during the peak periods of large salmon runs, they make heavy use of salmon runs elsewhere in Upper Cook Inlet, most notably using waters near the mouth of the Susitna and Beluga rivers, and rivers feeding into Knik Arm and Chickaloon Bay (Goetz et al. 2012). In addition, they continue to use the waters in the lower 9 miles of the Kenai River during periods of low in-river human activity (Ovitz 2019). Overall, salmon returns in Cook Inlet drainages remain strong, however Brenner et al. (2019) reported that the 2018 Upper Cook Inlet commercial harvest of salmon was 61% less than the recent 10-year average annual harvest. Additionally, it is possible that fewer salmon may be available to belugas due to anthropogenic activity. Little information is available on salmon returns to those drainages most heavily exploited by Cook Inlet beluga whales. It is unknown how the newly established personal use dipnet fishery on the Susitna River from July 10-31 each year may affect future salmon returns or whether the human activity associated with this fishery may reduce prey availability to the beluga whales that rely heavily upon Susitna drainage salmon.

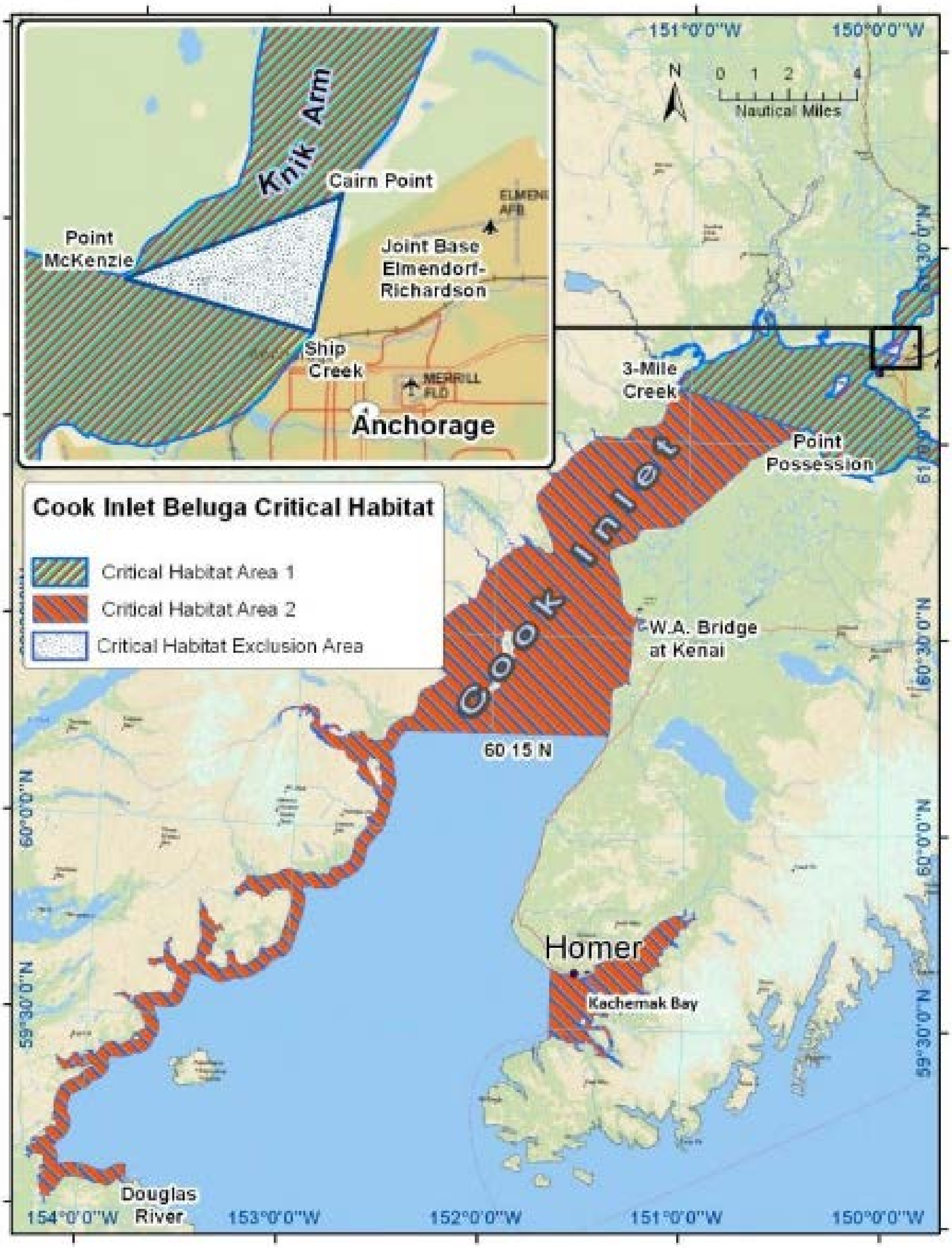

Figure 31. Designated critical habitat for Cook Inlet beluga whales.

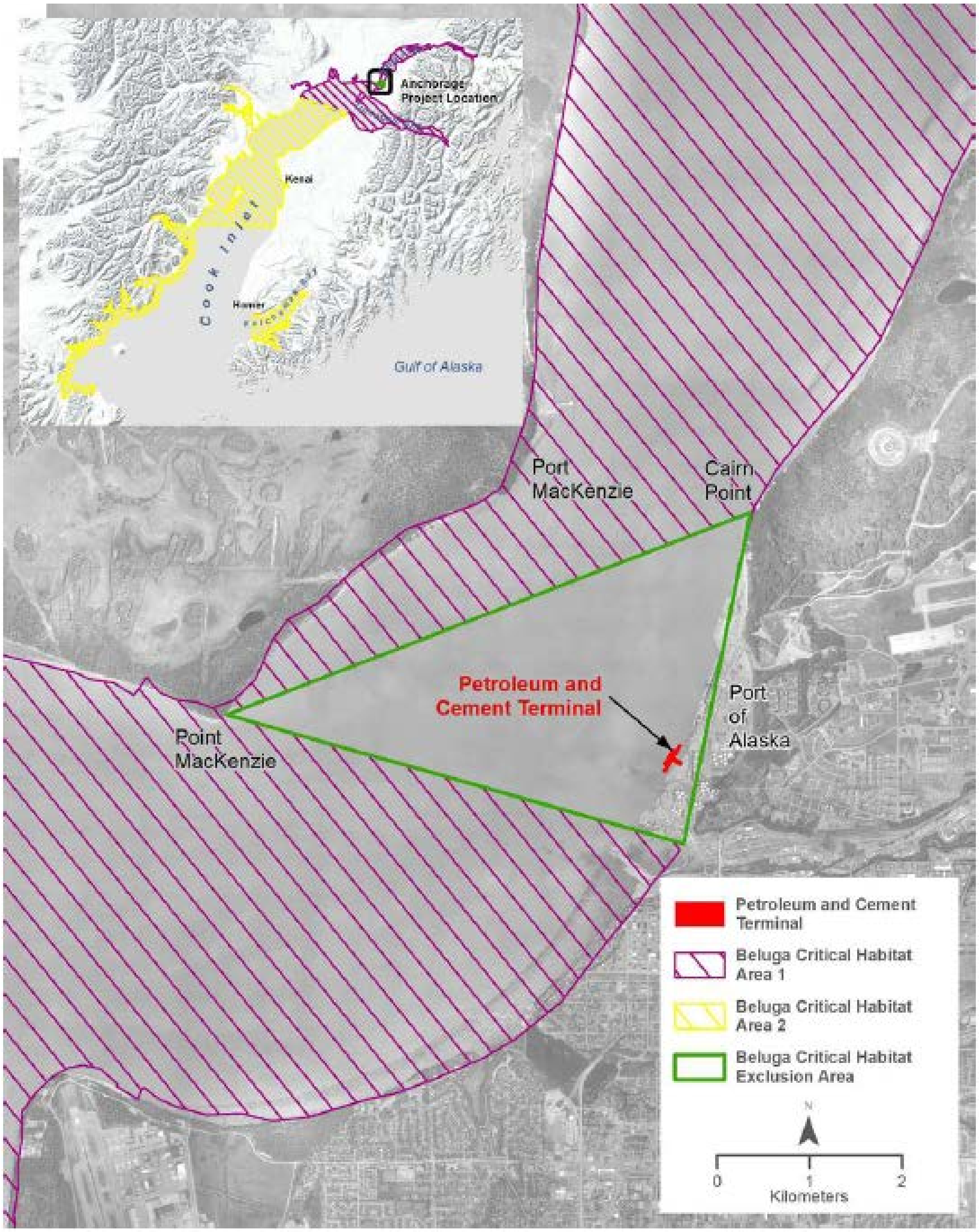

Figure 32. Designated Cook Inlet beluga critical habitat near the POA PCT site.

4.2.2 Steller sea lion

4.2.2.1 Status and Population Structure

The Steller sea lion was listed as a threatened species under the ESA on November 26, 1990 (55 FR 49204). In 1997, NMFS reclassified Steller sea lions as two DPSs based on genetic studies and other information (62 FR 24345; May 5, 1997). At that time, the eastern DPS (which includes animals from east of Cape Suckling, Alaska, at 144°W longitude) was listed as threatened and the Western DPS (which includes animals from west of Cape Suckling, at 144°W longitude) was listed as endangered. On November 4, 2013, the eastern DPS was removed from the endangered species list (78 FR 66140). Information on Steller sea lion biology, threats, and habitat (including critical habitat) is available in the revised Steller Sea Lion Recovery Plan (NMFS 2008b).

As summarized most recently by Muto et al. (2019), the Western DPS of Steller sea lions decreased from an estimated 220,000 to 265,000 animals in the late 1970s to less than 50,000 in 2000. Factors that may have contributed to this decline include incidental take in fisheries, competition with fisheries for sea lion prey, legal and illegal shooting, predation, exposure to contaminants, disease, and ocean regime shift/ climate change (NMFS 2008b). The most recent comprehensive aerial photographic and land-based surveys of Western DPS Steller sea lions in Alaska (Fritz et al. 2016, Sweeney et al. 2018) estimated a total Alaska population (both pups and non-pups) of 53,303 (Muto et al. 2019). There are strong regional differences in trends in abundance of Western DPS Steller sea lions, with mostly positive trends in the Gulf of Alaska and eastern Bering Sea east of Samalga Pass (~170°W longitude) and generally negative trends to the west in the Aleutian Islands.

The population trends in the Gulf of Alaska were observed to be increasing until 2015 (Sweeney et al. 2018), however, in 2017, NMFS surveys observed anomalously low pup counts in these areas (Sweeney et al. 2018), which may be related to low availability of prey associated with warm ocean temperatures in the Gulf of Alaska during 2014-2016. Steller sea lion surveys focused on the Gulf of Alaska were conducted in 2019 (Sweeney et al. 2018) but the results are not yet available. The 2019 Pacific cod stock assessment indicated a continued low biomass level, and NMFS closed the Gulf of Alaska Pacific cod directed fishery for the 2020 season due to Steller sea lion protection measures (NMFS 2014) (50 CFR 679.20(d)(4)).

4.2.2.2 Distribution

Steller sea lions range along the North Pacific rim from northern Japan to California, with centers of abundance in the Gulf of Alaska and Aleutian Islands (Figure 33) (Loughlin et al. 1984). Although Steller sea lions seasonally inhabit coastal waters of Japan in the winter, breeding rookeries outside of the U.S. are located only in Russia (Burkanov and Loughlin 2005). Steller sea lions are not known to migrate annually, but individuals may widely disperse outside of the breeding season (late-May to early-July) (Jemison et al. 2013, Muto et al. 2019).

Land sites used by Steller sea lions are referred to as rookeries and haulouts. Rookeries are used by adult sea lions for pupping, nursing, and mating during the reproductive season (generally from late May to early July). Haulouts are used by all age classes of both genders but are generally not where sea lions reproduce. At the end of the reproductive season, some females may move with their pups to other haulout sites and males may migrate to distant foraging locations (Spalding 1964, Pitcher and Calkins 1981). Sea lions may make semi-permanent or permanent one-way movements from one site to another (Chumbley et al. 1997, Burkanov and Loughlin 2005). Round trip migrations of greater than 6,500 km by individual Steller sea lions have been documented (Jemison et al. 2013).

Most adult Steller sea lions occupy rookeries during the pupping and breeding season, which extends from late May to early July (Pitcher and Calkins 1981, Gisiner 1985), and exhibit high site fidelity (Sandegren 1970). During the breeding season some juveniles and non-breeding adults occur at or near the rookeries, but most are on haulouts (Rice 1998, Ban 2005, Call and Loughlin 2005).

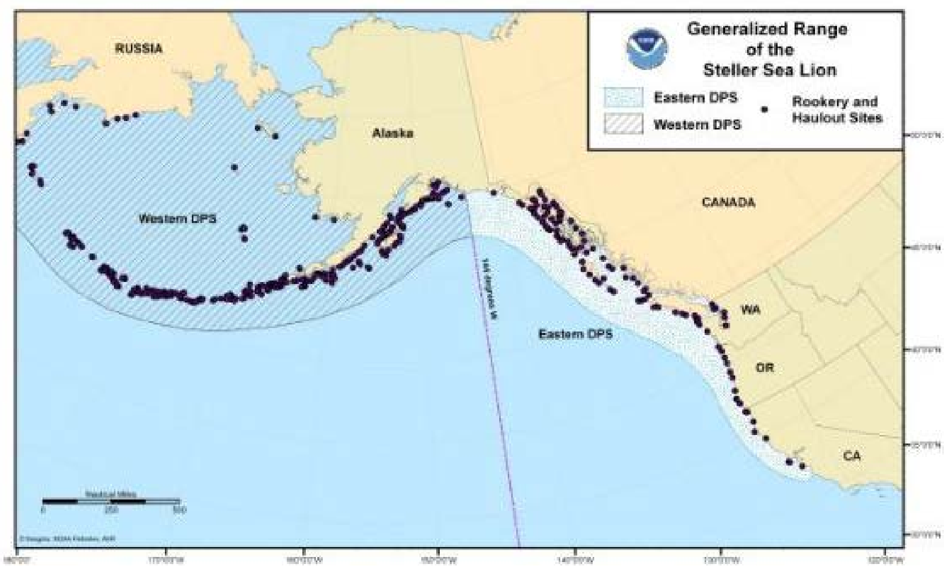

Figure 33. Generalized ranges of WDPS and EDPS Steller sea lions

About 3,600 sea lions use terrestrial sites in the lower Cook Inlet area (Sweeney et al. 2017), with additional individuals venturing into the area to forage. However, the nearest terrestrial sites (including rookeries and haulouts) to the POA are over 200 km away in the lower inlet (Figure 34).

Presence in Cook Inlet

Steller sea lions are not commonly seen in the mid and upper Inlet. Sightings during NMFS aerial survey for belugas in Cook Inlet, indicate that the majority of all Steller sea lions are expected to be found south of the Forelands (Rugh et al. 2005, Shelden et al. 2013, Shelden et al. 2015a). Sightings of Steller sea lions in the middle and upper areas of Cook Inlet are rare and not well documented (Jacobs Engineering 2017). Steller sea lions occupy rookeries during their pupping and breeding season (late May to early July), however, there have been sightings of small numbers of Steller sea lions during oil and gas projects in recent years. In 2012, during Apache's 3D Seismic surveys, there were three sightings of approximately four individuals in upper Cook Inlet (Lomac-MacNair et al. 2013). Marine mammal observers associated with Buccaneer's drilling project off Cape Starichkof observed seven Steller sea lions during the summer of 2013 (Owl Ridge 2014). During SAExploration's 3D Seismic Program in 2015, four Steller sea lions were observed in Cook Inlet. One sighting occurred between the West and East Forelands, one near Nikiski, and one northeast of the North Foreland in the center of Cook Inlet (Kendall et al. 2015). One Steller sea lion was observed near Ladd Landing for the Harvest Alaska Cook Inlet Pipeline Cross-Inlet Extension (CIPL) project during the summer (Sitkiewicz et al. 2018).

Density data is not available for Steller sea lions in upper Cook Inlet. Steller sea lions are anticipated to be encountered in low numbers, if at all, within the action area. Although Steller sea lions are rarely present in Knik Arm, they have been documented in Knik Arm during past POA projects. Monitoring data covers the construction season (April through November) across multiple years of effort. Three sightings of what was likely a single individual occurred in the project area in 2009 and two sightings occurred in 2016. During dredging activities at the POA in June 2019, a Steller sea lion was observed in the port area on one day (POA 2019). Steller sea lions can linger in the area for multiple days.

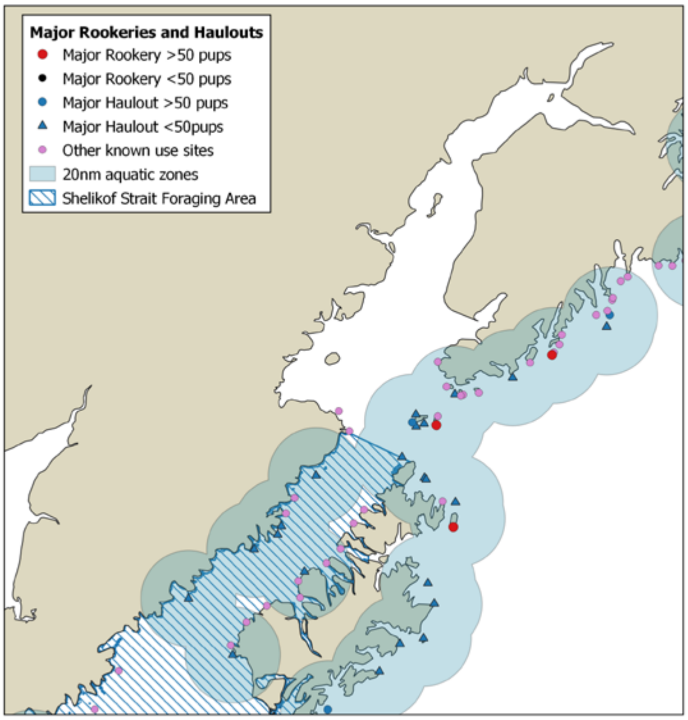

Figure 34. Steller sea lion sites in and near Cook Inlet. Designated critical habitat in this region includes the major rookeries, major haulouts, adjacent land and air zones within 3000 ft of the major rookeries and haulouts, 20nm aquatic zones around major rookeries and haulouts, and the Shelikof Strait aquatic foraging area (50 CFR § 226.202).

4.2.2.3 Feeding, Diving, Hauling out and Social Behavior

The foraging strategy of Steller sea lions is strongly influenced by seasonality of sea lion reproductive activities on rookeries, and the seasonal presence of many prey species. Steller sea lions are generalist predators that eat a variety of fishes and cephalopods (Pitcher and Calkins 1981, Calkins and Goodwin 1988, NMFS 2008b) and occasionally other marine mammals and birds (Pitcher and Fay 1982, NMFS 2008b).

During summer Steller sea lions feed mostly over the continental shelf and shelf edge. Females attending pups forage within 20 nm of breeding rookeries (Merrick and Loughlin 1997), which is the basis for designated critical habitat around rookeries and major haulout sites.

Steller sea lions tend to make shallow dives of less than 250 m (820 ft) but are capable of deeper dives (NMFS 2008b). Female foraging trips during winter tend to be longer in duration and farther from shore (130 km), during which foraging dives are deeper (frequently greater than 250 meters). Summer foraging dives, on the other hand, tend to be closer to shore (about 16 kilometers) and shallower (100 to 250 m) (Merrick and Loughlin 1997). Adult females stay with their pups for a few days after birth before beginning a regular routine of alternating foraging trips at sea with nursing their pups on land. Female Steller sea lions use smell and distinct vocalizations to recognize and create strong social bonds with their newborn pups.

Steller sea lions do not migrate, but they often disperse widely outside of the breeding season (Merrick and Loughlin 1997). Because of their polygynous breeding behavior, in which individual, adult male sea lions will breed with a large number of adult females, Steller sea lions have clearly-defined social interactions. Steller sea lions are gregarious animals that often travel in large groups of up to 45 individuals (Keple 2002), and rafts of several hundred Steller sea lions are often seen adjacent to haulouts. Individual rookeries and haulouts may be comprised of hundreds of animals. At sea, groups usually consist of females and subadult males as adult males are usually solitary (Loughlin 2002).

4.2.2.4 Hearing, Vocalizations, and Other Sensory Capabilities

The ability to detect sound and communicate underwater is important for a variety of Steller sea lion life functions, including reproduction and predator avoidance. NMFS categorizes Steller sea lions in the otariid pinniped functional hearing group, with an applied frequency range between 60 Hz and 39 kHz in water (NMFS 2018a). Studies of Steller sea lion auditory sensitivities have found that this species detects sounds underwater between 1 to 25 kHz (Kastelein et al. 2005), and in air between 250 Hz and 30 kHz (Mulsow and Reichmuth 2010). Sound signals from vessels are typically within the hearing range of Steller sea lions, whether the animals are in the water or hauled out.

4.2.2.5 Steller Sea Lion Critical Habitat

NMFS designated critical habitat for the Steller sea lion on August 27, 1993 (58 FR 45269), citing the physical and biological habitat features that support reproduction, foraging, rest, and refuge, including terrestrial, air, and aquatic zones. Steller sea lion critical habitat west of 144°W (Figure 35) includes a 20 nautical mile buffer around all major haulouts and rookeries, as well as associated terrestrial, air, and aquatic zones, and three large offshore foraging areas (Shelikof Strait, Bogoslof, and Seguam Pass) (50 CFR § 226.202).

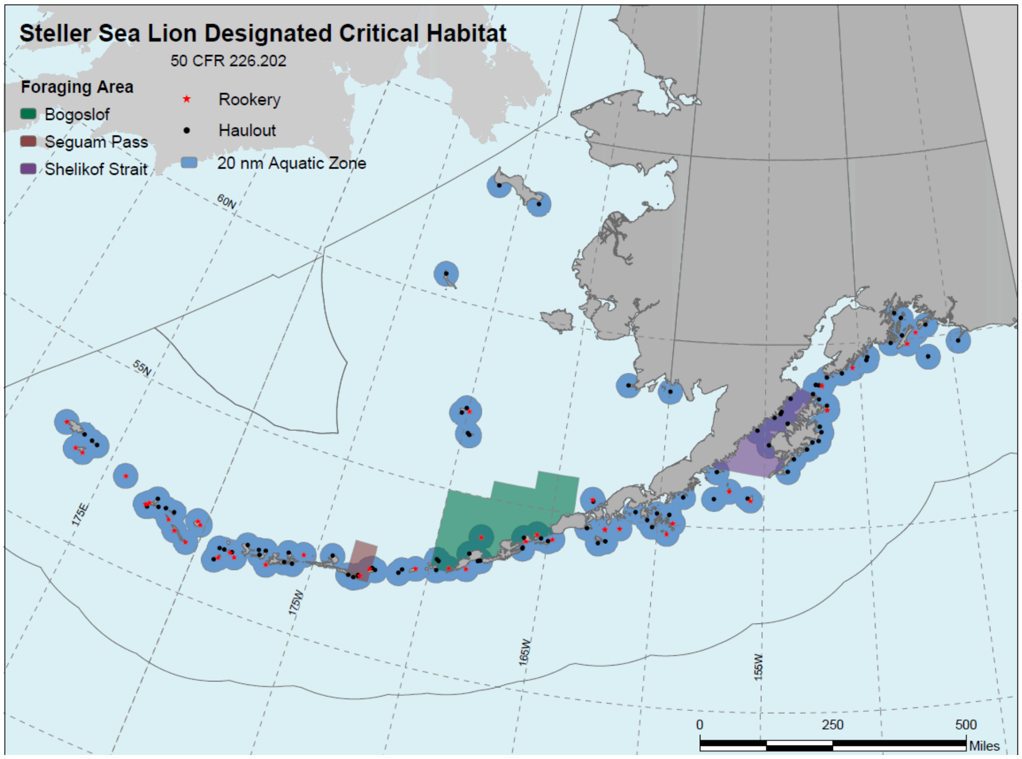

Figure 35. Designated Steller sea lion critical habitat west of 144°W. Designated critical habitat (50 CFR § 226.202) includes the major rookeries, major haulouts, 20nm aquatic zones around major rookeries and haulouts, and the Shelikof Strait aquatic foraging area.

NMFS identified physical and biological features essential for conservation of Steller sea lions in the final rule to designate critical habitat (58 FR 45269). The POA PCT project action area does not overlap with Steller sea lion critical habitat (Figure 34 and Figure 35); the nearest critical habitat is over 200 km southwest of the project area.

1. *Terrestrial zones that extend 3,000 feet (0.9 km) landward from each major haulout and major rookery in Alaska.*
2. *Air zones that extend 3,000 feet (0.9 km) above the terrestrial zone of each major haulout and major rookery in Alaska.*
3. *Aquatic zones that extend 3,000 feet (0.9 km) seaward from each major haulout and major rookery in Alaska that is east of 144°W longitude.*
4. *Aquatic zones that extend 20 nautical miles (37 km) seaward from each major rookery and major haulout in Alaska that is west of 144°W longitude.*
5. *Three special aquatic foraging areas: the Shelikof Strait area, the Bogoslof area, and the Seguam Pass area, as specified at 50 CFR §226.202(c).*

4.2.3 Western North Pacific DPS and Mexico DPS Humpback Whales

Humpback whales are found in all oceans of the world with a broad geographical range from tropical to temperate waters in the Northern Hemisphere and from tropical to near-ice-edge waters in the Southern Hemisphere.

Additional information on humpback whale biology and natural history is available at:

https://www.fisheries.noaa.gov/species/humpback-whale
http://alaskafisheries.noaa.gov/pr/humpback
https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock

4.2.3.1 Status and Population Structure

In 1970, the humpback whale was listed as endangered worldwide, under the Endangered Species Conservation Act (ESCA) of 1969 (35 FR 18319; December 2, 1970), primarily due to overharvest by commercial whalers. Congress replaced the ESCA with the ESA in 1973, and humpback whales continued to be listed as endangered, and were considered “depleted” under the MMPA.

Following the cessation of commercial whaling, humpback whale numbers increased. NMFS conducted a global status review (Bettridge et al. 2015), and after analysis and extensive public review, NMFS published a final rule on September 8, 2016 (81 FR 62260) recognizing 14 DPSs. Four of these were designated as endangered and one as threatened, with the remaining nine not warranting ESA listing status.

Based on an analysis of migration between winter mating/calving areas and summer feeding areas using photo-identification, Wade et al. (2016) concluded that whales feeding in Alaskan waters belong primarily to the Hawaii DPS (recovered), with small numbers from the Western North Pacific DPS (endangered) and Mexico DPS (threatened) individuals. In Cook Inlet (which is considered part of the Gulf of Alaska summer feeding area), we consider Hawaii DPS individuals to comprise 89 percent of the humpback whales present, Mexico DPS individuals to comprise 10.5 percent, and Western North Pacific DPS individuals to comprise 0.5 percent (Table 13).

Approximately 1,059 animals (CV=0.08) comprise the Western North Pacific DPS (Wade et al. 2016). The population trend for the Western North Pacific DPS is unknown. Humpback whales in the Western North Pacific remain rare in some parts of their former range, such as the coastal waters of Korea, and have shown little signs of recovery in those locations. The Mexico DPS is threatened, and is comprised of approximately 3,264 animals (CV=0.06) (Wade et al. 2016) with an unknown, but likely declining, population trend (81 FR 62260). The Hawaii DPS is not listed under the ESA, and is comprised of 11,398 animals (CV=0.04). The annual growth rate of the Hawaii DPS is estimated to be between 5.5 and 6.0 percent.

Whales from these three DPSs overlap on feeding grounds off Alaska, and are visually indistinguishable unless individuals have been photo-identified on breeding grounds and again on feeding grounds. All waters off the coast of Alaska may contain ESA-listed humpbacks.

Table 13. Probability of encountering humpback whales from each DPS in the North Pacific Ocean (columns) in various feeding areas (on left). Adapted from Wade et al. (2016).

Summer Feeding Areas	North Pacific Distinct Population Segments			
	Western North Pacific DPS (endangered)[1]	**Hawaii DPS (not listed)**	**Mexico DPS (threatened)**	**Central America DPS (endangered)[1]**
Kamchatka	100%	0%	0%	0%
Aleutian I/ Bering/ Chukchi Seas	4.4%	86.5%	11.3%	0%
Gulf of Alaska	0.5%	89%	10.5%	0%
Southeast Alaska / Northern BC	0%	93.9%	6.1%	0%
Southern BC / WA	0%	52.9%	41.9%	14.7%
OR/CA	0%	0%	89.6%	19.7%

[1] For the endangered DPSs, these percentages reflect the 95% confidence interval of the probability of occurrence in order to give the benefit of the doubt to the species and to reduce the chance of underestimating potential takes.

4.2.3.2 Distribution

Humpback whales generally undertake seasonal migrations from their tropical calving and breeding grounds in winter to their high-latitude feeding grounds in summer, although some individuals may remain in Alaska waters year-round. Most humpbacks that feed in Alaska winter in temperate or tropical waters near Mexico, Hawaii, or in the western Pacific near Japan. In the spring, those animals migrate back to Alaska, where food is abundant. They tend to concentrate in several areas, including Southeast Alaska, Prince William Sound, Kodiak, the mouth of Cook Inlet, and along the Aleutian Islands (Ferguson et al. 2015).

Humpback whales occur throughout the central and western Gulf of Alaska from Prince William Sound to the Shumagin Islands. Seasonal concentrations are found in coastal waters of Prince William Sound, Barren Islands, Kodiak Archipelago, Shumagin Islands, and south of the Alaska Peninsula. Large numbers of humpbacks have also been reported in waters over the continental shelf, extending up to 100 nm offshore in the western Gulf of Alaska (Wade et al. 2016).

Presence in Cook Inlet

Humpback whales have been observed throughout Cook Inlet, however, they are primarily seen in lower and mid Cook Inlet. During the NMFS aerial beluga whale surveys between 1993 and 2016, there were 88 sightings of an estimated 192 individual humpback whales (Figure 36), all of which occurred in the lower inlet (Rugh et al. 2000, Rugh et al. 2005, Shelden et al. 2013, Shelden et al. 2015a, Shelden et al. 2017). Additionally, during the 2013 marine mammal monitoring program, marine mammal observers reported 29 sightings of 48 humpback whales (Owl Ridge 2014) at Cosmopolitan State well site #A-1 (on the eastern part of lower Cook Inlet, about six miles north of Ninilchik), and during the 2014 Apache seismic surveys in Cook Inlet (south of the action area), marine mammal observers reported six individuals (Lomac-MacNair 2014).

Recent studies and monitoring events have also documented humpback whales further north in Cook Inlet, indicating that humpbacks occasionally use the upper Inlet. Marine mammal monitoring conducted north of the Forelands in May and June of 2015 reported two humpback whales (Jacobs Engineering 2017). Shortly after these observations were made, a dead humpback was found in the same area, suggesting that this animal may have entered the area in a compromised state. PSOs observed two humpback whales near the mouth of Ship Creek, near Anchorage, in early September 2017 during dock renovation work (ABR 2017). In 2017, a dead humpback whale was seen floating in Knik Arm, finally beaching at Kincaid Park; necropsy results were inconclusive. Recent monitoring by Hilcorp in upper Cook Inlet during the CIPL project also included 3 humpback whale sightings near Ladd Landing, north of the Forelands (Sitkiewicz et al. 2018). Finally, in spring 2019, a young humpback whale stranded in Turnagain Arm (NMFS unpublished data).

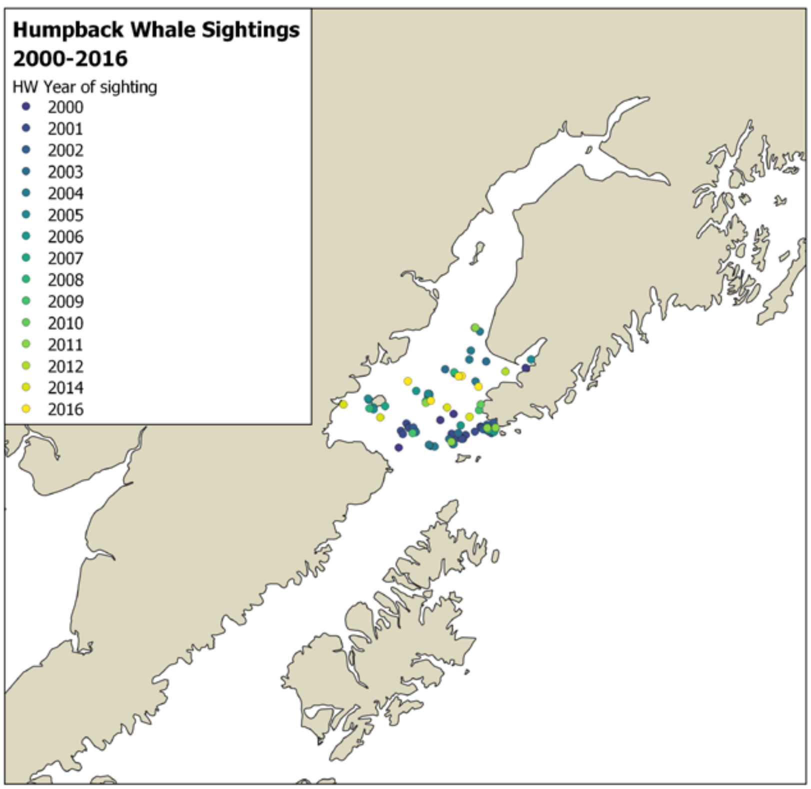

Figure 36. Humpback whale observations during aerial surveys for belugas in Cook Inlet, 2000-2016. (Rugh et al. 2000, Rugh et al. 2005, Shelden et al. 2013, Shelden et al. 2015a, Shelden et al. 2017)

Density data is not available for humpback whales in upper Cook Inlet. Sightings of humpback whales in the project area are rare. Few, if any, humpback whales are expected to approach the project area. However, there were two sightings in 2017 of what was likely a single individual at the Ship Creek boat launch (ABR 2017).

4.2.3.3 Feeding and Prey Selection

Humpback whales in the North Pacific forage in the coastal and inland waters along California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk (Tomilin 1967, Johnson and Wolman 1984). Of the four Biologically Important Areas (BIA) in the Gulf of Alaska described by (Ferguson et al. 2015) that are important feeding areas for humpback whales, Kodiak Island is the closest to the action area (Figure 37 and Figure 38).

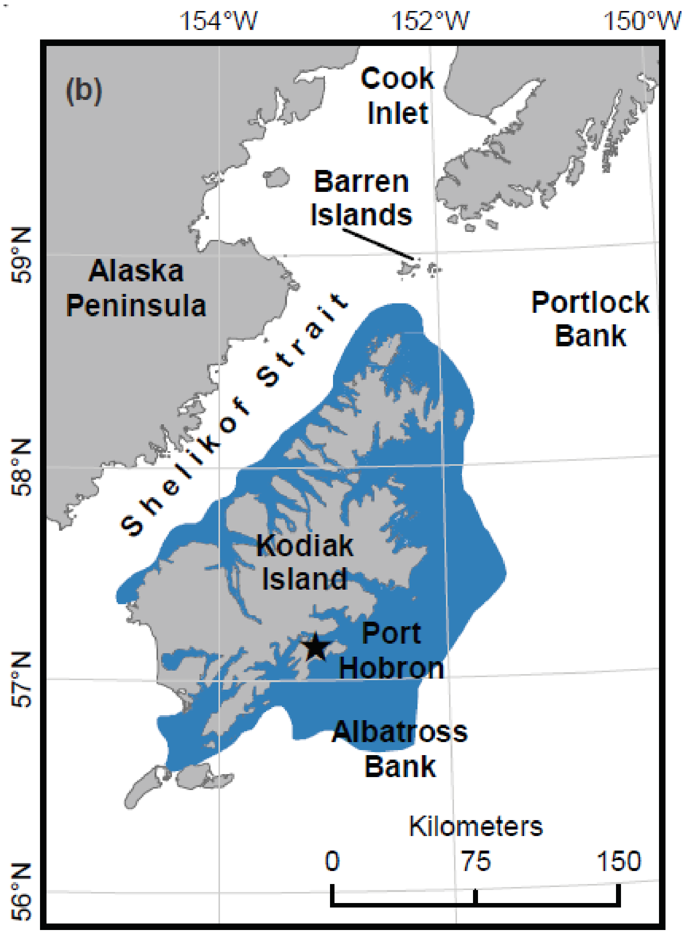

Figure 37. Seasonal humpback whale feeding BIA around Kodiak, near the mouth of Cook Inlet. During aerial surveys from 1999 to 2013, humpback whales were seen throughout the year in this area, with the greatest densities July-September (Ferguson et al 2015).

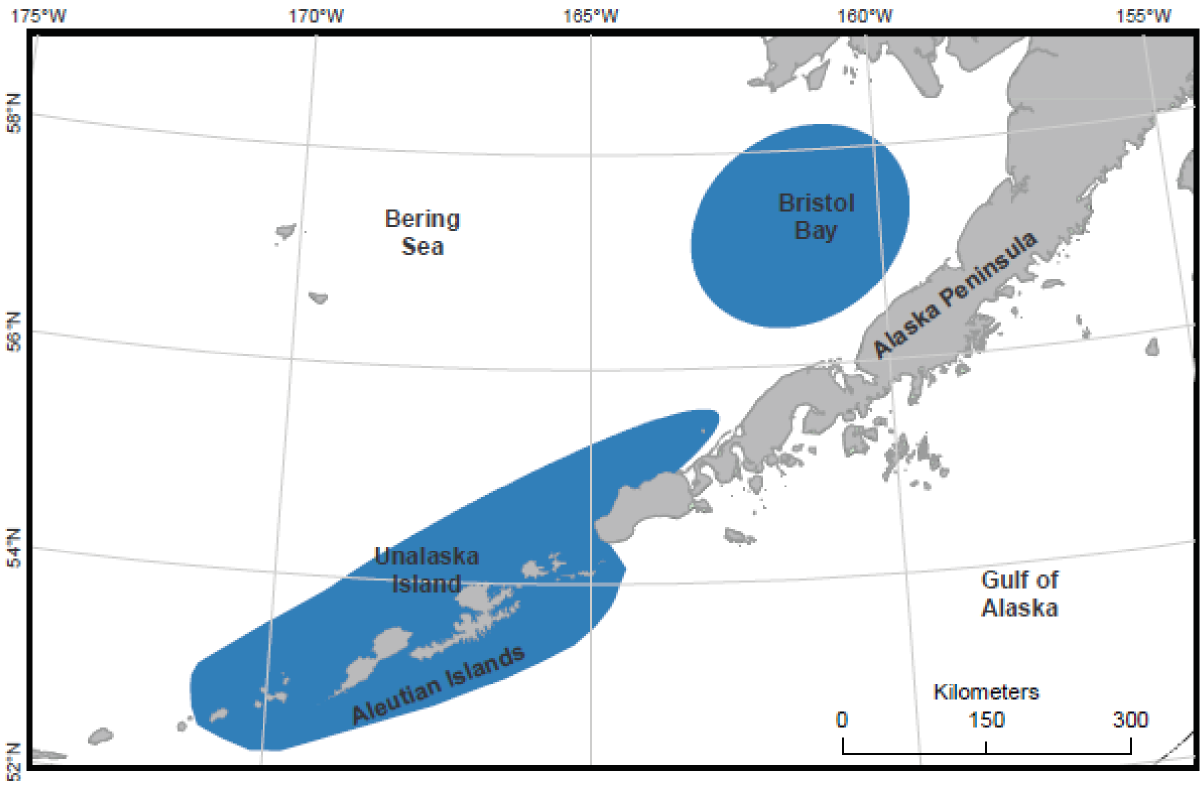

Figure 38. From Ferguson et al. 2015 (AI and BS; Figure 7.7). Humpback whale feeding BIAs, with highest densities from June through September; these BIAs were substantiated through satellite-tagging data, aerial- and vessel-based surveys, acoustic recordings, and photo-identification.

Their diverse diet is comprised of species including herring (*Clupea pallasii*), mackerel (*Scomber japonicus*), sand lance (*Ammodytes hexapterus*), juvenile walleye pollock (*Theragra chalcogramma*), capelin (*Mallotus villosus*), eulachon (*Thaleichthys pacificus*), Atka mackerel, Pacific cod (*Gadus microcephalus*), saffron cod (*Eleginus gracilis*), Arctic cod (*Boreogadus saida*), juvenile salmon (*Oncorhynchus* spp.), and rockfish (*Sebastes* spp.) (Hain et al. 1982, Baker 1985, Geraci et al. 1989).

Humpback whales exhibit flexible feeding strategies, sometimes foraging alone and sometimes cooperatively (Clapham 1993). In many locations, feeding in the water column can vary with time of day, with whales bottom feeding at night and surface feeding near dawn (Friedlaender et al. 2009). In the Northern Hemisphere, feeding behavior is varied and frequently features novel capture methods involving the creation of bubble structures to trap and corral fish; bubble nets, clouds, and curtains can be observed when humpback whales are feeding on schooling fish (Hain et al. 1982).

Humpback whales are ‘gulp’ or ‘lunge’ feeders, capturing large mouthfuls of prey during feeding rather than continuously filtering food, as may be observed in some other large baleen whales (Goldbogen et al. 2008, Simon et al. 2012). When lunge feeding, whales advance on prey with their mouths wide open, then close their mouths around the prey and trap them by forcing engulfed water out past the baleen plates.

4.2.3.4 Hearing, Vocalizations, and Other Sensory Capabilities

Because of the lack of captive subjects and logistical challenges of bringing experimental subjects into the laboratory, no direct measurements of mysticete hearing are available. Consequently, hearing in mysticetes is estimated based on other means such as vocalizations (Wartzok and Ketten 1999), anatomy (Ketten 1997, Houser et al. 2001), behavioral responses to sound (Edds-Walton 1997), and nominal natural background noise conditions in their likely frequency ranges of hearing (Clark and Ellison 2004). The combined information from these and other sources strongly suggests that mysticetes are likely most sensitive to sound from an estimated tens of hertz to ~10 kHz (Southall et al. 2007). However, evidence suggests that humpbacks can hear sounds as low as 7 Hz up to 24 kHz, and possibly as high as 30 kHz (Ketten 1997, Au et al. 2006). These values fall within the NMFS (NMFS 2018a) generalized low-frequency cetacean hearing range of 7 to 35 kHz.

Because of their size, no audiogram has been produced for humpback whales. However, Helweg et al. (2000) and Houser et al. (2001) modeled a predicted audiogram based on the relative length of the basilar membrane (within the inner ear) of a humpback whale, integrated with known data on cats and humans. The result (Figure 39) shows sensitivity to frequencies from about 700 Hz to 10 kHz, with maximum relative sensitivity between 2 to 7 kHz. Because ambient noise levels are higher at low frequencies than at mid frequencies, the absolute sound levels that humpback whales can detect below 1 kHz are probably limited by increasing levels of natural ambient noise at decreasing frequencies (Clark and Ellison 2004).

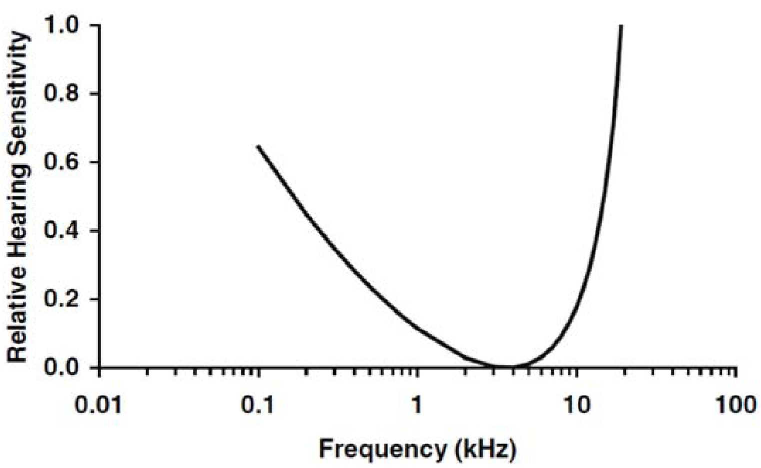

Figure 39. Predicted audiogram of humpback whale, derived by integrating the humpback frequency-position function with the sensitivity-position function derived from cat and human audiometric and anatomic data (Houser et al. 2001).

5. ENVIRONMENTAL BASELINE

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action areas that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR § 402.02).

This section discusses the environmental baseline, focusing on existing anthropogenic and natural activities within the action area and their influences on listed species and their critical habitat that may be adversely affected by the proposed action. Species and critical habitat that may be affected by the proposed action include Cook Inlet beluga whales, Cook Inlet beluga whale critical habitat, Western DPS humpback whales, Mexico DPS humpback whales, and Western DPS Steller sea lions. Although some of the activities discussed below are outside the action area, they may still have an influence on listed species or their habitat in the action area.

The listed species, as well as other resident marine mammal species, may be impacted by a number of anthropogenic activities present in Cook Inlet. Over 65 percent of Alaska's human population (737,080) resides within southcentral Alaska or the Cook Inlet region (Alaska Department of Labor and Workforce Development 2019). The high degree of human activity, especially within upper Cook Inlet, has produced a number of anthropogenic risk factors that marine mammals must contend with, including: coastal and marine development, oil and gas development, ship strikes, noise pollution, water pollution, prey reduction, direct mortalities, and research, in addition to factors operating on a larger scale such as predation, disease, and environmental change. The species may be affected by multiple threats at any given time, compounding the impacts of the individual threats. Anthropogenic risk factors are discussed individually below.

5.1 Coastal Development

Beluga whales and Steller sea lions use nearshore environments to rest, feed, and breed and thus could be affected by any coastal development that impacts these activities. Humpback whales mostly occupy areas offshore and are less likely to be affected by coastal development.

Alaska population projections anticipate about a 34 percent growth in the populations of Anchorage/Mat-Su and the Kenai Borough over the next 30 years (Robinson et al. 2018). As the population continues to grow, coastal development will continue to result in the loss of habitat, increased vessel traffic, increased pollutants, and increased noise associated with construction and maintenance activities. Any projects requiring Federal authorization or funding (e.g., Chuitna Coal Mine, Ocean Renewable Power Company Tidal Energy Projects, and future expansions at the POA beyond this consultation) will undergo section 7 consultation. However as the human population in the area increases, coastal development with uncertain impacts to Cook Inlet are likely to occur.

Some development has resulted in both the direct loss of habitat from construction of roads, housing, or other shoreline developments, and indirect loss associated with bridges, boat traffic, in-water noise, and discharges that affect water quality. Frequent use of shallow, nearshore, and estuarine habitats makes beluga whales and Western DPS Steller sea lions particularly prone to regular interaction with human activities (Perrin 1999), and thus the animals are likely to be affected by those activities.

While the majority of the Cook Inlet shoreline is undeveloped, there are municipalities, port facilities, airports, wastewater treatment plants, roads, mixing zones, and railroads that occur along or close to the shoreline (Figure 40). Knik Arm supports the largest port and military base in the state. Construction in Cook Inlet associated with coastal development includes dredging (e.g., at the Port of Alaska[8]), and pile driving (e.g., at the Port of Alaska, Ship Creek boat launch, Port MacKenzie, several small projects in the Kachemak Bay area), and oil and gas development. Significant construction projects in Cook Inlet are discussed in the following sections, many of which have undergone separate section 7 consultations. In this section, we describe the physical aspects of development; noise aspects of development are discussed in Section 5.3.

Anthropogenic activities related to coastal development may detrimentally affect Cook Inlet beluga critical habitat through loss or degradation of habitat and alterations in the availability of prey in critical habitat areas. Anthropogenic activities in the vicinity of Cook Inlet beluga critical habitat broadly include dredging; oil or gas activities; hard rock quarrying; laying of electrical, communication, or fluid lines; construction of docks, bridges, breakwaters, or other structures; and other activities. These activities may cause avoidance or destruction of an area used by prey as a result of anthropogenic disturbance. Permanent structures, such as docks, platforms, or bridges, can alter the habitat by altering local tidal flow. However, because anthropogenic structures may repel some species, but attract others, the net effect on prey species remains unknown (NMFS 2010).

Cities, villages, ports, airports, wastewater treatment plants, refineries, highways, and railroads are situated adjacent to areas designated as Cook Inlet beluga whale critical habitat. This development has resulted in the alteration of near shore beluga habitat and changes in habitat quality due to vessel traffic, noise, and pollution (NMFS 2008a, 2016b).

5.1.1 Road Construction

The Alaska Department of Transportation undertook Seward Highway improvements from Mile 75 to 107 (along Turnagain Arm) beginning in 2015. These activities included geophysical and geotechnical testing, on-shore blasting, pile removal, and installation at stream crossings, fill placed into Turnagain Arm to facilitate roadway straightening, and construction of a boat ramp at

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[8] The Anchorage Assembly voted Oct. 24, 2017 to rename the Port of Anchorage as the Port of Alaska in a move to emphasize the importance of the infrastructure to the entire state rather than just its largest city.

Windy Point. This also includes resurfacing 15 miles of roadway, straightening curves, installing new passing lanes and parking areas, and replacing 8 existing bridges along the Seward Highway between mileposts 75 and 90.

During geotechnical activities, beluga whales were observed on 15 of the 16 days of monitoring at Twentymile Bridge from April 6 to April 23, 2015. Even though no in-water activities occurred at night (at Twentymile Bridge), roadway flaggers present throughout the night indicated they could hear beluga whales at the bridge site during nighttime hours. During the 2015 season, there were 18 observations of beluga whale groups, ranging in size from 3-30. Shutdowns typically occurred when beluga whales were at the mouth of Twentymile River to ensure the animals did not enter the harassment zone during in-water activities (HDR 2015). Frequent sightings of belugas at the mouth of the Twentymile River are consistent with 2018 observations reported by the Beluga Whale Alliance where, from August 10-Oct. 9, belugas were observed at the Twentymile River mouth on 12 of 22 occasions (Beluga Whale Alliance, unpublished data).

As of the end of 2019, three bridges had been replaced during Phase 1, with the final five planned for Phase 2 beginning in mid-2020. Replacing these bridges will include vibratory and impact pile installation and removal of both 24- and 48-inch piles. In-water work on this project will be avoided from May 15 to June 15 to avoid harassment of Cook Inlet beluga whales during the eulachon run, and any work conducted below mean high water (MHW) will require marine mammal monitoring by PSOs. In 2015, NMFS concurred that this Seward Highway Milepost 75 to 90 Bridge Replacement project (including mitigation measures) is not likely to adversely affect Cook Inlet beluga whales.

In 2015, NMFS concurred that the Seward Highway Milepost 105-107 Windy Corner project (including mitigation measures) is not likely to adversely affect Cook Inlet beluga whales. The project will realign the highway and the railroad along 3.2 km (2 mile) segment of the Seward Highway in the vicinity of Windy Corner. In-water work includes land-based blasting and continuous noise from fill placement. The start of this project has been delayed since the consultation was completed. According to the Alaska Department of Transportation website, this project is expected to start construction in the summer of 2021.

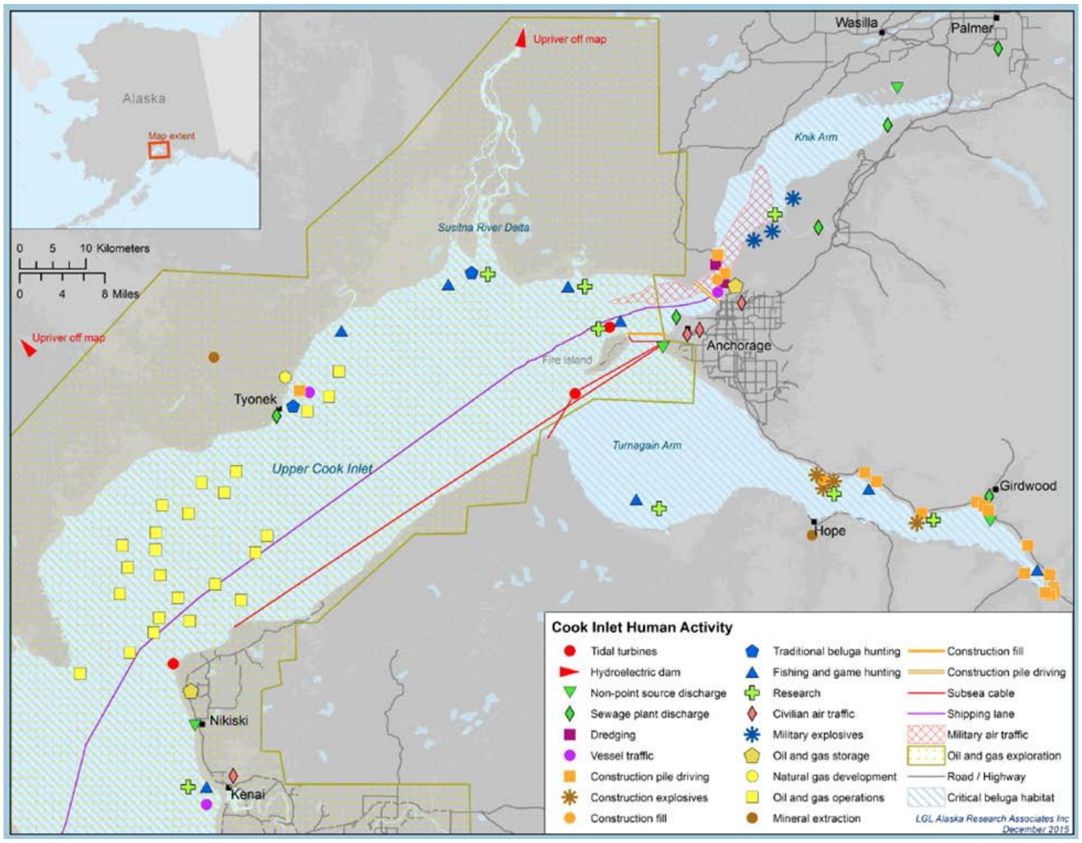

Figure 40. Development and anthropogenic activities in Cook Inlet (LGL 2015, unpublished data).

5.1.2 Port Facilities

Cook Inlet is home to port facilities at Anchorage, Point Mackenzie, Nikiski, Kenai, Homer, Seldovia, and Port Graham; barge landings are present at Tyonek, Drift River, and Anchor Point.

Anchorage has a small boat ramp near Ship Creek, which was renovated in 2017. It is the only hardened public access boat ramp in Upper Cook Inlet. However, numerous other boat launch sites (e.g., beach launch at Tyonek, Captain Cook State Recreation Area, City of Kenai boat launch, multiple boat launch locations near the mouth of the Kenai River, and Kasilof River State Recreation Site) provide Cook Inlet access to small boats.

Port of Alaska

The POA (i.e., Port of Anchorage at that time) Expansion Project (USACE 2009) included pile driving (including sheet and 36-in round piles) and dredging between 2008 and 2011. Cook Inlet beluga whales were listed under the ESA in October of 2008, therefore, ESA section 7 consultation covered work from 2009 through 2011. NMFS Permits Division authorized 34 takes of belugas per year of the project (there was no take issued for humpback whales or Steller sea lions). The POA reported that 40 beluga whales were observed within the designated 160 dB disturbance zones, and a single Steller sea lion was sighted at the facility (ICRC 2012). Table 11 includes a summary of beluga whale sightings.

In 2015, NMFS issued a Letter of Concurrence for section 7 consultation for the POA Terminal 3 repair (NMFS 2015). This project involved removal of a fender panel and installation of 2 24-in round piles. Mitigation measures were implemented to avoid take of marine mammals, therefore no take was authorized.

In 2016, NMFS issued a section 7 biological opinion for the POA's Test Pile Program (NMFS 2016a) to evaluate sound attenuation devices for potential use during port expansion projects, including the proposed action in this opinion. The NMFS Permits Division authorized 26 Level B harassment takes for Cook Inlet belugas, and 6 Western DPS Steller sea lions. During the course of this project, belugas entered the Level B exclusion zone on 9 occasions. Only one 4-minute delay of start of operations was necessitated to avoid prohibited takes of belugas, and one authorized instance of Level B harassment occurred, affecting a single whale (Cornick and Seagars 2016).

In 2018, NMFS issued a Letter of Concurrence for section 7 consultation for the POA Fender Pile and Replacement Repair project (NMFS 2018d). This project included pile driving of 44 22-in round piles. Mitigation measures were implemented to avoid take of marine mammals, therefore no take was authorized. No sightings of protected species occurred during pile driving activities. However, on May 30, 2019, a small group of belugas were observed by the construction crew before in water work began. When the PSO arrived, they observed three adults traveling north and milling.

In 2019, NMFS completed a section 7 consultation for the South Floating Dock. The South Floating Dock will be used to stage and support small vessels, such as first responder rescue craft, small work skiffs, and tug boats. The South Floating Dock will be relocated from its existing location immediately south of the existing Petroleum Oil and Lubricants Terminal 2, to the southern extent of the South Backlands Stabilization Project, south of the new PCT. Depending on their condition and compliance with current design standards, the existing trusses, gangways, and pile caps will be relocated to the new site. The support and float guide piles will not be reused, and will be cut off at the mudline. A total of twelve 36-inch pipe piles will be installed to accommodate placement of the dock at its new location. In-water construction of the South Floating Dock was originally scheduled to occur in 2019, however, this work was not able to be completed. The South Floating Dock is currently scheduled for 2020 or 2021. The NMFS Letter of Concurrence (issued July 25, 2019) evaluated impacts to ESA-listed species if pile driving activities occurred in 2019 and did not take into consideration potential overlap of pile installation with the PCT project, therefore, with this new information NMFS expects to reinitiate consultation for the South Floating Dock. Additional mitigation measures may be included in the reinitiation process.

In 2020 the POA is applying for a Nationwide Permit 3, Maintenance (NWP3) for the POA Fender Pile Replacement and Repair Project. The purpose of the project is to replace 180 corroding and failing 22-inch pin piles within the POA's existing fendering system. Pre- and post-earthquake (2018) inspections have shown that these piles are in a state of imminent failure and require emergency repair. It has been determined through engineering evaluation that these piles are currently providing only 10 percent of the required resistance for safely berthing ships at the POA, presenting a substantial safety hazard and potential threat to commerce in Alaska. The fendering system is comprised of 107 fender assemblies each supported by two pin piles. A total of 23 fender assemblies were replaced in 2015 (described above, Terminal 3 Repair) and 2019 (described above, Fender Pile and Replacement Repair project). The POA plans to repair the remaining 84 fender assemblies via installation of 168. Shipping schedules - including cruise, cargo, fuel, cement, and military vessels - allow for only one or two fenders to be repaired each week, resulting in a maximum installation rate of 22 fenders (44 piles) per construction season. At that rate, it is estimated that future repairs will take up to five years to complete, including one contingency year. Work may begin as early as May 2020, however, NMFS has not yet received request for consultation from the USACE.

In order to reinforce each fender assembly, a 22-inch pile would be installed inside of each existing 24-inch pile up to a 45-foot embedment depth using an impact and/or vibratory hammer. Installing the new pile within the existing pile would reduce noise impacts and the potential for incidental dock damage during maintenance. For piles that are determined to be in extremely poor condition or that have already failed, a diving Contractor would be mobilized to the site to cut the pile off at the mudline and remove the non-embedded portion of the pile. This scenario may occur with 25 to 50 percent of the new piles. In-water work would include pile installation and fender repair within previously disturbed areas; no excavation or fill is associated with this project.

The U.S. Army Corps of Engineers has been conducting maintenance dredging annually at the Port of Alaska since 1965, and continues to do so throughout each year. The POA is dredged to the depth of minus 35 feet mean lower low water (MLLW). Dredged materials are dumped 3,000 feet abeam of the POA dock face at the Anchorage in-water disposal site. NMFS issued a Letter of Concurrence for their current USACE permit in 2017.

In 2018, NMFS issued a Letter of Concurrence for the POA to conduct transitional dredging at the existing Terminal facility and dredged material disposal offshore. These activities will provide the needed depths for berthing vessels at the PCT. Once the POA's dredging is complete the USACE will maintain dredging at this location.

Dredging operations also occur annually at the Ship Creek Boat Ramp, located approximately 1.4 km (0.8 mi) southwest of the POA PCT project location. The dredging at this site is accomplished in early May during minus 3 foot tides, and is usually accomplished in three to four days using heavy machinery. Dredging at the POA does not seem to be a source of re-suspended contaminants (USACE 2009), and belugas often pass near the dredge (USACE 2008, ICRC 2012, POA 2019b, USACE 2019). The POA's current permit and associated consultation are expiring and the POA has submitted a permit application to the USACE, however, NMFS has not yet received a request for consultation on the Ship Creek Boat Ramp dredging.

Port MacKenzie

Port MacKenzie is along western lower Knik Arm. Coastal development at this site began in 2000 with the construction of a barge dock. Additional construction and bulkhead repair activity has occurred since then; Port MacKenzie currently consists of a 152 m (500 ft.) bulkhead barge dock, a 366 m (1,200 ft.) deep draft dock with a conveyor system, a landing ramp, and more than 8,000 acres of adjacent uplands. Current operations at Port MacKenzie may include dry bulk cargo movement and storage, depending on the current state of the port and existing demand for its facilities. The seawall to this port has failed twice (in the winter of 2015-2016 and 2016-

2017), necessitating emergency pile driving and other repair measures to avoid additional loss of fill and damage to sheet piles. Emergency consultations occurred after much of the repair work had been completed. However, during April 2016, marine mammal monitoring occurred on site during pile driving operations. Observers recorded belugas in or near the pile driving exclusion zone on 12 occasions on 7 days from April 18-26. No pile driving was occurring during any of these close approaches, so no takes occurred and no shut-downs were ordered (LLC 2016).

Other Ports

The Drift River Terminal facility in Redoubt Bay is used primarily as a loading platform for shipments of crude oil. The docking facility there is connected to a shore-side tank farm and designed to accommodate tankers in the 150,000 deadweight-ton class. The Drift River Terminal had an original storage capacity of up to six million gallons of crude oil. In 2009, a volcanic eruption of Mt. Redoubt forced the evacuation of the terminal and a draw-down of oil stored on-site (Alaska Journal of Commerce 2009). Hilcorp bought the facility in 2012 and, after numerous improvements, partially reopened the facility to oil storage and tanker loading operations. As part of Hilcorp's Cook Inlet ITRs (NMFS 2019), Hilcorp plans on decommissioning the Drift River Terminal in 2023 if the pipeline between the Drift River Terminal and Christy Lee is planned to be abandoned prior to 2025.

Nikiski is home to several privately owned docks including the Offshore Systems Kenai (OSK). Activity at Nikiski includes the shipping and receiving of anhydrous ammonia, dry bulk urea, liquefied natural gas, sulfuric acid, petroleum products, caustic soda, and crude oil. In 2014, the Arctic Slope Regional Corporation expanded and updated its Rig Tenders Dock in Nikiski, in anticipation of increased oil and gas activity in Cook Inlet and to accommodate oil and gas development in the Chukchi and Beaufort seas.

Ladd Landing Beach, located near Tyonek, serves as public access to the Three Mile subdivision and a staging area for various commercial fishing sites in the area.

Western DPS Steller sea lions are affected by activities at ports throughout their range, especially where fish processing and noise overlap, such as in Kodiak harbor. Port activities in Homer, Port Graham, and Nikiski are most likely to affect Western DPS Steller sea lions. Kodiak harbor is not in the action area of this project.

Eley (2012) estimated that large ship port calls could increase by 40 percent (200 ships per year) with the construction of the Alaska Liquefied Natural Gas (LNG) pipeline and full development of Port MacKenzie and Ladd's Landing (Eley 2012).

5.2 Oil and Gas Development

Cook Inlet is estimated to have 500 million barrels of oil and over 19 trillion cubic feet of natural gas that are undiscovered and technically recoverable (Wiggin 2017). Schenk et al. (2015) determined that there may also be unconventional oil and gas accumulations in Cook Inlet of up to 637 billion cubic feet of gas and 9 million barrels of natural gas liquids. Unconventional oil and gas accumulations: (1) have Estimated Ultimate Recoveries generally lower than conventional wells, (2) have low permeability and porosity, (3) require artificial stimulation for primary production, most commonly by hydraulic fracturing, (4) have only local to no migration of hydrocarbons (source rocks are reservoirs or in close proximity to reservoirs), (5) have no well-defined trap or seal, (6) have variable water production, (7) are generally not buoyant upon water, (8) have few truly dry holes, (9) have abnormal pressures, and (10) are regional in extent.

Lease sales for oil and gas development in Cook Inlet began in 1959 (Alaska Department of Natural Resources 2014). Prior to the lease sales, there were attempts at oil exploration along the west side of Cook Inlet. By the late 1960s, 14 offshore oil production facilities were installed in upper Cook Inlet, indicating that most of the Cook Inlet platforms and much of the associated infrastructure is over 40 years old. Today, there are 17 offshore oil and gas platforms in Cook Inlet. Figure 41 shows the ongoing oil and gas activities in state waters as of May 2019. Active oil and gas leases in Cook Inlet total 211 leases encompassing approximately 450,412 acres of State leased land of which 311,265 acres are offshore (Alaska Department of Natural Resources 2020)[9] (Figure 42).

In 2017, BOEM held Lease Sale #244 in Cook Inlet (Figure 44). Hilcorp was the only company responding, submitting bids on 14 of 224 tracts/Blocks offered; their successful bids encompass 31,005 acres. In 2019, NMFS issued Incidental Take Regulations for Hilcorp's oil and gas activities in Cook Inlet (NMFS 2019), including seismic surveys, and other exploration and development activities within these blocks (Figure 44). These seismic surveys are discussed further below.

Kenai LNG Plant

The existing Kenai LNG liquefaction and terminal complex adjacent to the coast of Cook Inlet began operating in 1969. Until 2012, it was the only facility in the United States authorized to export LNG produced from domestic natural gas. With LNG shipments from the terminal declining, the terminal's owner announced in mid-2017 that it would put the plant in long-term shutdown, and the terminal has remained in warm-idle since 2015. In early 2019, however, the owners informed NMFS of their intention to bring the plant back into operation within the next few years.

Based on existing active leases and estimates of undeveloped oil and gas resources, oil and gas development will likely continue in Cook Inlet; however, the overall effects on listed marine mammals are unknown (NMFS 2008a, b). The Cook Inlet Beluga Recovery Plan identified potential impacts from oil and gas development including increased noise from seismic activity, vessel traffic, air traffic, and drilling; discharge of wastewater and drilling muds; habitat loss from the construction of oil and gas facilities; and contaminated food sources and/or injury resulting from an oil spill or natural gas blowout (NMFS 2016b).

[9] http://dog.dnr.alaska.gov/documents/leasing/periodicreports/lease_lasactiveleaseinventory.pdf; accessed 1/22/2020

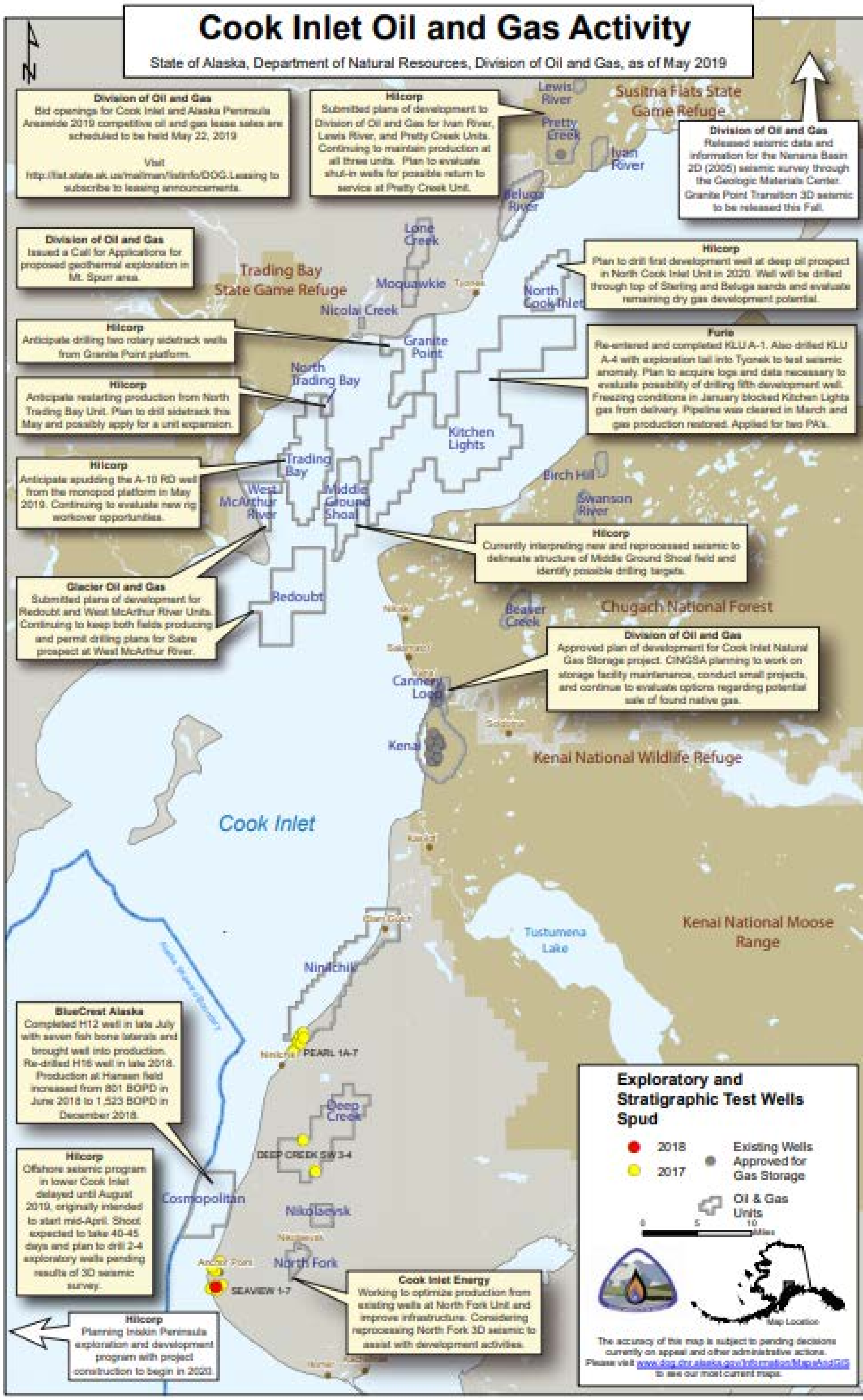

Figure 41. Oil and gas activity in Cook Inlet as of May, 2019.

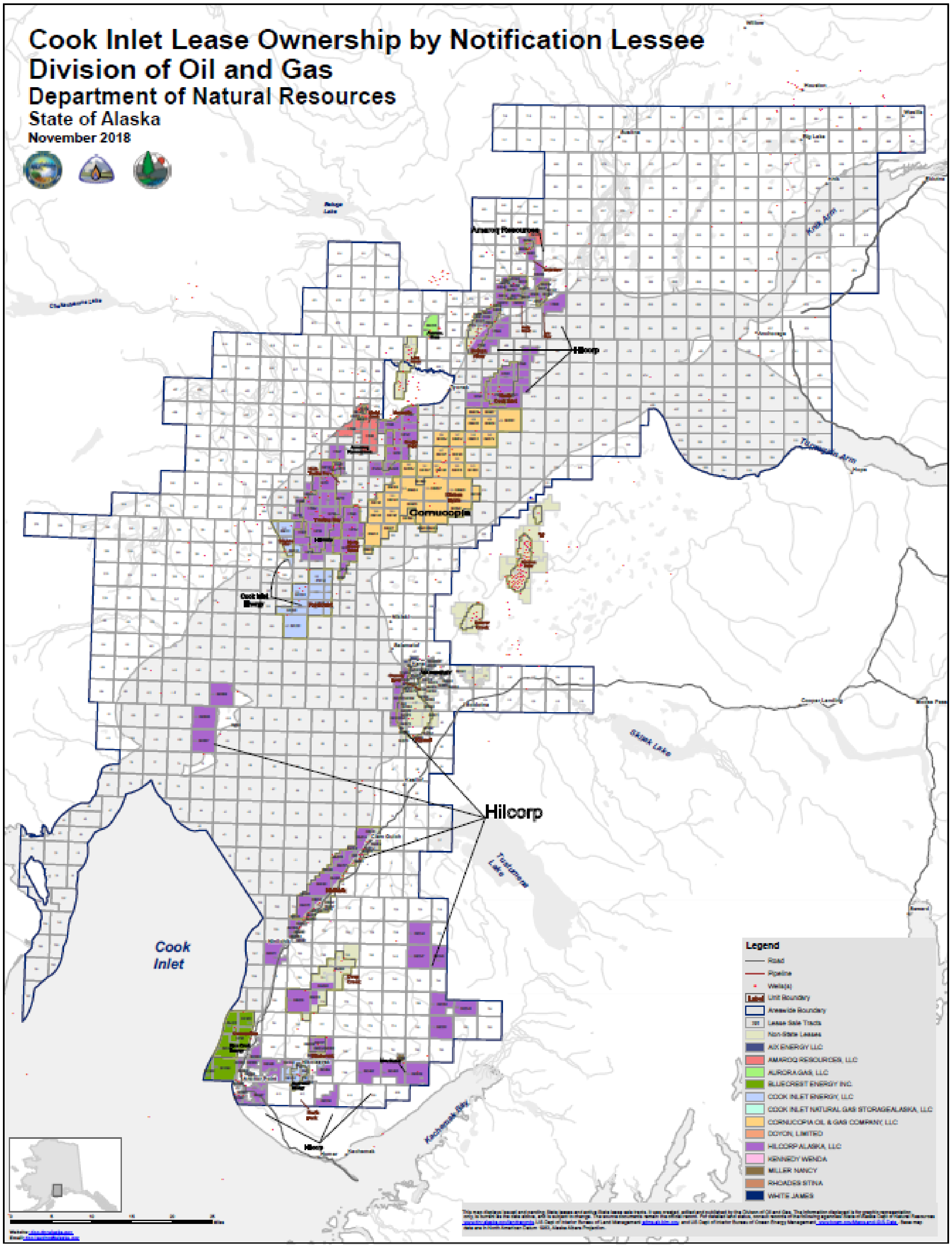

Figure 42. Cook Inlet Lease Ownership by Notification Lessee
http://dog.dnr.alaska.gov/Documents/Maps/CookInlet_NotificationLesseNov2018_Labeled.pdf

5.3 Underwater Installations

Pipelines are an essential part of oil and gas activities in Cook Inlet. There are numerous undersea pipelines in Cook Inlet, including oil and gas pipelines (Figure 43). The possibility of pipeline failures are always associated with oil and gas development, with the associated possibility of oil spills, gas leaks, or other sources of marine petrochemical contamination.

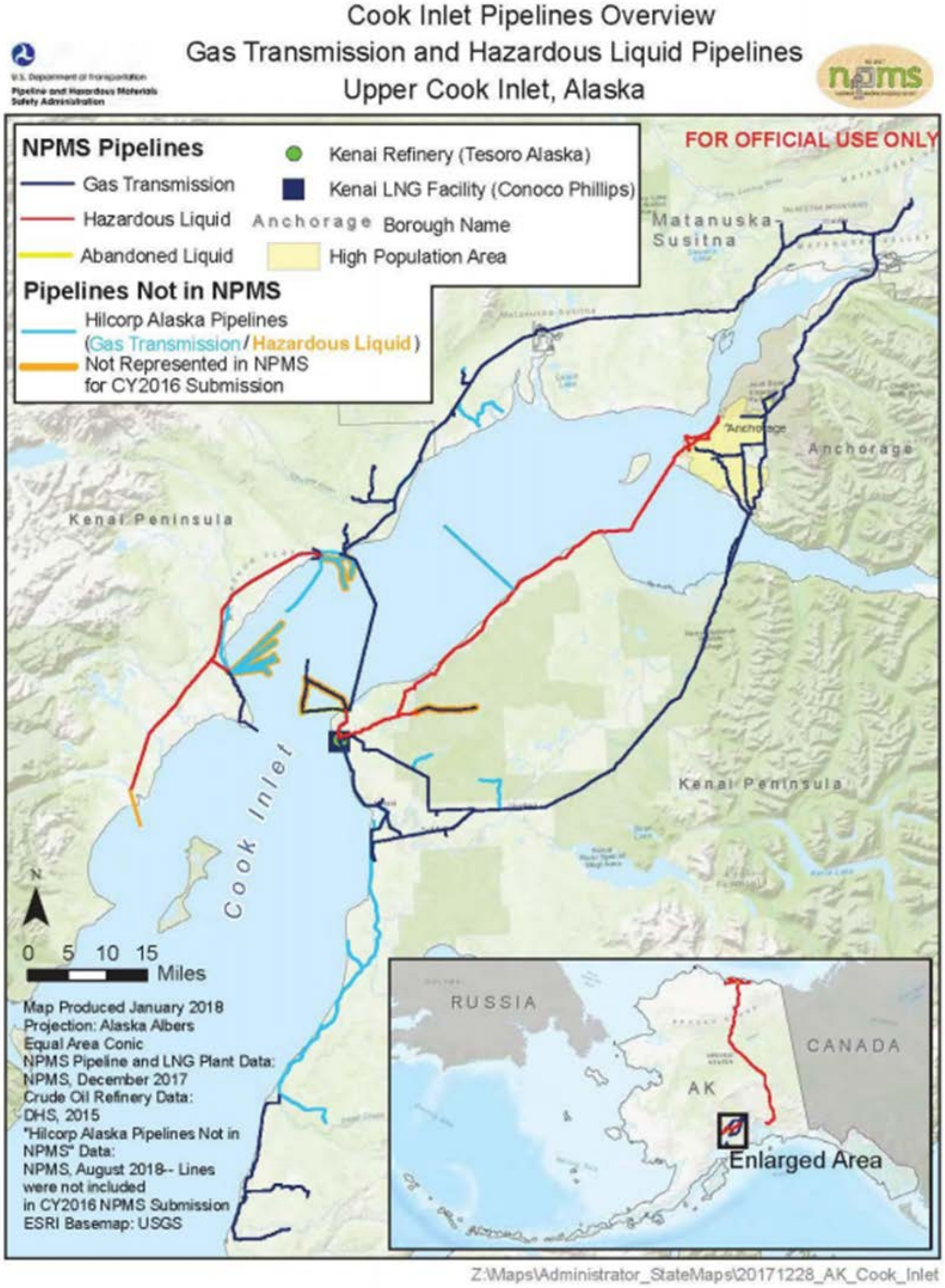

Figure 43. Pipelines in Cook Inlet.

Trans-Foreland Pipeline

In 2014, the Trans-Foreland Pipeline Co. LLC (owned by Tesoro Alaska) received approval from state, Federal (including NMFS section 7 AKR-2014-9394), and regional agencies to build the Trans-Foreland Pipeline, a 46.7-km (29-mi) long, 20.3-cm (8-in) diameter oil pipeline from the west side of Cook Inlet to the Tesoro refinery at Nikiski and the Nikiski-Kenai Pipeline company tank farm on the east side of Cook Inlet. The pipeline will be used by multiple oil producers in western Cook Inlet, to replace oil transport by tanker from the Drift River Tank farm. Horizontal directional drilling will be used at nearshore locations at the East and West Forelands to install the pipeline. This pipeline has not been constructed.

Hilcorp Cook Inlet Pipeline Cross Inlet Extension

In 2018, Hilcorp was issued an IHA to Harvest Alaska, LLC (Harvest), associated with their plans to extend their existing undersea pipeline network to connect their Tyonek platform to the land-based Tyonek/Beluga, Alaska, pipeline at a point about 4 miles (6.4 km) north of the village of Tyonek. The IHA authorized Hilcorp to incidentally take, by Level B harassment, 40 Cook Inlet beluga whales, 6 Steller sea lions, and 5 humpback whales (NMFS 2018c). This project was completed in 2018 (Sitkiewicz et al. 2018).

Alaska LNG Project

The Alaska LNG Project is being designed to carry natural gas from the North Slope to southcentral Alaska and for export internationally. Proposed infrastructure includes an 800-mile long, large diameter pipeline from the North Slope that would cross Cook Inlet north of the Forelands and terminate at a liquefaction facility proposed at the Nikiski area on the Kenai Peninsula. This project could eventually ship up to 2.4 billion cubic feet of LNG per day. The Alaska Gasline Development Corporation (AGDC) has applied for MMPA authorization for the Cook Inlet portion of the project, and the Federal Energy Regulatory Commission issued a Draft Environmental Impact Assessment in June 2018. The final authorizations, including the MMPA permits and ESA consultation, are expected in June 2020.

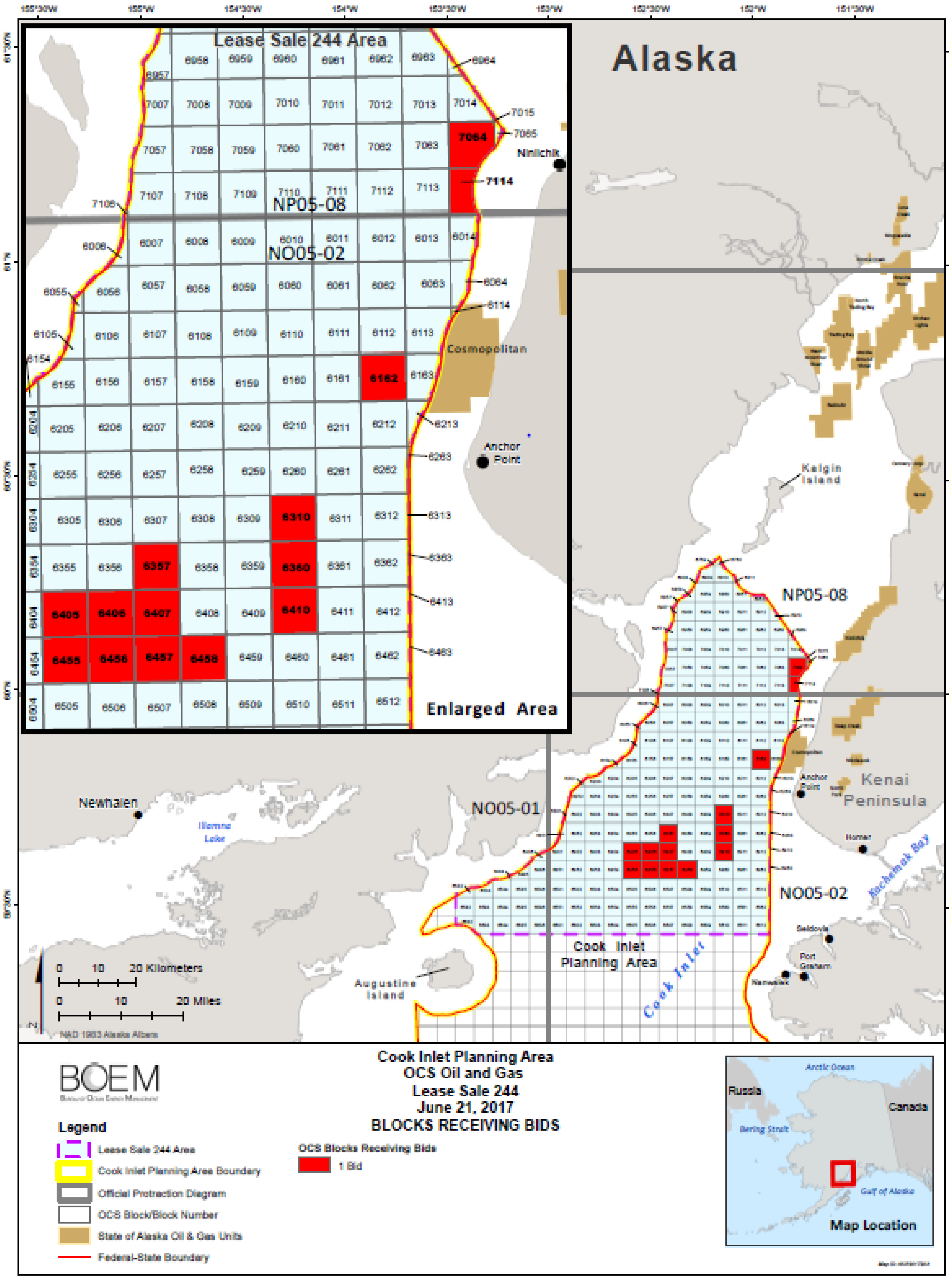

Figure 44. Lease Sale 244 blocks receiving bids.

5.4 Natural and Anthropogenic Noise

Because noise is a primary source of disturbance to marine mammals, and the category of disturbance most focused on in Incidental Harassment Authorizations, this opinion considers it as a separate category of the Environmental Baseline, although it is generally attributable to other factors in the Baseline, such as coastal development or oil & gas development.

Underwater sound in Cook Inlet is categorized as physical noise, biological noise, and human-caused noise. Natural physical noise originates from wind, waves at the surface, currents, earthquakes, ice movement, tidal currents, and atmospheric noise (Richardson et al. 1995). Tidal influences in Cook Inlet are a predominant contributor of physical noise to the acoustic environment (Burgess 2014, BOEM 2016).

Biological noise includes sounds produced by marine mammals (particularly whales and dolphins, but also pinnipeds), fish (Maruska and Mensinger 2009), and invertebrates (Chitre et al. 2005). Human-caused noise includes vessel motor sounds, oil and gas operations, maintenance dredging, aircraft overflights, construction noise, and infrastructure maintenance noise. Much of upper Cook Inlet is a poor acoustic propagation environment due to shallow depths and sand and mud bottoms. In general, ambient and background noise levels within the action area in Cook Inlet are assumed to be less than 120 dB whenever conditions are calm, and exceeding 120 dB during environmental events such as high winds and peak tidal fluctuations (Blackwell and Greene 2003, Illingworth & Rodkin 2014).

5.4.1 Seismic Surveys in Cook Inlet

Cook Inlet has a long history of oil and gas activities including seismic exploration, geophysical and geological (G&G) surveys, exploratory drilling, increased vessel and air traffic, and platform production operation. A seismic program occurred near Anchor Point, Alaska, in the fall of 2005. Geophysical seismic operations were conducted in Cook Inlet during 2007, near Tyonek, East and West Forelands, Anchor Point, and Clam Gulch. Additional small seismic surveys were conducted in Cook Inlet during 2012. From 2013 to 2015 approximately 3,367 km^2 (1,300 mi^2) of three-dimensional (3D) and 40,000 km (25,000 mi) of two-dimensional (2D) seismic line surveys have been conducted in Cook Inlet (Figure 45). A large seismic program took place in 2013 and 2014; data were collected between Anchorage and Anchor Point. Another large seismic survey took place in 2015 and 2016 in Cook Inlet between Beluga, Alaska, and across Cook Inlet to Salamatof, Alaska, and along the eastern inlet between Kalifornsky, Alaska, and south to Anchor Point. More recently, Hilcorp conducted a 3D seismic survey in lower Cook Inlet in September 2019.

Seismic surveys use high energy, low frequency sound in short pulse durations to characterize subsurface geology (Richardson et al. 1995), often to determine the location of oil and gas reserves. Geophysical seismic activity has the potential to harass or harm marine mammals (Nowacek et al. 2015), including beluga whales.

In the past, large airgun arrays of greater than 3,000 in^3 were used for seismic exploration in Cook Inlet; these can produce source noise levels exceeding 240 dB re 1 μPa rms. However, smaller arrays are now being used in Cook Inlet because of the generally shallow water environment and the increased use of ocean-bottom cable and ocean-bottom node technology (Rigzone 2012). Seismic surveys in Cook Inlet have used maximum airgun arrays of 1,760 and 2,400 in^3 with source levels of about 237 dB re 1 μPa_{RMS}. Shallow water surveys have involved 440, 620, and 880 in^3 arrays with source sound pressure levels less than 230 dB re 1 μPa_{RMS}. Measured radii to Level B (160 dB) harassment isopleths have ranged from 3 to 9.5 km (1.8-5.9 mi).

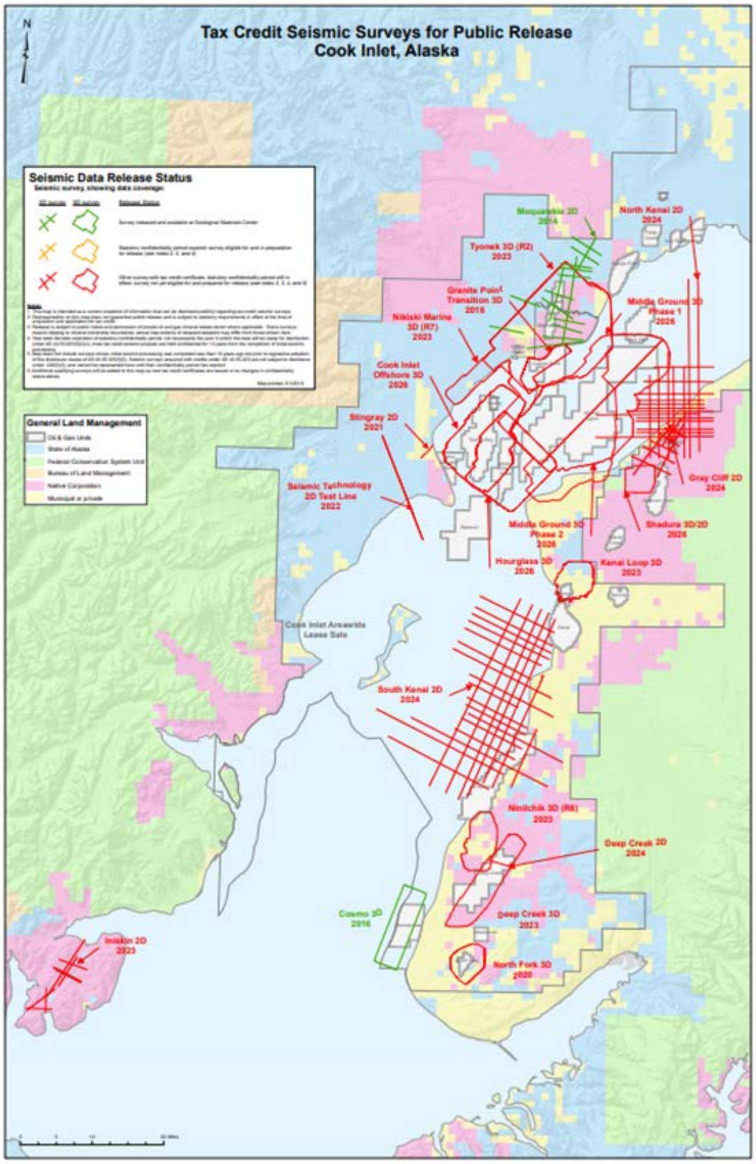

Figure 45. Seismic surveys in Cook Inlet. Dates indicate year technical data is scheduled for release. [10]

[10] http://dog.dnr.alaska.gov/Documents/Programs/CookInletTaxCreditSeismicData.pdf

Apache Seismic Exploration (2012-2014)
During over 1,800 hours of seismic activity in 2012, Apache Alaska Corporation (Apache) reported zero takes of either beluga whales or Steller sea lions; although some protected marine mammals were observed within zones ensonified to greater than 120 and 160 dB prior to powering down or shutting down of equipment. The company experienced five delays resulting from clearing the 160 dB disturbance zone, six shutdowns, one power-down, one shutdown followed by a power-down, and one speed and course alteration (Lomac-MacNair et al. 2013). In 2014, however, despite implementing a total of 13 shut-downs and 7 ramp-up delays for marine mammals, observers recorded a total of 29 takes (12 beluga whales, 6 harbor porpoise, 9 harbor seals, and 2 humpback whales) from noise exposures (25 at ≥160 dB_{RMS} and 4 at ≥180 dB_{RMS}) (Lomac-MacNair 2014). Also during Apache's 2014 operations, four groups of beluga whales occurred less than 500 m from the Apache source vessel during seismic operations (0.0014 groups per hour of effort x 3,029.2 total hours of observation effort) (Lomac-MacNair et al. 2014). The report does not state whether seismic guns were firing at this time. If these close approaches by belugas occurred during operation of the 1,760 in^3 airgun array that was being used, that would represent 4 groups of belugas (of unstated group size) subjected to Level A take (Level A take isopleth for 1,760 in^3 array for cetaceans = 1,840 m). This report mistakenly indicates there were no Level A takes of Cook Inlet beluga whales in that year because mitigation actions were taken immediately upon observation of whales in this zone. However, by the time the whales were observed, unauthorized take had already occurred.

NMFS is aware of at least one humpback whale having been observed and possibly taken in upper Cook Inlet (by harassment and/or injury) by Apache's seismic operations on April 25, 2014, by the M/V *Peregrine Falcon* operating a 1,760 in^3 airgun array at full volume. The humpback whale was first observed 1.5 km (0.9 mi) from the sound source at a time when all whales within 1.84 km (1.1 mi) of the sound source would have been exposed to MMPA Level A take (sound impulses in excess of 180 dB). Although seismic operations were shut down immediately after observing this animal, the whale apparently was exposed to full volume seismic impulses during the time it transited from 1.84 km to 1.5 km (1.1 mi to 0.9 mi) from the sound source. Assuming seismic shots were fired at 15 second intervals and assuming the whale traveled directly towards the source at the average cruising speed of a humpback whale (4.0 km/hour [2.5 mi/hour]) (Noad and Cato 2007), then this whale would have been exposed to at least 19 shots while it was within the exclusion zone prior to shut-down; 19 shots exceeding the 180 dB threshold for Level A take[11].

SAE 3D Seismic Exploration (2015)
Seismic operations took place in upper Cook Inlet; they began on 15 May 2015, and continued until 27 September 2015. Eight vessels operated during the surveys including two seismic source vessels, the M/V *Arctic Wolf* and M/V *Peregrine Falcon*, and one mitigation vessel, the M/V *Westward Wind*. Seven PSOs were stationed on the source and mitigation vessels, including two

[11] This project occurred prior to the issuance of the new Level A guidance (NMFS 2018a), and references the old 180/190 Level A thresholds.

on each source vessel, and three on the mitigation vessel. PSOs monitored from the vessels during all daylight seismic operations and most daylight non-seismic operations.

One trained passive acoustic monitoring (PAM) operator was stationed on a vessel to conduct monitoring during nighttime hours using a dipping or over-the-side hydrophone.

A total of 932 sightings (i.e., groups) of approximately 1,878 individual marine mammals were visually observed from 15 May through 27 September 2015. Harbor seals were the most commonly observed species with 823 sightings (~ 1,680 individuals), followed by harbor porpoises with 52 sightings (~65 individuals), sea otters with 29 sightings (~79 individuals), and beluga whales with eight sightings (~33 individuals). Large whale sightings consisted of three humpback whale sightings (~3 individuals), one minke whale sighting (1 individual), and one unidentified large cetacean. Other observations include one killer whale sighting (~2 individuals), one Dall's porpoise, four Steller sea lions, two unidentified dolphins/porpoise, five unidentified pinnipeds, and two unidentified marine mammals.

Passive acoustic monitoring occurred from 1 July through 27 September and yielded a total of 15 marine mammal acoustic detections including two beluga whale and 13 unidentified porpoise. Nine detections occurred during seismic activity and six occurred during non-seismic activity. There were no acoustic detections of baleen whales or pinnipeds.

Of these visual observations and acoustic detections, 207 marine mammals were confirmed within both the Level A (190 and 180 dB) and B (160 dB) exposures zones, resulting in 194 Level B and 13 Level A exposures (Kendall et al. 2015).

Species composition of animals known to occur within the Level B exposure zone, through visual observations, included harbor porpoises, a Steller sea lion, harbor seals, and an unidentified large cetacean. An additional two beluga whales and one unidentified porpoise were acoustically detected within the Level B exposure zone. Marine mammals observed within the Level A exposure zone included harbor porpoises, a Steller sea lion, and harbor seals.

Additional takes were avoided due to the 70 sightings that occurred during clearing the disturbance zone, 14 sightings that occurred during ramp-up, and the 18 shut downs that were implemented because of these sightings. No power downs or speed/course alterations were performed due to marine mammal sightings (Kendall et al. 2015).

Hilcorp 3D Seismic – Lower Cook Inlet, OCS (2019)

Hilcorp conducted a 3D seismic survey from September 10-October 17, 2019 in Lower Cook Inlet, comprised of approximately 790 square kilometers (km^2) over 8 Outer Continental Shelf (OCS) lease blocks (Figure 44). The seismic survey included four vessels: one source, two support, and one for marine mammal mitigation. PSOs were stationed onboard the source (Polarcus *Alima*) and mitigation (R/V *Q105*) vessels. Daily aerial surveys were conducted with a fixed- wing, high-wing P68C aircraft based in Homer, Alaska, that flew east-west transects over the seismic activity area. The sightings during the seismic project are presented in Table 14.

Table 14. Sightings of ESA-listed marine mammals during Hilcorp's 2019 seismic surveys in Lower Cook Inlet.

ESA-listed species	# of sightings[1]	Estimated # of Individuals[2]	Project Level B Exposures[4]
Fin whale	8	23	10.9
Humpback whale[3]	14	38	31.5
Beluga whale	2	2	0
Steller sea lion	5	5	4.9

[1] One sighting equals one group.
[2] Totals do not include re-sightings.
[3] Includes both Western North Pacific and Mexico DPS.
4 Based on actual take + estimated take.

5.4.2 Oil and Gas Exploration, Drilling, and Production Noise

The greatest noise levels from drilling platforms originate from operating noises from the oil platform, not from the noise generated by drilling, with frequencies generally below 10 kHz. In general, noise from the platform itself is thought to be very weak because of the small surface area (the four legs) in contact with the water (Richardson et al. 1995) and that the majority of the machinery is on the deck of the platform, which is above the water surface. However, noise carried down the legs of the platform likely contributed to the higher noise levels than anticipated (Blackwell and Greene 2003). Blackwell and Greene (2003) recorded underwater noise produced at Phillips A oil platform (now the Tyonek platform) at distances ranging from 0.3 to 19 km (0.2 to 12 mi) from the source. The highest recorded sound level was 119 dB at a distance of 1.2 km (0.75 mi). Noise between two and 10 kHz was measured as high as 85 dB as far out as 19 kilometers from the source. This noise is audible to beluga, humpback, and fin whales and Steller sea lions.

<u>AK LNG (2016)</u>
In 2016, ExxonMobil Alaska LNG LCC (EMALL) conducted geophysical and geotechnical surveys in Upper Cook Inlet, including within the Susitna Delta Exclusion Zone (SUDEX), under the terms of an IHA and biological opinion issued by NMFS. Operations involving G&G equipment did not occur within the SUDEX between 15 April and 15 October, 2016. PSOs monitored for all marine mammals prior to and during all vessel movements when vessels were under power within the SUDEX. A total of 3 marine mammal sightings consisting of 5 estimated individuals were seen within the SUDEX. These included 2 sightings of beluga whales (4 individuals), and 1 sighting of a single harbor seal. The two beluga whale sightings occurred greater than 700 m from the vessel outside of the harassment zone for that project activity (vessel movement). All marine mammal sightings in the SUDEX occurred during non-operational periods (i.e. when no vibracore operations were occurring) (Smultea Environmental Sciences 2016).

Furie Exploration Drilling (2017)
Within the Kitchen Lights Unit (KLU) of Cook Inlet, Furie intends to drill up to nine wells between 2017 and 2021. The KLU is an offshore lease area of 83,394 acres, north of the East Foreland and south of the village of Tyonek in Cook Inlet, Alaska.

The Furie KLU drilling have the potential to affect the endangered Cook Inlet beluga whale, the endangered Western North Pacific DPS humpback whale, the threatened Mexico DPS humpback whale, the endangered Western DPS Steller sea lion, the endangered fin whale, and designated critical habitat for Cook Inlet beluga whales and Steller sea lions.

Actions associated with Furie's proposed activity include transport of a jack-up rig, the *Randolph Yost*, by up to three tugs to the drilling sites, high-resolution geophysical surveys, pile driving at each drilling location, drilling operations, vessel and air traffic associated with rig operations, fuel storage, and well completion activities. NMFS completed consultation on this action in 2017 (NMFS 2017a). No take is anticipated or authorized for 2017 operations. However, subsequent activities will require MMPA authorization.

Hilcorp Oil and Gas
In addition to the seismic survey discussed above, the Hilcorp Incidental Take Regulations issued in 2019 included oil and gas exploration, development, production, and decommissioning activities in Cook Inlet, Alaska between June 1, 2019 and June 1, 2024. Hilcorp plans to conduct the exploratory drilling program April to October between 2020 and 2022. The exact start date is currently unknown and is dependent on the results of the seismic survey, geohazard survey, and scheduling availability of the drill rig. It is expected that each well will take approximately 40 to 60 days to drill and test. Beginning in spring 2020, Hilcorp plans to possibly drill two and as many as four exploratory wells, pending results of the 3D seismic survey in the lower Cook Inlet OCS leases. After testing, the wells may be plugged and abandoned.

5.4.3 Construction and Dredging Noise

Pile driving and dredging are the primary sources of construction noise in Cook Inlet. The Port of Alaska is dredged annually and construction noise from pile driving is the primary noise source from the proposed activities in this opinion.

Port MacKenzie, located just two miles away across Cook Inlet, has also undergone recent renovations and multiple emergency repairs requiring pile driving, including removal and installation of sheet piles (NMFS 2017b).

The majority of such construction activities have taken place near Anchorage. Therefore, most of the studies documenting construction noise in Cook Inlet have occurred within the action area. These studies have focused almost exclusively on pile driving because of the concerns of potential harassment to beluga whales from this activity. As a result there is very little to no documentation of noise levels from other construction activity in Cook Inlet. Only a few studies have recorded dredging noise near the POA (USACE-DOER 2001, URS 2007).

Small and/or private docks also may utilize pile driving as a part of their expansions or repairs (e.g., the OSK dock in Nikiski was approved to be upgraded and expanded in 2012). Repair of sewage lines and construction of dock facilities occurred during the time that this project took place; activities that introduced noise to the marine environment. However, there was no documentation of noise levels from this repair work.

5.4.4 Vessel Traffic Noise

Cook Inlet is a regional hub of marine transportation throughout the year, and is used by various classes of vessels, including containerships, bulk cargo freighters, tankers, commercial and sport-fishing vessels, and recreational vessels. Vessel traffic density in Cook Inlet is concentrated along the eastern margin of the Inlet between the southern end of the Kenai Peninsula and north to Anchorage (Figure 46). Oil produced on the western side of Cook Inlet is transported by tankers to the refineries on the east side. Decommissioning of the Drift River Terminal (included as a component activity covered by the Hilcorp ITRs) would eliminate one substantial source of tanker traffic in Cook Inlet.

Two of the vessels that make regular calls to the POA, the *Midnight Sun* and the *North Star*, are 53,000-horsepower, 839-foot cargo ships that pass through Cook Inlet at 15 to 20 knots four times per week, equaling 208 transits per year (Eley 2012). Blackwell and Greene (2003) observed that beluga whales “did not seem bothered” when the whales were travelling slowly within a few meters of the hull and stern of the moored cargo-freight ship *Northern Lights* in the Anchorage harbor area. They speculated that in areas where belugas are subjected to a lot of (perennial) boat traffic, they may habituate and become tolerant of the vessels. However, noises from ships and other activities in Cook Inlet area may cause a decrease or cessation of beluga vocalizations, or mask their vocalizations (Castellote et al. 2015).

Blackwell and Greene (2003) recorded underwater noise produced by both large and small vessels near the POA. The tugboat *Leo* produced the highest broadband levels of 149 dB re: 1 μPa at a distance of approximately 100 m (328 ft), while the docked *Northern Lights* (cargo freight ship) produced the lowest broadband levels of 126 dB re: 1 μPa at 100 to 400 m (328-1,312 ft). Continuous noise from ships generally exceeds 120 dB re 1 μPa_{RMS} to distances between 500 and 2,000 m (1,640 and 6,562 ft), although noise effects are short term as the vessels are continuously moving (BOEM 2017).

Steller sea lions and humpback and fin whales may exhibit varying reactions to the presence of vessels, ranging from attraction (especially if animals are habituated to vessels as a source of food) to avoidance. Some vessels, such as tugs towing barges or oil rigs, can produce sound capable of harassing marine mammals located over 2 km from the source (Jacobs Engineering 2017).

Shipping and transportation may affect Cook Inlet beluga critical habitat through the effects of noise, physical disturbance, and discharge (accidental and illegal) of oil, fuel, or other toxic substances carried by ships. The physical disturbance and noise associated with shipping and transportation activities could displace beluga prey species from preferred habitat areas that contain the features essential for the species, or that alter the quantity and/or quality of these essential features (NMFS 2014, 2016b). In the event of an oil spill, habitats could become oiled, and the quantity and/or quality of primary prey resources could be adversely affected. Vessel traffic and tourism encroachment in critical habitat areas could disturb and displace Cook Inlet belugas and/or their prey species, resulting in reduced conservation value of the critical habitat.

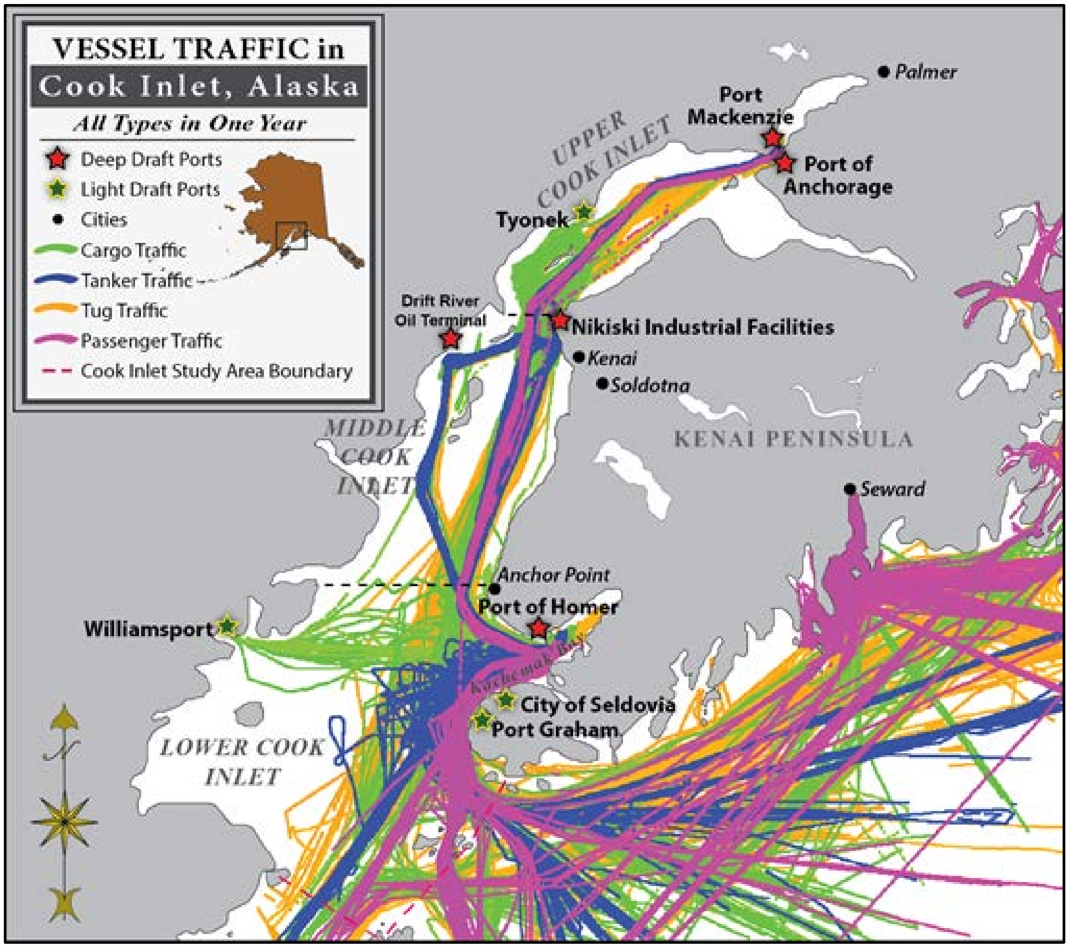

Figure 46. Summary of Cook Inlet Vessel Traffic by Vessel Type (Cape International, Inc. 2012, BOEM 2017b). Only vessels more than 300 gross tons are shown.

5.4.5 Aircraft Noise

The airspace above Cook Inlet experiences significant levels of aircraft traffic. Anchorage Ted Stevens International Airport is directly adjacent to lower Knik Arm and receives high volumes of commercial air traffic. It is also the second largest air cargo hub in the U.S. Joint Base Elmendorf Richardson also has a runway near and airspace directly over Knik Arm. Lake Hood in Anchorage is the world’s largest and busiest seaplane base and the only seaplane base with primary airport status in the U.S. (Federal Aviation Administration 2016). Other small public runways are found at Birchwood, Goose Bay, Merrill Field, Girdwood, the Kenai Municipal Airport, Ninilchik, Homer, and Seldovia. Oil and gas development projects often involve helicopters and fixed-winged aircraft, and aircraft are used for surveys of natural resources including Cook Inlet beluga whales. Airborne sounds do not transfer well to water because much of the sound is attenuated at the surface or is reflected where angles of incidence are greater than 13°; however, loud aircraft noise can be heard underwater when aircraft are within or near the

13^{o} overhead cone and surface conditions are calm (Richardson et al. 1995).

Richardson et al. (1995) observed that beluga whales in the Beaufort Sea will dive or swim away when low-flying (500 m (1640 ft)) aircraft pass above them. Observers aboard Cook Inlet beluga whale survey aircraft flying at approximately 244 m (800 ft) report little or no change in swimming direction of the whales (Rugh et al. 2000). However, ground-based biologists note that Cook Inlet belugas often dive and remain submersed for longer than is typical when aircraft fly past at low altitudes or circle them (NMFS unpublished data). Individual responses of belugas may vary, depending on previous experiences, beluga activity at the time of the noise, and noise characteristics.

The noise and visual presence of aircraft can result in behavioral changes in whales such as diving, altering course, vigorous swimming, and breaching (Patenaude et al. 2002). Aircraft can also result in disturbance to Steller sea lions, especially if they are hauled out on land. Disturbance on a rookery or haulout could easily lead to serious injury or death, mainly due to trampling. MML scientists have reported an event where over 1,000 sea lions stampeded off a beach in response to a large helicopter over 1 mile away (Withrow 1982).

5.4.6 Noise and Critical Habitat

Due to the industrial activity, development, and vessel traffic in the vicinity of Cook Inlet beluga critical habitat, a wide variety of anthropogenic noise sources are present. Many sources of anthropogenic noise are seasonal and occur during the ice-free months, although anthropogenic noise is present year-round. Sources include vessel noise from tugs, tankers, cargo ships, fishing vessels, small recreational vessels, dredging, pile-driving, military detonations, and seismic surveys (NMFS 2016b).

Recent literature reviews on the effects of sound on fish (Popper and Hastings 2009) conclude little is known about these effects and that it is not yet possible to extrapolate from one experiment to other signal parameters of the same noise, to other types of noise, to other effects, or to other species. Limited available scientific literature indicates that noise can evoke a variety of responses from fish. Pile driving can induce a startle response and/or an avoidance response, and can cause injury or death to fish close to the noise source (McCauley et al. 2003, Slabbekoorn et al. 2010, Casper et al. 2012, Halvorsen et al. 2012). It is likely that fish will avoid sound sources within ranges that may be harmful (McCauley et al. 2003).

Of all known Cook Inlet beluga and Steller sea lion prey species, only coho salmon (*Oncorhynchus kisutch*) have been studied for effects of exposure to pile driving noise (Casper et al. 2012, Halvorsen et al. 2012). These studies defined very high noise level exposures (210 dB re $1 \mu Pa_{rms}$) as threshold for onset of injury, and supported the hypothesis that one or two mild injuries resulting from pile driving exposure at these or higher levels are unlikely to affect the survival of the exposed animals in a laboratory environment. Rodkin (2009) studied the effects to juvenile coho salmon from pile driving of sheet piles at the Port of Anchorage in Knik Arm of Cook Inlet. The fish were exposed to in-situ noise from vibratory or impact pile driving at distances ranging from less than 1 meter to over 30 meters. The results of this study showed no mortality of any test fish within 48 hours of exposure to the pile driving activities. Subsequent necropsies showed no effects or injuries as a result of the noise exposure. The effects of noise on other Cook Inlet beluga and Steller sea lion prey species, such as eulachon, gadids, and flounder species, is unknown (NMFS 2008b, 2016b).

5.5 Water Quality and Water Pollution

Potential sources of pollutants in Cook Inlet could include: (1) discharge from industrial activities, excluding wastewater treatment facilities; (2) discharge from community wastewater treatment facilities; (3) runoff from urban, agriculture, and mining sources; and (4) accidental spills or discharge from oil and gas production (Moore et al. 2000, NMFS 2008a). Main sources of pollutants found in Cook Inlet likely include the 10 wastewater treatment facilities, stormwater runoff, airport deicing, military training at Eagle Bay, and discharge from oil and gas development (Moore et al. 2000, NMFS 2008a).

Upper Cook Inlet was designated as a Category 3 on the Clean Water Act (CWA) Section 303(d) list of impaired water bodies by the Alaska Department of Environmental Conservation (ADEC 2013), indicating there is insufficient data to determine whether the water quality standards for any designated uses are attained. Lower Cook Inlet is not listed as an impaired waterbody due to lack of information to the contrary; however, the ADEC determined that the overall condition of Southcentral Alaska coastal waters were rated as good based on examining water quality, sediment quality, and fish tissue contaminants collected from 55 sites in the survey area (ADEC 2013).

The Cook Inlet region is the most populated and industrialized region of the state. Its waters receive various pollutant loads through activities that include urban runoff, oil and gas activities (e.g., discharges of drilling muds and cuttings, production waters, treated sewage effluent discharge, deck drainage), municipal sewage treatment effluents, oil and other chemical spills, fish processing, and other regulated discharges. Many pollutants are regulated by either the Environmental Protection Agency (EPA) or the ADEC, who may authorize certain discharges under the National (or Alaska) Pollution Discharge Elimination System (NPDES/APDES; section 402 of the CWA of 1972). It is necessary to manage pollutants and toxins to protect and maintain the biological, ecological, and aesthetic integrity of these waters.

The Recovery Plan for the Cook Inlet Beluga Whale (NMFS 2016b) states that exposure to industrial chemicals, as well as to natural substances released into the marine environment, is a potential health threat for Cook Inlet belugas and their prey. An in-depth review of available information on pollution and contaminants in Cook Inlet is presented in the Recovery Plan.

Cook Inlet beluga whales are exposed to chemical concentrations that are typically lower than those experienced by other Arctic marine mammals (Becker et al. 2000, Becker et al. 2010). Levels of heavy metals, pesticides, petroleum hydrocarbons, and polychlorinated biphenyl (PCB) compounds found in Cook Inlet’s water column and sediments were below detection limits; and heavy metal concentrations were below management levels (KABATA 2004, NMFS 2008a, USACE 2008).

5.5.1 Petrochemical spills

Given the amount of oil and gas production and vessel traffic, spills of petroleum products are a threat to marine mammals inhabiting Cook Inlet. Research indicates cetaceans are capable of detecting oil, but they do not seem to avoid it (Geraci and St. Aubin 1990), and oil has been implicated in the deaths of pinnipeds, including Steller sea lions (St. Aubin 1990). Pinnipeds exposed to oil at sea through incidental ingestion, inhalation, or limited surface contact do not appear greatly harmed by the oil; however, pinnipeds found close to the source or who must emerge directly in oil appear substantially more affected. Oil spills that occur in or upstream of Cook Inlet could result in marine mammals experiencing direct contact with the oil, with possible effects to skin and/or respiratory systems. Cook Inlet beluga whales could be affected through residual oil from a spill, even if they were not present during the oil spill, due to the highly mobile nature of oil in water and the extreme tidal fluctuations in Cook Inlet (NMFS 2008a). Prey contamination is also likely, but the effect of contaminated prey on belugas remains unknown. Spill clean-up efforts could also result in displacement of whales from essential feeding areas.

Polycyclic aromatic hydrocarbons (PAHs), a group of contaminants found in petroleum products, combined with other contaminants, may cause cancer in beluga whales (Kingsley 2002) and are otherwise a concern with respect to the conservation and recovery of the Cook Inlet beluga whale. Cook Inlet belugas appear to be bioaccumulating PAHs from the environment and prey (Norman et al. 2015).

Toxic substances, such as oil, may be a contributing factor in the decline of the Western DPS Steller sea lion population (NMFS 2008b). Sea lions exposed to oil through inhalation, dermal contact and absorption, direct ingestion, or through the ingestion of prey may become heavily contaminated with PAHs. The Exxon Valdez oil spill occurred after the current Steller sea lion population decline began, although this spill almost certainly contributed further to the decline. Mortalities from toxic contamination are strongly linked to this spill. Twelve sea lion carcasses were found in Prince William Sound, and 16 carcasses were found near Prince William Sound, along the Kenai coast, and at the Barren Islands. Elevated PAH levels were present in the animals found dead shortly after the spill (NMFS 2008b).

While construction of an oil/gas facility may result in a small amount of habitat loss, an oil spill in Cook Inlet could result in widespread habitat degradation impacting beluga whales and putting the population at risk. Individuals from the Western DPS of Steller sea lions and listed humpback whales within Cook Inlet may also be put at risk due to such a spill, but population level effects would be far less likely, unless the spill was sufficiently large to impact areas outside Cook Inlet.

It is not known whether humpback whales avoid oil spills; however, humpbacks have been observed feeding in a small oil spill on Georges Bank (NMFS 1991). The greatest impacts of oil spills on humpbacks could occur indirectly. Local depletion of food resources may occur as a result of displacement and mortality of their food resources, many of which are highly susceptible to the toxic effects of oil and are essentially unable to move away from the site of a spill. Other more mobile prey species may suffer from mortality of eggs and immature life stages (NMFS 1991), possibly reducing future availability of prey.

According to the ADEC’s oil spills database, oil spills in marine waters consist mostly of harbor and vessel spills, and spills from platform and processing facilities. A reported 477,942 liters (126,259 gal) (from 79 spills) of oil was discharged in the Cook Inlet area since July 1, 2013, primarily from vessels and harbor activities and from exploration and production facilities. Three of the ten largest spills in Alaska during state fiscal year 2014 occurred in Cook Inlet; these included 84,000 gallons of produced water by Hilcorp in the Kenai gas field; 9,100 gallons of process water released by the Tesoro API Tank Bypass Spill; and a Flint Hills, Anchorage spill of 4,273 gallons of gasoline (ADEC 2015).

A spill baseline study conducted as part of the Cook Inlet Risk Assessment estimated a historical vessel spill rate of 3.4 spills (regardless of size) per year, with 3.9 spills per year forecasted for the years 2015 through 2020 across all vessel categories (Nuka Research and Planning and Pearson Consulting LLC 2015). Historical rates ranged from 0.7 spills per year for tank ships to 1.3 spills per year for non-tank/non-workboat vessels (Nuka Research and Planning and Pearson Consulting LLC 2015). Eight large spills (≥ 1000 bbl) from vessels (tankers and, in one case, a tug) are documented in Cook Inlet between 1966 and 2015 (BOEM 2016). No large spills have occurred in the area in recent years (BOEM 2017).

On February 7, 2017, a Hilcorp helicopter flying between Nikiski and Platform A identified bubbles resulting from a natural gas leak in one of their pipelines. The gas leak was reported to the National Response Center and ADEC. Subsequent Hilcorp data revealed that the leak had been occurring since late December. The initial estimated leak rate was between 225,000 to 325,000 cubic feet per day from an eight-inch pipeline 80 feet below Cook Inlet waters (Hilcorp 2017b). The cause of the release was a large rock that caused a breach in the line.

Hilcorp worked closely with NMFS, the Pipeline and Hazardous Materials Safety Administration (PHMSA), ADEC, and other stakeholders to conduct mitigation and monitoring actions during the gas release and subsequent repair. Initially, Hilcorp significantly reduced gas flow through the line, but did not shut down the line completely for fear of residual oil leaking into the marine environment. Divers installed a temporary pipeline clamp on April 13, 2017, but due to weather and ice conditions, a permanent repair was not completed until May 19, 2017. Limited aerial surveys of wildlife in the vicinity of the leak did not indicate the presence of any marine mammals near the leak (Hilcorp unpublished data).

On April 1, 2017, an oil spill was detected off the Anna Platform in Cook Inlet. Hilcorp reported the incident to ADEC on the same day. Documentation from Hilcorp indicates the release resulted from an accident on the Anna Platform production facility flare system. It was estimated a maximum of three gallons of oil was discharged into the marine environment. Subsequent to these accidents, Hilcorp has updated their Integrity Management Plan.

The Anna Platform experienced a diesel beam tank spill of 441 gallons on January 24, 2018. All the diesel was recovered and recycled. Hilcorp has also reported recent minor spills (≤ 200 gallons) of drilling mud from the Steelhead and Granite Platforms and a glycol spill from the Bruce Platform, with most or all spilled material recovered[12].

The ADEC Statewide Oil Spills Database[12] has records of three spills in Cook Inlet in 2019, a

[12] http://dec.alaska.gov/Applications/SPAR/PublicMVC/PERP/SpillSearch

release of 0.1 lb of natural gas from Hilcorp Platform A in Trading Bay on April 27, 2019 which naturally dispersed, a 42 gal spill of crude oil from the Drift River Terminal also on April 27, 2019 for which the disposal method was not reported, and an onshore spill of 210 gal of crude oil at the Hilcorp MGS Onshore Facility in Nikiski on April 15, 2019. The disposal method for the onshore spill was not reported, but it appears to have been contained to land and did not enter the marine environment. A fourth incident was reported to ADEC on May 1, 2019 consisting of a multi-day gas leak of unknown quantity at Hilcorp's Platform A.

5.5.2 Wastewater Discharge

Ten communities currently discharge treated municipal wastes into Cook Inlet. Wastewaters entering these plants may contain a variety of organic and inorganic pollutants, metals, nutrients, sediments, bacteria and viruses, and other emerging pollutants of concern. Wastewater from the Municipality of Anchorage, Nanwalek, Port Graham, Seldovia, and Tyonek receive primary treatment, wastewaters from Homer, Kenai, and Palmer receive secondary treatment, and wastewaters from Eagle River and Girdwood receive tertiary treatment.

Wastewater treatment facilities undergo primary, secondary, or tertiary treatment prior to being discharged into a body of water. Primary treatment involves sedimentation. In general, this includes removing 50 to 70 percent of the solid particulate from the wastewater prior to discharge (Sonune and Ghate 2004). In addition to sedimentation, secondary treatment involves adding a biological component to remove the remaining organic matter. Tertiary treatment involves both primary and secondary treatment as well as additional processes to increase the water quality of the discharge (Sonune and Ghate 2004).

The Anchorage John M. Asplund Wastewater Treatment Facility (AWTF) is the largest wastewater facility in Alaska and is located in upper Cook Inlet, within the action area. AWTF provides primary treatment only and removes approximately 80 percent of solids prior to discharge[13]. The facility was built in 1972, upgraded in 1982 (28 million gallons per day [mgd]), and then upgraded again in 1989 (58 mgd). The EPA issues a waiver to AWTF for secondary treatment and allows the direct discharge of wastewater into Cook Inlet near Point Woronzof once the wastewater has undergone primary treatment. AWTF is allowed to discharge primary treated wastewater due to the levels of sediment they are able to extract and the extreme tides and currents of Cook Inlet[13]. Once the sediment is removed from the wastewater, the sludge is incinerated.

The Village of Tyonek wastewater treatment facility, located near the portion of Cook Inlet most heavily used by feeding Cook Inlet beluga whales, provides primary treatment prior to wastewater discharge. Tyonek operates on a gravity fed sewer that drains into a community septic tank. Every spring and fall, the solids are transferred to a sludge lagoon for dewatering. The liquid effluent is then discharged into Cook Inlet. The village uses approximately 60 gallons of water per day, most of which ends up as discharged liquid effluent.

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[13] https://www.awwu.biz/home/showdocument?id=1466

There are other wastewater treatment facilities in Cook Inlet, including in Kenai[14]. The City of Kenai wastewater facility is one of the larger wastewater treatment facilities in Cook Inlet and is located near the largest runs of salmon in Cook Inlet. The Kenai wastewater treatment facility discharges secondary treated wastewater from its treatment plant directly into Cook Inlet, and the sludge is taken to the Soldotna landfill. The facility's design flow is 1.330 mgd with an average daily flow of 0.573 mgd. The City of Kenai began upgrades to the facility in 2018, and will continue upgrades in 2019 and 2020[15].

Wastewater discharge from oil and gas development could increase pollutants in Cook Inlet (NMFS 2008a). Discharge includes but are not limited to drilling fluids (muds and cuttings), produced water (water phase of liquid pumped from oil wells), and domestic and sanitary waste (NMFS 2008a, EPA 2015). Under the NPDES permit issued by EPA, oil and gas facilities are required to monitor the effluent for pollutants and meet standards specified in the permit before it is discharged into Cook Inlet (EPA 2015).

5.5.3 Mixing Zones

In 2010, EPA consulted with NMFS on the approval of ADEC's Mixing Zone Regulation section [18 AAC 70.240], including most recent revisions, of the Alaska Water Quality Standards [18 AAC 70; WQS] relative to the endangered Cook Inlet beluga whale (NMFS 2010). The 2010 biological opinion concluded that there was insufficient information to conclude whether belugas could be harmed by the elevated concentrations of substances present in mixing zones, but that the action was not likely to jeopardize the continued existence of the species. The 2010 opinion did not address the effects of the proposed action on Cook Inlet beluga whale habitat, which NMFS designated in 2011. In 2019, NMFS issued a biological opinion on the effects of EPA approval of the Mixing Zone Regulation following designation of Cook Inlet beluga whale critical habitat and concluded that the Mixing Zone Regulation is not likely to destroy or adversely modify designated Cook Inlet beluga whale critical habitat.

5.5.4 Stormwater Runoff

Stormwater pollutants may include street and aircraft deicer, oil, pesticides and fertilizers, heavy metals, and fecal coliform bacteria. Public Works (WMS) and the Alaska Department of Transportation and Public Facilities (ADOT&PF) are responsible for identifying, monitoring, and controlling pollutants in stormwater. Stormwater from other communities in the action area (e.g., Kenai) may also contribute to pollutants that enter Cook Inlet. The effects of stormwater on the Cook Inlet beluga whale have not been studied and are unknown (NMFS 2008a).

Numerous releases of petroleum hydrocarbons have been documented from the POA, JBER, and the Alaska Railroad Corporation (ARRC). The POA transfers and stores petroleum oils, as well as other hazardous materials; and since 1992, all significant spills and leaks have been reported. Past spills have been documented at each of the bulk fuel facilities within the POA and also on

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[14] https://www.soldotna.org/departments/utilities/waste-water-treatment
[15] https://www.kenai.city/publicworks/page/water-sewer

JBER's property (POA 2003).

JBER is listed on the National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, because of known or threatened releases of hazardous substances, pollutants, or contaminants. Spills have also been reported at the ARRC rail yard. In 1986, petroleum seeped into Ship Creek from the nearby rail yard, and several oil spills occurred in 2001 (Army 2010). Freight handling activities have historically caused numerous surface stains and spills at the rail yard.

5.5.5 Aircraft De-icing

Airport deicing contributes to the levels of pollutants found in Cook Inlet. Deicing and anti-icing of aircraft and airfield surfaces are required by the Federal Aviation Administration to ensure the safety of passengers. Deicing and anti-icing chemicals are used from October through May and may be used on aircraft, tarmacs, and runways. Depending on the application, deicing material is comprised of different chemicals. Ethylene glycol and propylene glycol are used on aircraft for anti-icing and deicing purposes, whereas potassium acetate and urea are used to deice tarmacs and runways. Much of the deicing material or their breakdown products eventually enter Cook Inlet. No studies exist analyzing the potential impacts on beluga whales from these deicing agents.

The Ted Stevens Anchorage International Airport and JBER airport are the largest airports in the Cook Inlet region. Other smaller airports exist throughout the Cook Inlet watershed, including Merrill Field, Lake Hood, and Lake Spenard (NMFS 2008a).

5.5.6 Ballast Water Discharges

Ballast water discharge from ships is another source of potential pollution as well as potential release of non-indigenous organisms into Cook Inlet. Information and statistics on ballast water management in Cook Inlet can be found at: https://www.circac.org/wp-content/uploads/2003nov-Cook-Inlet-Ballast-WAter-Catalogue-Nuka.pdf.

Discharges of wastes from vessels are regulated by the United States Coast Guard. Potential discharges include oily waste, sewer water, gray water (e.g., shower water), ballast water that may contain invasive marine species, and garbage. Gray water and sewer water, provided that they are free from oil waste, may be discharged in the open sea. However, by law, no discharges of any kind are allowed within three miles of land.

Ships can potentially release pollutants and non-indigenous organisms into Cook Inlet through the discharge of ballast water. It is a recognized worldwide problem that marine organisms picked up in ship ballast water, transported to foreign lands, and dumped into non-native habitats are responsible for significant ecological and economic perturbations costing billions of dollars. The National Ballast Information Clearinghouse reported that more than five million metric tons of ballast water was released in Cook Inlet, from Homer to Anchorage, between 1999 and 2003. Invasive species were found just off the POA in a 2004 survey by the Smithsonian Environmental Center. The effects of discharged ballast water and possible invasive species from such discharges on fin whales, humpback whales, and Cook Inlet beluga whales and Western

DPS Steller sea lions and their designated critical habitat are unknown. In order to try to protect Alaska's waters, ADFG developed an Aquatic Nuisance Species Management Plan (Fay 2002). Information and statistics ballast water management in Cook Inlet can be found at: https://www.circac.org/wp-content/uploads/2003nov-Cook-Inlet-Ballast-WAter-Catalogue-Nuka.pdf

5.5.7 Contaminants Found in Listed Species

Studies conducted in upper Cook Inlet, in areas of high concentrations of beluga whales, found levels of PCBs, pesticides, and petroleum hydrocarbons in the water column and sediment were below detectable limits and levels of heavy metals were below management levels (KABATA 2004, NMFS 2008a, USACE 2008).

Becker et al. (2000) compared tissue samples taken from harvested Cook Inlet beluga whales from two Arctic Alaskan populations, Greenland, Arctic Canada, and the St. Lawrence Estuary beluga population. They compared levels of PCBs, chlorinated pesticides, heavy metals, and other elements between populations. The results indicated that the Cook Inlet population had the lowest concentrations of PCBs, pesticides, cadmium, and mercury of all these populations, but had higher concentrations of copper than the other Arctic populations. Becker et al. (2000) suggested the difference in toxin levels was likely related to a difference in source (geographic or food web) and age distribution of the animals. A follow up study conducted by Becker et al. (2010) did not find significant changes in contaminant levels in the Cook Inlet beluga whale population with the inclusion of additional samples collected over the past decade; however, they did identify and document increasing levels of chemicals of emerging concern (e.g., polybrominated diphenyl ether, hexabromocyclododecane, and perfluorinated compounds) in the Cook Inlet population. Although the levels of contaminants found in the Cook Inlet beluga whale population are lower than levels found in other populations, the effects of these contaminants on this population are unknown (Becker et al. 2000, NMFS 2008a).

Steller sea lions are exposed to local and system-wide contaminants and pollutants as they traverse the North Pacific basin. Effects on other pinnipeds have included acute mortality, reduced pregnancy rates, immuno-suppression, and reduced survival of first born pups (Section III of NMFS (2008b)), but there have been no published reports of contaminants or pollutants (other than spilled oil) representing a mortality source for Steller sea lions (NMFS 2008b).

5.6 Fisheries

Cook Inlet supports several commercial fisheries, all of which require permits. The commercial fisheries in Cook Inlet are divided into the upper and lower Cook Inlet[16]. The upper Cook Inlet commercial fishing region consists of all waters north of Anchor Point and is further divided into the Northern (north of the West and East Foreland) and Central Districts (south of the Forelands to Anchor Point Light). Species commercially harvested in upper Cook Inlet include all five Pacific salmon species (drift and set gillnet), eulachon or smelt (dipnet), Pacific herring (gillnet),

[16] http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyarealci.main

and razor clams (hand-digging); however, sockeye salmon are the most economically valuable[17] (Shields and Dupuis 2017).

In 2016, approximately 3.0 million salmon were harvested commercially in upper Cook Inlet, which is under the average annual harvest from 1966-2016 (3.5 million salmon; (Shields and Dupuis 2017)). Approximately 95.8 tons of eulachon (100 tons is the maximum allowable harvest), 22.9 tons of herring, and 285,000 pounds of razor clams were commercially harvested in 2016 (Shields and Dupuis 2017).

Recreational fisheries exist in the river systems on the western Kenai Peninsula for salmon (king, silver, red, and pink), both freshwater and marine Dolly Varden char, and both freshwater rainbow trout and steelhead trout. In the marine waters throughout Cook Inlet, recreational fishing occurs for salmon (king and silver), Pacific cod, and halibut. Many of the charter fishing vessels targeting salmon and halibut operate out of Homer, in lower Cook Inlet.

NMFS assumes that ADFG will continue to manage fish stocks and monitor and regulate fishing in Cook Inlet to maintain sustainable stocks. An important remaining unknown is the extent to which Cook Inlet marine mammal prey is made less available due to commercial, subsistence, personal use, and sport fishing either by direct removal of the prey or by human-caused habitat avoidance. Gathering data on this threat near the mouths of salmon and eulachon spawning streams is especially important.

Potential impacts from commercial fishing on Cook Inlet beluga whales, humpback whales, and Steller sea lions include ship strikes, harassment, gear entanglement, reduction of prey, and displacement from important habitat. For example, the Kenai River is the most heavily-fished river in Alaska[18], while historically also important foraging habitat for Cook Inlet beluga whales (e.g., waters within and near the outlets of the Kenai and Kasilof Rivers during salmon season) (Ovitz 2019).

5.6.1 Entanglement

Prior to the mid-1980s, the only reports of fatal takes of belugas incidental to entanglement in fishing gear in Cook Inlet are from the literature (Murray and Fay 1979, Burns and Seaman 1986). While there have been sporadic reports since the mid-1980s of single belugas becoming entangled in fishing nets, the only known mortality associated with entanglement in a fishing net was from a young Cook Inlet beluga carcass recovered from a subsistence set net in 2012. Overall, the current rate of direct mortality from fisheries in Cook Inlet appears to be insignificant. There have been reports of non-lethal entanglement of Cook Inlet belugas. For example, in 2005, a Cook Inlet beluga entangled in an unknown object, perhaps a tire rim or a culvert liner, was photographed in Eagle Bay (McGuire et al. 2013), and another Cook Inlet beluga was repeatedly photographed 2010–2013 with what appeared to be a rope entangled around the upper portion of its body near the pectoral flippers (McGuire et al. 2014). It is not

[17] http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyarealci.main
[18] http://www.adfg.alaska.gov/index.cfm?adfg=ByAreaSouthcentralUpperKenai.fishingInfo

known if these animals were able to disentangle themselves or if they died as a result of the entanglements (NMFS 2016b).

Humpback whales can be killed or injured during interactions with commercial fishing gear, although the evidence available suggests that the frequency of these interactions may not have significant adverse consequence for humpback whale populations. Most humpbacks get entangled with gear between the beginning of June and the beginning of September, when they are on their nearshore foraging grounds in Alaska waters. Between 1990 and 2016, 29 percent of humpback entanglements were with pot gear and 37 percent with gillnet gear. Longline gear comprised only 1-2 percent of all humpback fishing gear interactions.

A photographic study of humpback whales in southeastern Alaska in 2003 and 2004 found at least 53 percent of individuals showed some kind of scarring from fishing gear entanglement (Neilson et al. 2005). During 2010-2014, mortality and serious injury of humpback whales occurred in the Bering Sea/Aleutian Islands pollock trawl fishery (1 each in 2010 and 2012) and the Bering Sea/Aleutian Islands flatfish trawl fishery (1 in 2010). The estimated average annual mortality and serious injury rate from observed U.S. commercial fisheries is 0.6 Western North Pacific DPS humpback whales in 2010-2014 (Muto et al. 2018). There are no known occurrences of fishery-related take of humpback whales in the action area.

Overall, the estimated mean annual mortality and serious injury rate from U.S. commercial fisheries is 31 sea lions per year, which is likely an underestimate of the actual level (Muto et al. 2018). Of these, 16 are taken in federally managed commercial fisheries. Results from a study conducted in the Aleutian Islands during June and July 1985, found that a very low percentage of observed sea lions entangled in discarded fishing net or twine, and a second study conducted during November 1986 found no entangled pups and only one entangled juvenile out of a total of 3,847 sea lions examined (NMFS 2008b). Juveniles are likely to be most vulnerable to entanglement in marine debris. Overall, the relative impact on the recovery of the WDPS of Steller sea lion due to entanglement in marine debris is ranked as low (NMFS 2008b).

An observer program for the Cook Inlet salmon set and drift gillnet fisheries was implemented in 1999 and 2000 in response to the concern that there may be significant numbers of marine mammal injuries and mortalities that occur incidental to these fisheries. Observer coverage in the Cook Inlet drift gillnet fishery was 1.75 percent and 3.73 percent in 1999 and 2000, respectively. The observer coverage in the Cook Inlet set gillnet fishery was 7.3 percent and 8.3 percent in 1999 and 2000, respectively (Manly 2006). There were no mortalities of Steller sea lions observed in the set or drift gillnet fisheries in either 1999 or 2000 (Manly 2006).

5.6.2 Competition for Prey

Fisheries in Cook Inlet have varying likelihoods of competing with marine mammals for fish depending on gear type, species fished, timing, and fisheries location and intensity. For Cook Inlet beluga whales, there is a possibility of reduced prey availability and/or habitat displacement due to commercial and recreational fishing activity. The operation of watercraft near the mouths and deltas of rivers entering Cook Inlet, Turnagain Arm, and Knik Arm can affect beluga whales, hindering them from using these waters in pursuit of eulachon and salmon prey. For example, while NMFS has numerous reports of beluga whales in the Kenai River prior to and after the summer salmon fishing season, they have not been observed in or near the river in recent times when salmon runs are strong and fishing activity (commercial, recreational, and personal use) is high (Castellote et al. 2015, Shelden et al. 2015b).

There is strong indication that Cook Inlet beluga whales are dependent on access to relatively dense concentrations of high value prey species, particularly in the spring and throughout the summer months. Norman (2011) estimated that the total biomass of fish consumed by 350 Cook Inlet beluga whales during the summer would be approximately 1250 metric tons. Chum, coho, and other salmonid species constitute >54 percent of the Cook Inlet beluga whales' summer diet (Hobbs and Shelden 2008). In 2016, approximately 3.0 million salmon were harvested commercially in upper Cook Inlet, which is below the average annual harvest of 3.5 million from 1966-2016. Approximately 95.8 tons of smelt (100 tons is the maximum allowable harvest), 22.9 tons of herring, and 285,000 pounds of razor clams were commercially harvested from upper Cook Inlet in 2016 (Shields and Dupuis 2017). A significant reduction in the amount of available prey could impact the energetics for Cook Inlet beluga whales and delay recovery.

Whether fisheries reduce Steller sea lion prey biomass and quality at local and/or regional spatial scales, leading to a reduction in Steller sea lion survival and reproduction, has been a matter of considerable debate among the scientific community (NMFS 2008b). The most recent minimum total annual (direct) mortality of Western DPS Steller sea lions associated with commercial fisheries is 31 individuals (Muto et al. 2018).

There is no known information summarizing interactions between fishing in Cook Inlet and large cetaceans. Prey competition is unlikely to occur, as the important foraging areas for humpback whales are outside of Cook Inlet.

5.7 Tourism

There are no commercial whale-watching companies operating in upper Cook Inlet. The popularity of whale watching and the close proximity of beluga whales to Anchorage make it possible that such operations may exist in the future. Vessel-based whale-watching, should it occur, would likely stress the beluga population by increasing intrusion into beluga habitat not ordinarily accessed by many boats. The small size and low profile of beluga whales, and the poor visibility within the Cook Inlet waters, may increase the temptation for whale watchers to approach the beluga whales more closely than recommended for marine mammals. However, it is unlikely this industry will reach the levels of intensity seen elsewhere because of upper Cook Inlet's climate and navigation hazards (e.g., shallow waters, extreme tides, and currents). We are aware that some aircraft have circled around groups of Cook Inlet beluga whales, disrupting their diving and possibly feeding activities (NMFS, unpublished data). NMFS has undertaken outreach efforts to educate local pilots of the potential consequences of such actions, providing guidelines encouraging pilots to maintain altitudes of 1,500 feet over belugas and not to circle over them.

Tourism continues to grow in lower Cook Inlet, on the Kenai Peninsula, with two popular destinations being Homer and Kenai on the western Peninsula (and mid to lower Inlet). While fishing in the Kenai River is a major draw, a number of commercial vessel-based tour companies operate in the marine waters of lower Cook Inlet, primarily out of Homer. These tour vessels range from small, six-passenger vessels to larger vessels that carry 100 or more passengers. These tours including fishing options, however wildlife viewing (including marine mammal watching) is also popular.

In addition to vessel and land-based tourism, there are a number of commercial operators for flight-seeing tours out of Homer. These operators offer tours for glacier and wildlife viewing, including whales, bears, mountain goats, and moose. These flights occur over land on the Kenai Peninsula, the waters of lower Cook Inlet (Kachemak Bay), and across the Inlet to the places such as Katmai National Park and McNeil River State Game refuge. While flying along the coast or over marine waters, these planes have the potential to disturb marine mammals, including whales, but particularly also pinnipeds on haulouts and rookeries, such as sea lions.

5.8 Direct Mortality

Within the proposed action area there are several potential sources of direct anthropogenic mortality, including shooting, strandings, fishery/gear/debris interactions, vessel collisions, predation, and research activities.

5.8.1 Subsistence Harvest

The ESA and MMPA allow for the harvest of marine mammals by Alaska Natives for subsistence purposes and for traditional handicrafts. Subsistence hunters in Alaska are not authorized to take humpback whales (Muto et al. 2018). However, one humpback whale was illegally harvested in Kotlik in October, 2006, and another was illegally harvested in Toksook Bay in May, 2016.

Annual statewide data on community subsistence harvest of Steller sea lions are no longer collected as of 2009. The mean annual subsistence take (harvested plus struck-and-lost) from the Western DPS from 2004 through 2008, combined with the mean annual take between 2011-2015 from St. Paul and St. George, is 204 sea lions per year (Muto et al. 2018). Subsistence harvest of Western DPS Steller sea lions occurs under co-management agreements with NMFS, and occurs at or well below sustainable levels of harvest.

The effect from past subsistence harvests on the Cook Inlet beluga whale population was significant (Figure 14). While an unknown amount of harvest occurred for decades or longer, the subsistence harvest levels increased substantially in the 1980s and 1990s to unsustainable levels. Reported subsistence harvests during 1994-1998 probably account for the stock’s decline during that interval. In 1999, beluga whale subsistence harvest discontinued as a result of both a voluntary moratorium by the hunters that spring, and Public Law 106-553 section 627, which required hunting of Cook Inlet beluga whale for subsistence uses be conducted pursuant to a cooperative agreement between NMFS and affected Alaska Native organizations. In 2005, a co-management agreement allowed the harvest of two whales. In 2006, the co-management agreement allowed the harvest of one whale, however no whales were taken due to poor weather, and hunters’ avoidance of females with calves.

In 2008, NMFS issued regulations (73 FR 60976; October 15, 2008) establishing long-term limits on the maximum number of Cook Inlet beluga whales that may be taken for subsistence by Alaska Natives. These long-term harvest limits, developed for five-year intervals, require that the abundance estimates reach a minimum five-year average of 350 belugas (50 CFR 216.23(f)(2)(v)). No hunt has been authorized since 2006.

5.8.2 Poaching and Illegal Harassment

Due to their distribution within the most densely populated region in Alaska and their approachable nature, the potential for poaching beluga whales in Cook Inlet exists. Although NMFS maintains an enforcement presence in upper Cook Inlet, effective enforcement across such a large area is difficult. No poaching incidents have been confirmed to date, although NMFS Enforcement has investigated several reported incidences of Cook Inlet beluga whale harassment.

Poaching and illegal harvest of Steller sea lions has historically occurred throughout their range. The NMFS Alaska Marine Mammal Stranding Program documented 60 Steller sea lions with suspected or confirmed firearm injuries from 2000–2016 in Southeast and Southcentral Alaska (Wright and Savage 2016). Western DPS Steller sea lions with suspected gunshot wounds have been found stranded on shore along the outer Copper River Delta as recently as 2016 (Wright and Savage 2016). Investigations led to guilty pleas and convictions of two men for illegally shooting the sea lions[19].

Few illegal harvests of humpback whales have occurred in Alaska (only 2 cases are known), and those that have occurred resulted primarily from the misperception by subsistence hunters in western Alaska that they could harvest large whales other than bowheads (e.g., humpback, gray, and minke whales) legally.

5.8.3 Stranding

Live stranding occurs when a marine mammal is found in waters too shallow to swim. Cook Inlet beluga whales are probably predisposed to stranding because they breed, feed, and molt in the shallow waters of upper Cook Inlet where extreme tidal fluctuations occur. However, stranding events that last more than a few hours may result in mortalities. Strandings can be intentional (e.g., to avoid killer whale predation), accidental (e.g., chasing prey into shallows then becoming trapped by receding tide), or a result of injury, illness, or death.

An estimated 876-953 live beluga strandings and a total of 214 dead beluga beachings have been documented in Cook Inlet from 1988 through 2015 (NMFS 2016b). Beluga whale stranding events may represent a significant threat to the conservation and recovery of this stock.

In nearly all known cases, strandings of humpback whales represent animals that died at sea of various other causes and washed ashore; a young humpback whale live stranded on mud in Turnagain Arm in April 2019, and while it freed itself on an incoming tide at one point, the animal later died.

[19] https://www.justice.gov/usao-ak/pr/two-alaska-men-charged-harassing-killing-steller-sea-lions-and-obstructing-investigation

Live strandings do not often occur among sea lions, which have mobility out of water, although pinniped strandings and mortality resulting from entanglement in fishing gear have been documented (Loughlin and York 2000, Raum-Suryan et al. 2009, Muto et al. 2018).

5.8.4 Predation

Killer whales are the only natural predators for beluga whales and Steller sea lions in Cook Inlet (Muto et al. 2018). Beluga whale stranding events have also been correlated with killer whale presence, and Native hunters report that beluga whales intentionally strand themselves in order to escape killer whale predation (Huntington 2000). Killer whale sightings were not well-documented and were likely rare in the upper inlet prior to the mid-1980s. From 1982 through 2014, 29 killer whale sightings in upper Cook Inlet (north of the East and West Forelands) were reported to NMFS. It is not known which of these were mammal-eating killer whales (i.e., transient killer whales) that might prey on beluga whales or fish-eating killer whales (i.e., resident killer whales) that would not prey on beluga whales.

Between 9 and 12 beluga whale deaths during this time (1982-2014) were suspected to be a direct result of killer whale predation (NMFS 2016b). From 2011 through 2014, NMFS received no reports of killer whale sightings in upper Cook Inlet or possible predation attempts. Prior to 2000, an average of one Cook Inlet beluga whale was killed annually by killer whales (Shelden et al. 2003). During 2001-2012 only three Cook Inlet beluga whales were reported as preyed upon by killer whales (NMFS unpublished data). This is likely an underestimate, however, as the remains of preyed-upon belugas may sink and go undetected by humans. Killer whale predation has been reported to have a potentially significant impact on the Cook Inlet beluga whale population (Shelden et al. 2003).

The risk to Western DPS Steller sea lions from killer whale predation is considered potentially high (Muto et al. 2018), and may be one of the causes contributing to population declines.

5.8.5 Vessel Strikes

Cook Inlet beluga whales may be susceptible to vessel strike mortality. To date, however, only one whale death, in October 2007, has been attributed to a potential vessel strike based on bruising consistent with blunt force injuries (NMFS unpublished data). Beluga whales may be especially susceptible to strikes from commercial and recreational fishing vessels (as opposed to cargo ships, oil tankers, and barges) since both belugas and fishing activities occur where salmon and eulachon congregate. A number of beluga whales have been photographed with propeller scars (McGuire et al. 2014), suggesting that small vessel strikes are not rare, but such strikes are often survivable. Small boats are able to quickly approach and disturb these whales in their preferred shallow coastal habitat.

Although risk of vessel strike has not been identified as a significant concern for Steller sea lions, the recovery plan for this species states that Steller sea lions may be more susceptible to ship strike mortality or injury in harbors or in areas where animals are concentrated, e.g., near rookeries or haulouts (NMFS 2008b). In 2007, a Steller sea lion was found in Kachemak Bay that may have been a part of a boat collision. The Steller sea lion had two separate wounds consistent with blunt trauma (NMFS Alaska Regional Office Stranding Database accessed May

2019).

From 1978-2012, there were at least 108 recorded whale-vessel collisions in Alaska, with the majority occurring in Southeast Alaska (Neilson et al. 2012). Among larger whales, humpback whales are the most frequent victims of ship strikes in Alaska, accounting for 86 percent of all reported collisions. There have been five documented large cetacean vessel collisions in Cook Inlet since 2001; one humpback whale, one fin whale, two beluga whale, and one unidentified large cetacean. In 2001, a humpback whale was discovered on the bulbous bow of a 710 ft container ship as it docked in the Port of Anchorage. It is unknown where the vessel may have collided with the whale. In 2002, a beluga whale was seen with 3 to 4 propeller slashes, it is unknown the actual cause of death. In 2005, a 28 ft charter boat hit an unidentified large cetacean (NMFS Alaska Regional Office Stranding Database accessed May 2019). In October 2012, a necropsy of another Cook Inlet beluga carcass indicated the most likely cause of death was "blunt trauma such as would occur with a strike with the hull of the boat" (NMFS AKR, unpub. data).

5.8.6 Research

Research is a necessary endeavor to assist in the recovery of threatened and endangered species; however, research activities can also disturb these animals. Research on marine mammals often require boats, adding to the vessel traffic, noise, and pollution near the action area. Aerial surveys could also disturb whales, especially when circling at low-altitudes to obtain accurate group counts occurs. Boat based surveys, such as photo-identification studies, often require the boat to closely approach whales or whale groups. Deployment and retrieval of passive acoustic monitoring devices requires a boat, which temporarily increases noise in the immediate area. However, once the instruments are deployed, passive acoustic monitoring is noninvasive.

Research activities can be more invasive, especially when they include animal capture, collecting blood and tissue samples, or attaching tracking devices such as satellite tags. In the worst case, research can result in deaths of the animals. Between 1999 and 2002, NMFS placed satellite tags on 18 beluga whales in upper Cook Inlet (Hobbs et al. 2005). Shortly after a tagging event in 2002, a tagged beluga whale was found dead; its tag had transmitted for only 32 hours. Another two tagged beluga whales transmitted data for less than 48 hours, with similar dive patterns; it is unknown whether these whales, tagged in the same manner as the one that died, also perished, or were fitted with defective tags (NMFS, unpublished data). In 2015, an additional animal previously tagged by researchers washed up dead, with infection at the site of instrument attachment implicated as a possible cause of death.

Although research may affect beluga whales, it is anticipated that research will continue to increase because there are many remaining data gaps on Cook Inlet beluga whale biology and ecology (NMFS 2016b). However, managers are cautious in permitting only minimally invasive research techniques.

Steller sea lions and humpback whales are more likely to be found in lower Cook Inlet, and as such, research activities on these species is focused in the lower inlet. There have been no known instances of research-related deaths of humpback whales in the lower inlet. Aerial surveys have the potential to affect Steller sea lions, primarily due to aircraft noise-induced sea lion stampedes that can result in the crushing of pups and young animals. Such events can occur after an aircraft has already passed by the animals.

5.9 Climate and Environmental Change

The physical environment of Cook Inlet is shifting, with a reduction in duration of seasonal sea ice. In Cook Inlet, mesozooplankton biomass increased each year from 2004 to 2006; however, sampling from late 2006 to early 2007 suggests biomass values are decreasing (Batten et al. 2018), a change the authors suggest was driven by changes in climate. Changes in temperature affect zooplankton abundance, which in turn may influence fish species composition, and hence, the quality and types of fish available for marine mammals.

Beluga whales seasonally breed and feed in nearshore waters during the summer, but are ice-associated during the remaining part of the year. Ice floes can offer protection from predators and, in some regions, support prey, such as ice-associated cod. Moore and Huntington (2008) suggested that belugas and other ice-associated marine mammals might benefit from warmer climates as areas formerly covered ice would be available to forage. However, given the limited winter prey available in upper Cook Inlet (where ice predominates during winter), less winter ice might not benefit Cook Inlet beluga whales.

An additional threat of climate change to belugas may not be solely the direct change in climate, but rather the effect regional warming would have on increased human activity. Less ice would mean increased vessel activity with an associated increase in noise, pollution, and risk of ship strike. Other factors include changing prey composition, increased killer whale predation due to lack of ice refuge, increased susceptibility to ice entrapment due to less predictable ice conditions, and increased competition with co-predators. Specific to Cook Inlet beluga whales, the greatest climate change risks would likely be potential changes in salmon and eulachon abundance, and any increase in winter susceptibility to killer whale predation. Also, more rapid melting of glaciers might change the silt deposition in the Susitna Delta, potentially altering habitat for prey (NMFS 2008a). However, the magnitude of these potential effects is unpredictable.

Whether recent increases in the presence of humpback whales in Cook Inlet can be attributed to climate change, whale population growth, or other factors remains speculative. There is no clear trend in the number of humpback whale sightings in lower Cook Inlet between 2004 and 2016 (Figure 36). Climate-driven changes in glacial melt are presumed to have profound effects on seasonal streamflow within the Cook Inlet drainage basin, affecting both anadromous fish survival and reproduction in unpredictable ways. Changes in glacial outwash will also likely affect the chemical and physical characteristics of Cook Inlet’s estuarine waters, possibly changing the levels of turbidity in the inlet. Whether such a change disproportionately benefits marine mammals, their prey, or their predators is unknown.

An Unusual Mortality Event (UME) of large cetaceans occurred in Alaskan waters in 2015-2016. Reports of dead whales included 22 dead humpback, 12 fin, 2 gray, 1 sperm, and 6 unidentified whales. The fin whales were observed stranded within a 27-day period around Kodiak Island. This was concurrent with an unusually large number of dead whales found in British Columbia, which included 6 humpback, 5 fin, and 1 sperm whale (NMFS unpublished data). The strandings were concurrent with the arrival in Alaskan waters of a persistent but anomalous ocean surface heat region dubbed “the Blob,” which extended to depths of 200 m, potentially affecting whale food resources. The mortalities were also concurrent with one of the strongest El Nino weather patterns on record, decreasing ice extent in the Bering Sea, and one of the warmest years on record in Alaska in terms of air temperature. While we cannot say with certainty that this UME was caused or exacerbated by climate change, it remains a reasonable hypothesis.

Another UME was declared for gray whales along the west coast of North America in 2019[20], with 48 whales stranding in Alaska (including one in Cook Inlet), out of a total of 235 across their migration route from Mexico to Alaska. While the cause of the UME is undetermined at this time, preliminary findings in several of the whales have shown evidence of emaciation. However, these findings are not consistent across all of the whales examined, so more research is needed.

Cook Inlet beluga whale critical habitat may be affected by climate change and other large-scale environmental phenomena including Pacific Decadal Oscillation (PDO) (a long-lived El Nino-like climate variability that may persist for decades) and ecological regime shifts. Climate change can potentially affect prey availability, glacial output and siltation, and salinity and acidity in downstream estuarine environments (NMFS 2010, 2016b). PDO may influence rainfall, freshwater runoff, water temperature, and water column stability. Ecological regime shifts, in which species composition is restructured, have been identified in the North Pacific (Hollowed and Wooster 1992, Anderson and Piatt 1999, Hare and Mantua 2000) and are believed to have affected prey species availability in Cook Inlet and the North Pacific. These events may result in seasonal and spatial changes in prey abundance and distribution and could affect the conservation value of designated critical habitat for Cook Inlet beluga whales.

5.10 Natural Catastrophic Changes

The critical habitat for Cook Inlet beluga whales is within a region of known seismic and volcanic activity and tsunami events. Earthquakes, volcanic eruptions, landslides, and tsunamis can alter the physical environment instantaneously. Catastrophic events are infrequent but have the potential to affect Cook Inlet beluga critical habitat by: decreasing prey abundance as a result of direct mortality; rendering habitat unsuitable for Cook Inlet beluga prey species; directly removing habitat areas (e.g., elevation changes, landslides, and tsunamis could block access to critical habitat); and degrading habitat quality (e.g., volcanic ash outfall could affect siltation and water chemistry; (NMFS 2016b)).

5.11 Summary of Stressors Affecting Listed Species in the Action Area

Several of the activities described in the *Environmental Baseline* have adversely affected listed species and designated critical habitat that occur in the action area:

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[20] https://www.fisheries.noaa.gov/national/marine-life-distress/2019-gray-whale-unusual-mortality-event-along-west-coast

- Coastal development (Figure 40), particularly at the Port of Alaska, has resulted in exposure of beluga whales to noise levels capable of causing harassment.
- Oil and gas development (Figure 41) has resulted in 79 spills releasing 126,259 gallons of oil into Cook Inlet since 1962.
- Seismic exploration has introduced sounds exceeding 240 dB into the marine environment, creating a 9.5 km-radius zone in which sound was sufficiently loud to cause harassment. Seismic exploration has resulted in harmful Level A noise exposure to both humpback and beluga whales. It has also resulted in the temporary degradation of Cook Inlet beluga whale critical habitat.
- Aircraft have been observed to cause behavioral changes to groups of feeding beluga whales when the aircraft flew past at low altitudes or circled the groups.
- Fisheries co-occur with concentrations of beluga prey (Figure 40), likely competing with the whales for their prey. Beluga whales no longer avail themselves of abundant but heavily human-exploited salmon runs off the Kenai River during summer as they once did.
- Propeller scars observed on belugas may have resulted from collisions with recreational or commercial fishing boats.
- Subsistence whaling for Cook Inlet beluga whales by Alaska Natives represents the largest known anthropogenic mortality for the stock, reducing the population from about 1,300 whales in 1979 to less than 300 whales. While the population appeared to be increasing until 2010, there appears to have been a steeper decline after 2010 than was previously thought, currently estimated at -2.3%/year.
- Subsistence harvest of Western DPS Steller sea lions occurs under co-management agreements with NMFS, and occurs at or well below sustainable levels of harvest.
- Vessel traffic in Cook Inlet (Figure 46) poses varying levels of threat to the species depending on the type and intensity of the shipping activity and its degree of spatial and temporal overlap with habitats. Strikes have involved cruise ships, recreational cruisers, fishing vessels, and skiffs. The presence, movements, and sound of ships in the vicinity of some species may cause them to abandon breeding or foraging areas.
- Whether contaminants have resulted in the degradation of Cook Inlet beluga whale critical habitat remains unknown. Contaminant loads in Cook Inlet beluga whales are low compared to other stocks.
- Wastewater is discharged into Cook Inlet, much of it untreated or undergoing only primary treatment. Effects of this discharge on marine mammals remain unknown.
- At least three Cook Inlet beluga whales died shortly after attachment of satellite transmitters to their backs in the early 2000s. No recent mortalities incidental to marine mammal research activities in the action area have been documented.
- There are insufficient data to make reliable estimations of the impact of climate change on marine mammals considered in this Biological Opinion. Effects of climate change and

other large scale environmental phenomena on Cook Inlet beluga whale critical habitat remain unknown.

- The beluga whale has undergone notable summer range restriction in recent years, and whales now occur predominantly in upper Cook Inlet (Figure 15).

The Cook Inlet beluga population continues to decline for unknown reasons, the population trend of Western North Pacific DPS of humpback whales is unknown, and Mexico DPS humpback whale population is likely declining. In contrast, Western DPS Steller sea lions within Cook Inlet appear to be stable or increasing, despite their continued exposure to the effects of the activities discussed in the *Environmental Baseline*.

Although we do not have information on other measures of the demographic status of Steller sea lions (for example, age structure, gender ratios, or the distribution of reproductive success) that would facilitate a more robust assessment of the probable impact of the *Environmental Baseline*,[21] we infer from their increasing abundance in the vicinity of Cook Inlet that the *Environmental Baseline* is not currently preventing the populations of these species from increasing.

The main threats to recovery of Western North Pacific and Mexico DPS humpback whales is thought to be entanglement in fishing gear and vessel strike due to increased shipping throughout their range (Muto et al. 2019). These threats are discussed in this *Environmental Baseline*, but do not appear to be significant stressors in Cook Inlet.

The cause, or causes, of the continued decline of Cook Inlet beluga whales is unknown. The Recovery Plan (NMFS 2016b) outlines multiple threats to Cook Inlet beluga whales (Table 8). Many of the projects and issues discussed in this *Environmental Baseline* are specific examples of these types of threats (e.g., noise, habitat loss or degradation, pollution, cumulative effects, etc.).

[21] Increase in a population's abundance is only one piece of evidence that a population is improving in status; however, because populations can increase while experiencing low juvenile survival (e.g., if low juvenile survival is coupled with reduced adult mortality) or when those individuals that are most sensitive to a stress regime die, leaving the most resistant individuals, increases in abundance are not necessarily indicative of the long-term viability of a species.

6. EFFECTS OF THE ACTION

"Effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR § 402.02).

This biological opinion relies on the best scientific and commercial information available. We try to note areas of uncertainty, or situations where data is not available. In analyzing the effects of the action, NMFS gives the benefit of the doubt to the listed species by minimizing the likelihood of false negative conclusions (concluding that adverse effects are not likely when such effects are, in fact, likely to occur).

We organize our effects analysis using a stressor identification – exposure – response – risk assessment framework for the proposed activities.

We conclude this section with an *Integration and Synthesis of Effects* that integrates information presented in the *Status of the Species* and *Environmental Baseline* sections of this opinion with the results of our exposure and response analyses to estimate the probable risks the proposed action poses to endangered and threatened species and designated critical habitat.

NMFS identified and addressed all potential stressors; and considered all consequences of the proposed action, individually and cumulatively, in developing the analysis and conclusions in this opinion regarding the effects of the proposed action on ESA-listed species and designated critical habitat.

6.1 Project Stressors

Stressors are any physical, chemical, or biological factor that can induce an adverse response. The effects section starts with identification of the stressors produced by the constituent parts of the proposed action. Based on our review of the data available, the POA PCT project may result in the following stressors to ESA-listed marine mammals and their designated critical habitat:

- Acoustic disturbance from pile driving activities;
- Acoustic and visual disturbance from vessels and project activities;
- Vessel strikes;
- Effects on prey species;
- Habitat alteration;
- Entanglement and ingestion of trash and debris; and
- Pollution from unauthorized spills.

6.2 Exposure and Response Analysis

As discussed in the *Approach to the Assessment* section of this opinion, exposure analyses are designed to identify the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence. In this step of our analysis, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent.

As discussed in *Mitigation Measures* section, the proposed mitigation measures should avoid or minimize exposure of Cook Inlet beluga whales, humpback whales, and Steller sea lions to stressors. Refer to Section 2.1.2 for details on the proposed mitigation measures.

For our exposure analyses, we generally consider an action agency's estimates of the number of marine mammals that might be "taken" over the duration of the proposed action. The NMFS Permits Division and AKR calculated the exposure and "take" estimates for the two Phases of the POA PCT project.

Following the exposure analysis is the response analysis. The response analyses determine how listed species are likely to respond after being exposed to an action's effects on the environment or directly on listed species themselves. Our assessments try to detect the probability of lethal responses, physical damage, physiological responses (particular stress responses), behavioral responses, and social responses that might result in reducing the fitness of listed individuals. Ideally, our response analyses consider and weigh evidence of adverse consequences, beneficial consequences, or the absence of such consequences.

Possible responses by ESA-listed marine mammals to project activities in this analysis are:

- Threshold shifts
- Auditory interference (masking)
- Behavioral responses including avoidance of portions of affected habitat
- Non-auditory physical or physiological effects

Responses from ESA-listed species to project activities are discussed for each stressor.

Threshold Shift

Exposure of marine mammals to very loud noise can result in physical effects, such as changes to sensory hairs in the auditory system, which may temporarily or permanently impair hearing. Temporary threshold shift (TTS) is a temporary hearing change, and its severity is dependent upon the duration, frequency, sound pressure, and rise time of a sound (Finneran and Schlundt 2013). TTSs can last minutes to days. Full recovery is expected, and this condition is not considered a physical injury. At higher received levels, or in frequency ranges where animals are more sensitive, permanent threshold shift (PTS) can occur. When PTS occurs, auditory sensitivity is unrecoverable (i.e., permanent hearing loss). The effect of noise exposure generally depends on a number of factors relating to the physical and spectral characteristics of the sound (e.g., the intensity, peak pressure, frequency, duration, duty cycle) and relating to the animal under consideration (e.g., hearing sensitivity, age, gender, behavioral status, prior exposures).

Both TTS and PTS can result from a single pulse or from accumulated effects of multiple pulses from an impulsive sound source (i.e., impact pile or pipe driving) or from accumulated effects of non-pulsed sound from a continuous sound source (i.e., vibratory pile driving). In the case of exposure to multiple pulses, each pulse need not be as loud as a single pulse to have the same accumulated effect.

As it is a permanent auditory injury, the onset of PTS may be considered an example of "Level A harassment" as defined in the MMPA. TTS is by definition recoverable rather than permanent, and has historically been treated as "Level B harassment" under the MMPA. Behavioral effects may also constitute Level B harassment, and are expected to occur at even lower noise levels than would generate TTS.

Masking

The concept of acoustic interference is familiar to anyone who has tried to have a conversation in a noisy restaurant or at a rock concert. In such situations, the collective noise from many sources can interfere with one's ability to understand, recognize, or even detect sounds of interest. Masking from anthropogenic noise sources may disrupt marine mammal communication when sound frequencies overlap with communication frequencies used by marine mammals. Studies have shown that cetaceans' response may be similar to that of humans speaking louder to communicate in a noisy situation.

Clark et al. (2009) developed a methodology for estimating masking effects on communication signals for low frequency cetaceans, including calculating the cumulative impact of multiple noise sources. For example, their technique calculates that in Stellwagen Bank National Marine Sanctuary, when two commercial vessels pass through a North Atlantic right whale's optimal communication space (estimated as a sphere of water with a diameter of 20 km), that space is decreased by 84 percent. This methodology relies on empirical data on source levels of calls (which is unknown for many species), and requires many assumptions about ambient noise conditions and simplifications of animal behavior. However, it is an important step in determining the impact of anthropogenic noise on animal communication. Subsequent research for the same species and location estimated that an average of 63 to 67 percent of North Atlantic right whales' communication space has been reduced by an increase in ambient noise levels, and that noise associated with transiting vessels is a major contributor to the increase in ambient noise (Hatch et al. 2012).

Vocal changes in response to anthropogenic noise can occur across sounds produced by marine mammals, such as whistling, echolocation click production, calling, and singing. Changes to vocal behavior and call structure may result from a need to compensate for an increase in background noise. In cetaceans, vocalization changes have been reported from exposure to anthropogenic noise sources such as sonar, vessel noise, and seismic surveying. Vocalizations may also change in response to variation in the natural acoustic environment (e.g., from variation in sea surface motion (Dunlop et al. 2014)). Holt et al. (2009) found that Southern Resident killer whales in Puget Sound near Seattle increased their call amplitude by 1 dB for every 1 dB increase in background noise levels.

Additionally, as anthropogenic sound increases in intensity, animals (including whales) are less able to compensate, and may cease auditory communication altogether. Kendall et al. (2014) found that beluga whales temporarily ceased vocalizing while travelling past the Port of Alaska during in-water construction activities.

The POA's PCT project may result in masking while pile driving is occurring. Although pile driving may occur from April through November, pile driving will occur during the daylight hours only, and during this time, pile driving will be intermittent, i.e., there will be periods of time when pile driving is not occurring. Therefore, it is not expected to result in extended periods of time where masking could occur. As stated above, masking only exists for the duration of time that the masking sound is emitted.

Behavioral Response

NMFS expects the majority of ESA-listed species responses to the proposed activities will occur in the form of behavioral response. Marine mammals may exhibit a variety of behavioral changes in response to underwater sound and the general presence of project activities and equipment, which can be generally summarized as:

- Modifying or stopping vocalizations,
- Changing from one behavioral state to another, and/or
- Avoidance or movement out of feeding, breeding, or migratory areas.

The response of a marine mammal to an anthropogenic sound will depend on the frequency, duration, temporal pattern, and amplitude of the sound as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). The distance from the sound source and whether it is perceived as approaching or moving away can affect the way an animal responds to a sound (Wartzok et al. 2003). For marine mammals, a review of responses to anthropogenic sound was first conducted by Richardson et al. (1995). More recent reviews (Nowacek et al. 2007, Southall et al. 2007, Southall et al. 2009, Ellison et al. 2012) focus on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated.

Except for some vocalization changes that may be compensating for auditory masking, all behavioral reactions are assumed to occur due to a preceding stress or cueing responses, however, stress responses cannot be predicted directly due to a lack of scientific data (see *Non-Auditory Physical or Physiological* Effects section). Responses can overlap; for example, an increased respiration rate is likely to be coupled with a flight response. Differential responses are expected among and within species since hearing ranges vary across species and individuals, the behavioral ecology of individual species is unlikely to completely overlap, and individuals of the same species may react differently to the same, or similar, stressor.

Marine mammal responses to anthropogenic sound vary by species, state of maturity, prior exposure, current activity, reproductive state, time of day, and other factors (Ellison et al. 2012). This is reflected in a variety of aquatic, aerial, and terrestrial animal responses to anthropogenic noise that may ultimately have fitness consequences (Francis and Barber 2013).

Non-Auditory Physical or Physiological Effects

Individuals exposed to noise can experience stress and distress, where stress is an adaptive response that does not normally place an animal at risk, and distress is a stress response resulting in a biological consequence to the individual. Both stress and distress can affect survival and productivity (Curry and Edwards 1998, Cowan and Curry 2002, Herráez et al. 2007, Cowan and Curry 2008). Mammalian stress levels can vary by age, sex, season, and health status (St. Aubin et al. 1996, Gardiner and Hall 1997, Hunt et al. 2006, Romero et al. 2008).

Anthropogenic activities have the potential to provide additional stressors above and beyond those that occur naturally. For example, various efforts have investigated the impact of vessels on marine mammals (both whale-watching and general vessel traffic noise) and demonstrated that impacts do occur (Erbe 2002, Williams et al. 2002, Williams and Ashe 2006, Williams and Noren 2009, Pirotta et al. 2015). In an analysis of energy costs to killer whales, Williams and Noren (2009) suggested that whale-watching in the Johnstone Strait resulted in lost feeding opportunities due to vessel disturbance. During flight and shipping restrictions following the September 11, 2001 terrorist attacks in the U.S., shipping traffic and associated ocean noise decreased along the northeastern U.S. This decrease in ocean noise was associated with a significant decline in fecal stress hormones in North Atlantic right whales, suggesting that chronic exposure to increased noise levels, although not acutely injurious, can produce stress (Rolland et al. 2012). These levels returned to their previous level within 24 hrs after the resumption of shipping traffic. Exposure to loud noise can also adversely affect reproductive and metabolic physiology (Kight and Swaddle 2011). In a variety of factors, including behavioral and physiological responses, females appear to be more sensitive or respond more strongly than males (Kight and Swaddle 2011).

If a sound is detected by a marine mammal, a stress response (e.g., startle or annoyance) or a cueing response (based on a past stressful experience) can occur. Although findings are preliminary because of the small numbers of samples collected, different types of sounds have been shown to produce variable stress responses in marine mammals. Belugas demonstrated no catecholamine (hormones released in situations of stress) response to the playback of oil drilling sounds (Thomas et al. 1990) but showed an increase in catecholamines following exposure to impulsive sounds produced from a seismic water gun (Romano et al. 2004).

Whales and Steller sea lions use hearing as a primary way to gather information about their environment and for communication; therefore, we assume that limiting these abilities is stressful. Stress responses may also occur at levels lower than those required for TTS (NMFS 2018a). Therefore, exposure to levels sufficient to trigger onset of PTS or TTS are expected to be accompanied by physiological stress responses (NRC 2003).

We expect individuals may experience both Level A and Level B acoustic harassment, may experience masking, and may exhibit behavioral responses from project activities. Therefore, we expect ESA-listed whales and sea lions may experience stress responses. If whales and sea lions are not displaced and remain in a stressful environment (i.e., within the behavioral harassment zone), we expect the stress response will diminish shortly after the individual leaves the area or after the cessation of the acoustic stressor.

6.2.1 Acoustic Sources Likely to Adversely Affect Listed Species[22]

As discussed in Section 2, *Description of the Proposed Action*, the Corps of Engineers intends to authorize pile driving activities within the action area, and NMFS Permits Division intends to authorize harassment of marine mammals incidental to this work.

6.2.1.1 Exposure Estimates

The exposure estimates were calculated by considering (1) acoustic thresholds above which the best available science indicates marine mammals will be behaviorally harassed or incur some degree of permanent hearing impairment; (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence of marine mammals within these ensonified areas; and (4) the number of days of activities.

Acoustic Thresholds

Since 1997, NMFS has used generic sound exposure thresholds to determine whether an activity produces underwater and in-air sounds that might result in impacts to marine mammals (70 FR 1871, 1872; January 11, 2005). NMFS recently developed comprehensive guidance on sound levels likely to cause injury to marine mammals through onset of permanent and temporary thresholds shifts (PTS and TTS) (83 FR 28824; June 21, 2018). NMFS is in the process of developing guidance for behavioral disruption (Level B harassment). However, until such guidance is available, NMFS uses the following conservative thresholds of underwater sound pressure levels,[23] expressed in root mean square[24] (rms), from broadband sounds that cause behavioral disturbance, and referred to as Level B harassment under section 3(18)(A)(ii) of the Marine Mammal Protection Act (MMPA) (16 U.S.C § 1362(18)(A)(ii)):

- impulsive sound: 160 dB_{rms} re 1 μPa
- non-impulsive sound: 120 dB_{rms} re 1μPa

However, ambient noise levels within Knik Arm are above the 120-dB threshold, and therefore, for purposes of this analysis, NMFS considers received levels above those of the measured ambient noise (122.2 dB) to constitute Level B harassment of marine mammals incidental to continuous noise, including vibratory pile driving (non-impulsive sound). Note that in considering the radius to the sound isopleth at which project acoustic effects are assumed to no longer exist, NMFS draws a distinction between ambient sound levels (natural sound levels in

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[22] Stressors that may affect designated critical habitat for Cook Inlet beluga whales are discussed in Section 6.3.

[23] Sound pressure is the sound force per unit micropascals (μPa), where 1 pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter. Sound pressure level (SPL) is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in acoustics is 1 μPa, and the units for underwater sound pressure levels are decibels (dB) re 1 μPa.

[24] Root mean square (rms) is the square root of the arithmetic average of the squared instantaneous pressure values.

the absence of all anthropogenic sound) and background sound (sound levels that include routine anthropogenic sound). NMFS does not consider background sounds, including routine anthropogenic sounds, in the calculation of the area affected by project sound.

Results from the most recent acoustic monitoring conducted at the Port are presented in Austin et al. (2016) and Denes et al. (2016) wherein sound levels were measured in absence of pile driving from May 27 through May 30, 2016 at two locations: "Ambient-Dock" and "Ambient-Offshore". NMFS considers the median sound levels to be most appropriate when considering background noise levels for purposes of evaluating the potential impacts of the POA's PCT Project on marine mammals. By selecting the median value to represent the ambient sound level, which is the 50th percentile of the measurements, we eliminate the few transient loud identifiable anthropogenic sound events that do not represent the true ambient sound condition of the area. This is relevant because during two of the four days (50 percent) when background measurement data were being collected, the U.S. Army Corps of Engineers was dredging Terminal 3 (located just north of the Ambient-Offshore hydrophone) for 24 hours per day with two 1-hour breaks for crew change. On the last two days of data collection, no dredging was occurring. Therefore, the median provides a better representation of background noise levels when the PCT project would be occurring, concurrent with routine anthropogenic sounds for that location. With regard to spatial considerations of the measurements, the "Ambient-Offshore" location is most applicable to this discussion as it is complies with a NMFS 2012 memo providing guidance on characterizing underwater background sound[25]. The median noise level collected over four days at the end of May at the "Ambient-Offshore" hydrophone was 122.2 dB. We note the "Ambient-Dock" location was quieter, with a median of 117 dB; however, that hydrophone was placed very close to the dock and not where we would expect Level B harassment to occur given mitigation measures (*e.g.*, shut downs). We therefore consider 122.2 dB to represent the average ambient sound level for this location, and use the 122.2 dB isopleth to define the threshold distance beyond which project-generated sound no longer causes Level B harassment of marine mammals. If additional data collected in the future warrant revisiting this issue, NMFS may adjust the 122.2 dB rms Level B harassment threshold for this location.

Under the PTS Technical Guidance, NMFS uses the following thresholds (Table 16) for underwater sounds that cause injury, referred to as Level A harassment under section 3(18)(A)(i) of the MMPA (16 U.S.C § 1362(18)(A)(i)) (NMFS 2018a). Different thresholds and auditory weighting functions are provided for different marine mammal hearing groups, which are defined in the Technical Guidance (NMFS 2018a). The generalized hearing range for each hearing group is in Table 15.

[25] On January 31, 2012, NMFS Northwest Regional Office issued guidance to characterize underwater background sound (overall sound levels absent those from the proposed activity) in areas of proposed activities that have the potential to injure or disturb marine mammals. That guidance provides specific instructions for how to conduct the measurements. Included in this is spatial orientation of the hydrophones.

Table 15. Underwater marine mammal hearing groups (NMFS 2018).

Hearing Group	**ESA-listed Marine Mammals In the Project Area**	**Generalized Hearing Range[1]**
Low-frequency (LF) cetaceans *(Baleen whales)*	Bowhead whales	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans *(dolphins, toothed whales, beaked whales)*	None	150 Hz to 160 kHz
High-frequency (HF) cetaceans *(true porpoises)*	None	275 Hz to 160 kHz
Phocid pinnipeds (PW) *(true seals)*	Ringed and bearded seals	50 Hz to 86 kHz
Otariid pinnipeds (OW) *(sea lions and fur seals)*	None	60 Hz to 39 kHz

[1]Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 db threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007) and PW pinniped (approximation).

These acoustic thresholds are presented using dual metrics of cumulative sound exposure level (L_E) and peak sound level (PK) for impulsive sounds and L_E for non-impulsive sounds.

Level A harassment radii can be calculated using the optional user spreadsheet[26] associated with NMFS Acoustic Guidance, or through modeling. In addition, NMFS uses the following threshold for in-air sound pressure levels from broadband sounds that cause Level B behavioral disturbance under section 3(18)(A)(ii) of the MMPA (16 U.S.C. § 1362(18)(A)(ii)): 100 dB_{rms} re 20μPa for non-harbor seal pinnipeds. Considering there are no known Steller sea lion haulouts within the vicinity of the POA and Steller sea lions have rarely been observed in the area, it is unlikely in-air Level B behavioral disturbance due to in-air sound will occur.

Table 16. PTS Onset Acoustic Thresholds for Level A Harassment (NMFS 2018a).

Hearing Group	**PTS Onset Acoustic Thresholds*** **(Received Level)**	
	Impulsive	**Non-impulsive**
Low-Frequency (LF) Cetaceans	$L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	$L_{E,LF,24h}$: 199 dB

[26] The Optional User Spreadsheet can be downloaded from the following website: http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm

Hearing Group	PTS Onset Acoustic Thresholds* (Received Level)	
	Impulsive	Non-impulsive
Mid-Frequency (MF) Cetaceans	$L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	$L_{E,MF,24h}$: 198 dB
High-Frequency (HF) Cetaceans	$L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	$L_{E,HF,24h}$: 173 dB
Phocid Pinnipeds (PW) (Underwater)	$L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	$L_{E,PW,24h}$: 201 dB
Otariid Pinnipeds (OW) (Underwater)	$L_{pk,flat}$: 232 dB $L_{E,OW,24h}$: 203 dB	$L_{E,OW,24h}$: 219 dB

* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.

Note: Peak sound pressure (L_{pk}) has a reference value of 1 µPa, and cumulative sound exposure level (L_E) has a reference value of 1µPa^{2}s. The subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (i.e., varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

The MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]" (16 U.S.C. § 1362(18)(A)).

While the ESA does not define "harass," NMFS issued guidance interpreting the term "harass" under the ESA as a means to: "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (Wieting 2016). For purposes of this consultation, we consider any exposure to Level B behavioral disturbance sound thresholds to constitute harassment under the ESA.

Area of Ensonification

The area of ensonification is the area of water that will be ensonified above the acoustic thresholds in a day. Here, we describe operational and environmental parameters of the activity that were used to identify the area ensonified, which include source levels and transmission loss coefficient. The estimated sound source levels and transmission loss coefficient used in our analysis are based on direct measurements during installation of unattenuated 48-in piles during the POA's 2016 TPP and measurements collected during marine construction projects conducted by the U.S. Navy. All source levels used in our analysis are presented in Table 17.

Table 17. Estimated Sound Source Level With and Without a Bubble Curtain

Method and Pile Size	**Sound Level at 10 m**						**Data Source**
	Unattenuated[1]			**Bubble Curtain**			
Vibratory	**dB rms**			**7 dB reduction, dB rms**			
144-in	178			171			Caltrans 2015
48-in	168			161			Austin et al 2016
36-in	166			159			Navy 2015
24-in	161			154			Navy 2015
Impact	**Unattenuated[1]**			**Bubble Curtain**			
	dB rms	**dB SEL**	**dB peak**	**dB rms**	**dB SEL**	**dB peak**	
144-in	209	198	220	202	191	213	Caltrans 2015
48-in	200	187	215	193	180	208	Austin et al 2016
36-in	194	184	211	187	177	204	Navy 2015
24-in	193	181	210	186	174	203	Navy 2015

[1] We note the only piles that may be driven or removed without a bubble curtain are 24-in battered piles. We included unattenuated SLs here for 36-in, 48-in, and 144-in piles to demonstrate how the 7dB reduction for bubble curtains was applied.

During the TPP, JASCO computed transmission loss (TL) coefficients, derived from fits of the received sound level data versus range. When using sound attenuation devices, TL coefficients varied between piles with values ranging from 13 to 19.2 for impact pile driving and from 12.6 to 17.9 for vibratory pile driving. For unattenuated pile driving, results for the hydraulic impact hammer yielded the highest TL coefficient, 19.2, indicating that sounds from the hydraulic impact hammer decayed most rapidly with range compared to the other hammers. The TL coefficient for unattenuated pile driving by the diesel impact hammer averaged 17.5. Sounds from the unattenuated vibratory hammer had TL coefficient values of 16.1 and 16.9.

Based on these data, the POA proposed different transmission loss rates depending on whether SEL (used for Level A harassment) or rms (used for Level B harassment) values were being evaluated. SPLrms is a pressure metric and SEL an energy metric. The difference in TL coefficient is a reflection of how SPLrms or SEL is dissipated in the marine environment. During underwater sound propagation, pressure amplitude tends to suffer more loss due to multipath propagation and reverberation, while acoustic energy does not dissipate as rapidly. Accordingly, the POA proposed using a TL rate of 16.85 for assessing potential for Level A harassment from impact pile driving but a TL rate of 18.35, based on Austin et al. (2016), when assessing potential for Level B harassment from impact pile driving. For vibratory pile driving, SPLrms is used for both Level A harassment and Level B harassment analysis and, based on Austin et al. (2016), the POA applied a TL rate of 16.5. NMFS found these transmission loss rates acceptable and carried them forward in our analysis.

When the NMFS Technical Guidance (2016) was published (and revised in 2018; (NMFS

2018a)), in recognition of the fact that ensonified area/volume could be more technically challenging to predict because of the duration component in the new thresholds, NMFS Permits Division developed a User Spreadsheet that includes tools to help predict a simple isopleth that can be used in conjunction with marine mammal density or occurrence to help predict takes. NMFS Permits Division notes that because of some of the assumptions included in the methods used for these tools, it is anticipated that isopleths produced are typically going to be overestimates to some degree (and therefore more conservative), which may result in some degree of overestimate of Level A harassment take. However, these tools offer the best way to predict appropriate isopleths when more sophisticated 3D modeling methods are not available, and NMFS continues to develop ways to quantitatively refine these tools, and will qualitatively address the output where appropriate. For stationary sources (such as pile driving), the NMFS User Spreadsheet predicts the closest distance at which a marine mammal would not incur PTS despite remaining at that distance throughout the duration of the activity.

The User Spreadsheet also includes a default, single frequency weighting factor adjustment (WFA) to account for frequency hearing groups. During the 2016 TPP, the POA collected direct measurements of sound generated during installation of 48-in piles. The spectra associated with impact and vibratory driving of 48-in unattenuated piles was also derived. Therefore, for this proposed action, NMFS accepted POA’s applied spectra approach for 48-in piles but relied on the User Spreadsheet default WFA for all other pile sizes. Inputs used in the User Spreadsheet for 24-in, 36-in and 144-in piles, and the resulting isopleths are reported in Table 18.

To calculate the Level B harassment isopleths, NMFS considered SPLrms source levels and the corresponding TL coefficients of 18.35 and 16.5 for impact and vibratory pile driving, respectively. The resulting Level A harassment and Level B harassment isopleths are presented in Table 19.

Table 18. NMFS User Spreadsheet Inputs.

Spreadsheet Tab Used	**24-in (unattenuated)**	**24-in (bubble curtain)**	**36-in (bubble curtain)**	**48-in (bubble curtain)**	**144-in (bubble curtain)**
	E.1) Impact pile driving	**E.1) Impact pile driving**	**E.1) Impact pile driving**	**E.1) Impact pile driving**	**E.1) Impact pile driving**
USER SPREADSHEET INPUT: IMPACT PILE DRIVING (TL = 16.85)					
Source Level (Single Strike/shot SEL)	181	174	177	180	191
Weighting Factor Adjustment (kHz)	2	2	2	measured spectra	2
Number of strikes pile	100	100	3,000	2,300 or 3,000	5,000
Piles per day	4	4	1-3	1-3	0.3 or 0.7
	24-in (unattenuated)	**24-in (bubble curtain)**	**36-in (bubble curtain)**	**48-in (bubble curtain)**	**144-in (bubble curtain)**
Spreadsheet Tab Used	A) Non-Impul, Stat, Cont.	A) Non-Impul, Stat, Cont.	A) Non-Impul, Stat, Cont.	A) Non-Impul, Stat, Cont.	A) Non-Impul, Stat, Cont.
USER SPREADSHEET INPUT: VIBRATORY PILE DRIVING (TL = 16.5)					
Source Level (SPL RMS)	161	154	159	161	171
Weighting Factor Adjustment (kHz)	2.5	2.5	2.5	measured spectra	2.5
Time to drive single pile (minutes)	75	75	75	30	45
Piles per day	1-5	1-3	1-3	1	1

Table 19. Distances to Level A harassment, by hearing group, and Level B harassment thresholds per pile type and installation method.

Pile Size	Hammer Type	Attenuation	Piles installed/day	Level A harassment (m)					Level B harassment (m)
				LF	**MF**	**HF**	**PW**	**OW**	
48-in (2,300 strikes per pile)	Impact	Bubble Curtain	1	655	34	766	376	36	824
			2	989	51	1,156	567	55	
			3	1,258	65	1,470	721	70	
48-in (3,000 strikes per pile)	Impact	Bubble Curtain	1	767	39	897	440	43	824
			2	1,158	59	1,353	664	64	
			3	1,473	76	1,721	844	82	
48-in	Vibratory	Bubble Curtain	1	5	1	7	3	0	2,247
36-in	Vibratory	Bubble Curtain	3	12	1	17	8	1	1,699
			4	14	2	20	9	1	
	Impact	Bubble Curtain	1	509	26	595	292	28	296
			2	768	39	898	440	43	
			3	978	50	1,142	560	54	
24-in	Vibratory	Bubble Curtain	3	3	0	5	2	0	846
			4	4	0	6	3	0	
		Unattenuated (6 battered piles in Phase 2)	3	9	1	13	6	1	2,247
			4	19	2	27	12	1	
	Impact (50 restrikes per pile)	Bubble Curtain	1	30	1.5	35	17	2	261
			4	68	4	79	39	4	
		Unattenuated (6 battered piles in Phase 2)	1	75	4	90	44	4	629
			4	176	9	206	101	9	
144-in	Impact	Bubble Curtain	0.3	2,286	117	2,672	1,311	127	1,945
			0.7	3,781	194	4,418	2,167	210	1,945
	Vibratory	Bubble Curtain	1	24	3	34	15	1	9,069

Marine Mammal Occurrence and Exposure Estimates

For all ESA listed species, NMFS relied on marine mammal monitoring data collected during past POA projects to calculate exposure estimates. These data cover the construction season (April through November) across multiple years. For Cook Inlet beluga whales, NMFS used a multi-step analysis consisting of an evaluation of long-term/seasonal sighting data, proposed mitigation and monitoring measures, the amount of documented take from previous POA projects compared to authorized take, and considered group size. Estimated exposure from pile installation for Steller sea lions and humpbacks is calculated by the following equation: Exposure estimate = N * # days of pile installation, where: N = highest daily abundance estimate for each species in project area across all years of data.

Cook Inlet Beluga Whales

As described in the *Cook Inlet DPS Beluga Whale* section in Chapter 4, NMFS looked at several sources of information on marine mammal occurrence in upper Cook Inlet to determine how best to estimate the potential for exposure to pile driving noise from the PCT Project. NMFS used a multi-step analysis consisting of an evaluation of long-term, seasonal sighting data, mitigation and monitoring measures, the amount of documented take from previous POA projects compared to authorized take, and group size. NMFS did not use the density data from Goetz et al. (2012) for this specific project because the density data is based on June aerial surveys while the PCT project is occurring from April through November. Instead, the data available from previous monitoring at the POA provides a data set with observations from April through November and over several years, which represents the best data currently available for calculating beluga whale exposure estimates for this specific action. First, in lieu of density data, NMFS applied sighting rate data presented in Kendall and Cornick (2015) to estimate hourly sighting rates per month (April through November). The data and calculated exposure estimates (i.e., expected beluga presence) are presented below (Table 20).

Table 20. Uncorrected Beluga Whale Exposure Estimates for Phase 1 and Phase 2.

Month	Monitoring Data[1]			Estimated Take			
	Effort Hours	# of whales observed	Average whale per hr	Phase 1[2] Pile driving hours	Beluga Whale Exposures Phase 1	Phase 2[2] Pile driving hours	Beluga Whale Exposures Phase 2
April	12	2	0.17	25.64	4.27	16.37	2.73
May	156	40	0.26	51.29	13.15	32.71	8.39
June	280	8	0.03	51.29	1.47	32.71u	0.94
July	360	2	0.01	51.29	0.28	32.71	0.18
August	426	269	0.63	51.29	32.38	32.71	20.65
Sept	447	169	0.38	51.29	19.37	32.71	12.35
October	433	22	0.05	51.29	2.61	32.71	1.66

Month	Monitoring Data[1]			Estimated Take			
	Effort Hours	# of whales observed	Average whale per hr	Phase 1[2] Pile driving hours	Beluga Whale Exposures Phase 1	Phase 2[2] Pile driving hours	Beluga Whale Exposures Phase 2
Nov	215	175	0.82	25.64	20.91	16.37	13.35
Total	**2317**	**685**	**0.30**	**359.02**	**94.44**	**229.00**	**60.25**

[1] From Kendell and Cornick 2015.

[2] Assumes equal work distribution/month except in April and November when the POA has indicated they would be conducting only 2 weeks of pile driving due to time needed for mobilization and demobilization.

Second, NMFS then considered the mitigation measures (that are part of the proposed action) and the distribution of beluga whales in Knik Arm. There are several mitigation measures that reduce the likelihood of take including strict shutdown requirements for Cook Inlet beluga whales with a goal of avoiding Level B take. NMFS recognizes that in certain situations, pile driving may not be able to be shutdown prior to whales entering the Level B harassment zone due to construction safety concerns. Also during previous monitoring efforts, sometimes beluga whales were initially observed when they surfaced within the harassment zone. For example, on November 4, 2009, 15 whales were initially sighted approximately 950 meters north of the project site near the shore, and then they surfaced in the Level B harassment zone during vibratory pile driving (ICRC 2009). Construction activities were immediately shut down, but the 15 whales were documented as takes. On other occasions, beluga whales were initially sighted outside of the harassment zone and shut down was called, but the beluga whales swam into the harassment zone before activities could be halted, and take occurred. For example, on September 14, 2009, a construction observer sighted a beluga whale just outside the harassment zone, moving quickly towards the 1,300 meter Level B harassment zone during vibratory pile driving. The animal entered the harassment zone before construction activity could be shut down, and was documented as a take (ICRC 2009).

To more accurately estimate potential exposures, we looked at previous reported takes at the POA and those actually authorized. Between 2008 and 2012, NMFS authorized 34 beluga whale takes per year to POA with mitigation measures similar to the measures proposed here. The percent of the authorized takes that were documented as actually occurring during this time period ranged from 12 to 59 percent with an average of 36 percent (Table 21). NMFS applied the highest percentage of previous takes to ensure potential impacts to beluga whales are fully evaluated and to ensure the POA has authorization for an amount of take that is reasonably certain to occur. Therefore, NMFS estimated the potential exposures for this action by applying the previously reported 59 percent of the authorized takes to the exposures calculated for Phase 1 (n=94) and Phase 2 (n=64). This number represents the best conservative estimate of belugas that may be documented as having been exposed to Level B harassment.

Table 21. Authorized and Reported Beluga Whale Takes during POA activities from 2009- 2012.

ITA Effective Dates	Reported Takes	Authorized Take	Percent of authorized takes "used"
15 July 2008-14 July 2009	12	34	35
15 July 2009-14 July 2010	20	34	59
15 July 2010 - 14 July 2011	13	34	38
15 July 2011 - 14 July 2012	4	34	12

Finally, NMFS considered group size from the long-term scientific monitoring effort and POA opportunistic data to determine if these numbers represented realistic scenarios. Figure 47 presents data from the scientific monitoring program. The APU scientific monitoring data set documented 390 beluga whale sightings.

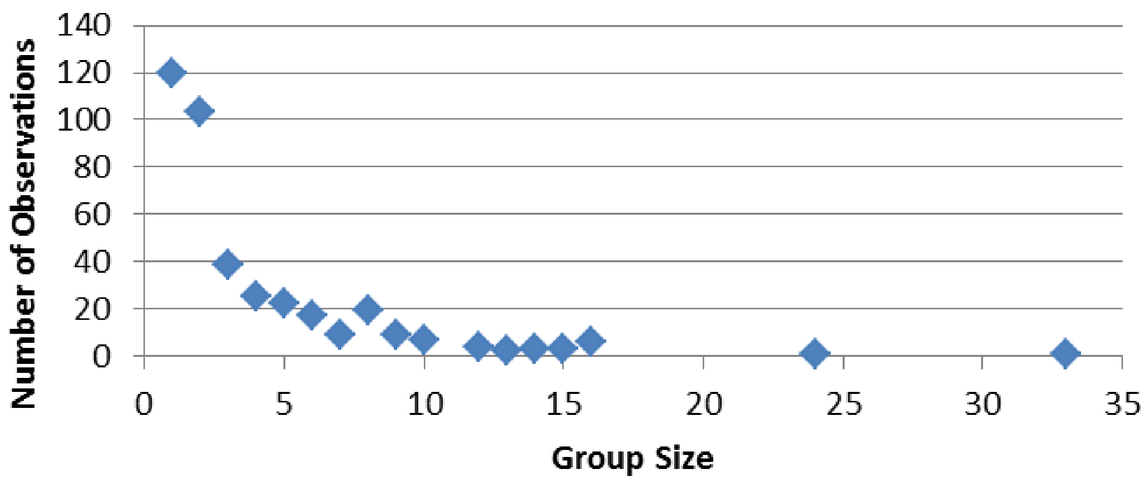

Figure 47. Cook Inlet beluga whale sighting data from POA scientific monitoring.

Group size exhibits a mode of 1 and a median of 2, indicating that over half of the beluga groups observed over the 5-year span of the monitoring program were of individual beluga whales or pairs. The 95th percentile of group size from the Alaska Pacific University (APU) scientific monitoring data set is 11.1 beluga whales. This means that, of the 390 documented beluga whale groups in this data set, 95 percent consisted of fewer than 11.1 whales; 5 percent of the groups consisted of more than 11.1 whales. NMFS concludes the amount of take proposed to be authorized following the approach above allows for the potential for large groups to be exposed to noise above NMFS harassment thresholds.

For reasons described above, we conclude this approach adequately analyzes the risk of beluga whale exposure to Level B harassment from the PCT project, with the potential for 55 exposures in Phase 1 and 35 exposures in Phase 2, for a total of no more than 90 exposures during the PCT project (Table 22). Due to the mitigation measures in place, we do not expect that Level A harassment will occur.

Table 22. Estimated beluga whale Level B harassment exposures.

PCT Construction Phase	Calculated Exposure	Final Estimated Exposure
Phase 1 – 2020	94	55
Phase 2 – 2021	60	35
Both Phase 1 and Phase 2	154	90

The NMFS Permits Division may issue a one-year IHA renewal with an expedited public comment period (15 days) when (1) another year of identical or nearly identical project activities is planned or (2) the activities would not be completed by the time the IHA expires and a second IHA would allow for completion of the activities beyond that described dates and duration. This leads to a potential overlap of Phase 1 and Phase 2 construction activities. The POA has indicated that it is unlikely that Phase 1 work would not be completed by the start of Phase 2. Therefore, NMFS AKR assumes that even if an IHA renewal is granted, a notable overlap of Phase 1 and Phase 2 activities are not expected to occur. Because the effects of the action are analyzed with a maximum of 55 belugas exposed to Level B harassment in a given year, NMFS AKR assumes that, if an IHA renewal is granted for activities that could not be completed in Phase 1, no more than 55 belugas would be exposed to Level B harassment during Phase 2.

Steller Sea Lions

Steller sea lions are anticipated to be encountered in low numbers, if at all, within the project area. However, individual animals can linger in the area for multiple days. Three sightings of what was likely a single individual occurred in the project area in 2009, and two sightings occurred in 2016 (over 19 days of work). Based on observations in 2016, NMFS anticipates an exposure rate of 2 individuals every 19 days during PCT pile installation and removal. Based on this rate, an exposure estimate of 13 sea lions takes during Phase 1 (127 days * [2 sea lions every 19 days]) and 8 Steller sea lion takes during Phase 2 (75 days for Phase 2 * [2 sea lions every 19 days]) was calculated.

During Phase 1, the Level A harassment isopleth is less than the 100 m shutdown zone for all scenarios; therefore, the potential for Level A exposure is negligible. During installation of the 144-in piles in Phase 2, there is a low potential for Level A harassment and an animal may remain for a couple days; therefore, of the 8 Steller sea lions exposures, 2 of them are expected to be Level A take. We expect these sea lions to be from the endangered Western DPS.

Humpback Whale

Sightings of humpback whales in the action area are rare, and the potential risk of exposure of a humpback whale to sounds exceeding the Level B harassment threshold is low. Few, if any, humpback whales are expected to approach the project area. However, there were two sightings (over 15 days of work) in 2017 of what was likely a single individual at the Ship Creek Boat Launch (ABR 2017), which is located south of the project area. Based on observations in 2017, NMFS estimates one humpback whale could be harassed every 16 days of pile driving. Therefore, NMFS calculates an exposure estimate of 8 humpback whale takes during Phase 1 (127 days for Phase 1 * [1 humpback whale every 16 days]) and 5 takes (75 days for Phase 2 *

[1 humpback whale every 16 days]) for Phase 2. This could include sighting a cow-calf pair on multiple days or multiple sightings of single humpback whales.

Based on the distances to the large Level A harassment thresholds relative to Level B harassment isopleths and the fact that humpback whale sightings in Upper Cook Inlet are rare, NMFS estimates two Level A harassment takes per year to account for a single individual or a cow/calf pair. Therefore, NMFS estimates two Level A harassment takes and six Level B harassment takes during Phase 1 and two Level A harassment takes and three Level B harassment takes for Phase 2. Of these takes, 10.5 percent are predicted to be from the Mexico DPS and 0.5 percent are predicted to be from the Western North Pacific DPS (Wade et al. 2016).

6.2.1.2 Effects from Impact and Vibratory Pile Driving Noise

Various studies have been conducted on the behavioral responses of cetaceans and pinnipeds in the presence of pile driving (Würsig et al. 2000, Blackwell et al. 2004, Carstensen et al. 2006, Tougaard et al. 2009, Brandt et al. 2011, Haelters et al. 2012, Dähne et al. 2013, Kendall et al. 2014, Wang et al. 2014, Hastie et al. 2015, Kendall and Cornick 2015). Data indicate noise from pile driving can be detected at distances of up to 70 km (Southall et al. 2007, Bailey et al. 2010). General responses of cetaceans from noise associated with pile driving include, but are not limited to, change in vocal behavior and avoidance of the area.

Beluga Whales

As discussed in the *Status of the Species* section (Section 4.1.1), NMFS assumes that beluga whale vocalizations are partially representative of their hearing sensitivities. NMFS categorizes Cook Inlet beluga whales in the mid-frequency cetacean functional hearing group, with an applied frequency range between 150 Hz and 160 kHz (NMFS 2018a). For their social interactions, belugas emit communication calls with an average frequency range of about 200 Hz to 7 kHz (Garland et al. 2015). At the other end of their hearing range, belugas use echolocation signals (biosonar) with peak frequencies at 40 to 120 kHz (Au 2000) to navigate and hunt in dark or turbid waters, where vision is limited. Belugas and other odontocetes make sounds across some of the widest frequency bands that have been measured in any animal group. In the first report of hearing ranges of belugas in the wild, results of Castellote et al. (2014) were similar to those reported for captive belugas, with most acute hearing at middle frequencies, about 10 to 75 kHz.

Southall et al. (2007) reviewed acoustic research for mid-frequency cetaceans exposed to multiple pulses (such as impact pile driving) and found there is no indication for a clear tendency for increasing probability and severity of responses with increasing received levels (Southall et al. 2007). In certain conditions, multiple pulses at relatively low received levels (~80 to 90 dB re 1 μPa) temporarily silenced individual vocal behavior for one species (sperm whale). In other cases with slightly different stimuli, received levels in the 120-180 dB range failed to elicit observable reactions from a significant percentage of individuals either in the field or the laboratory (Southall et al. 2007).

Beluga whales and other odontocetes have been shown to exhibit behavioral changes when exposed to very loud impulsive sound (Finneran et al. 2000, Finneran et al. 2002b). In upper

Cook Inlet, few studies conducted have documented beluga whale responses to pile driving activity (Kendall et al. 2014, Kendall and Cornick 2015, Castellote et al. 2018). Castellote et al. (2015) reported that weekly mean of daily beluga detection-positive hours (DPH) from Cairn Point, Point MacKenzie, and Six Mile (near sources of industrial noise) are very low compared to the DPH obtained in the quieter upper portion of Knik Arm.

A study conducted during the Port of Anchorage Marine Terminal Redevelopment (MTR) Project in Knik Arm detected an hourly click rate that was higher during times without (429 detected clicks/h) than with (291 detected clicks/h) construction activity; however, the difference was not statistically significant (Kendall et al. 2014). Kendall et al. 2014 noted that possible reasons for this difference could be: 1) lower frequency beluga whale vocalizations (e.g., whistles) were potentially masked, 2) there may have been an overall reduction in beluga vocalizations, or 3) belugas were avoiding the area during construction activity (Kendall et al. 2014). Kendall and Cornick (2015) visually observed beluga whales before and during pile driving activity at the MTR Project. They observed a decrease in sighting duration, an increase in traveling relative to other observed behaviors, and a change in group composition during pile driving activity. While areas near the POA, such as the Susitna Delta and Eagle Bay (Knik Arm) appear to be highly important areas for belugas, the immediate area around the POA itself is not believed to be an important area for essential beluga activities. Therefore, increased travel speed through the area, while indicating disturbance, likely does not indicate impairment of essential life functions.

Castellote et al. (2018) suggested that masking of beluga vocalizations likely occurs during impact pile driving activity; however, communication may occur between strikes. In another small cetacean, the Indo-Pacific humpbacked dolphin, Wang et al. (2014) suggested that vibratory pile driving noise may not adversely affect clicks produced; however, whistles produced by these dolphins are likely susceptible to auditory masking during vibratory pile driving.

During field observations in the Beaufort Sea, Miller et al. (2005) reported evidence of belugas avoiding large array seismic operations. Further, Romano et al. (2004) found that a captive beluga whale exposed to airgun sounds produced stress hormones with increasing sound pressure levels, and some hormone levels remained high as long as an hour after exposure (but these hormone levels were far less than those produced during beluga whale chase and capture events). Although the above observations occurred during beluga exposure to sound pressure levels above those that would be produced by the pile-driving proposed for the current project, they demonstrate that belugas are susceptible to sound-induced stress and may be behaviorally and physiologically disturbed by loud noises, potentially leading to restricted use of available habitat when such sounds are produced.

This information leads NMFS to conclude that beluga whales are likely to respond when exposed to sounds produced by pile driving operations. Of the beluga whales that may occur within the Level B harassment zone of pile driving, some whales may change their behavioral state – reduce the amount of time they spend at the ocean's surface, increase their swimming speed, change their swimming direction to avoid pile driving, change their respiration rates, increase dive times, reduce feeding behavior, and/or alter vocalizations and social interactions (Frid and Dill. 2002, Koski et al. 2009, Funk et al. 2010, Melcon et al. 2012, Kendall et al. 2014, Kendall and Cornick 2015). Some whales may be less likely to visibly respond if they are foraging. Beluga whales may experience physiological stress responses if they encounter pile driving noise or attempt to avoid pile driving noise and encounter another activity in the project area while they are engaged in avoidance behavior.

The implementation of mitigation measures such as: 1) not starting pile driving if a beluga is observed within Knik Arm or appears likely to enter Knik Arm; or 2) shutting down of pile driving activities if a beluga is observed within, or likely to enter, the Level B zone; will make it very unlikely that a beluga will experience a TTS. However, in the unlikely event that a beluga does enter the Level B zone during pile driving, as described in the *Threshold Shift* section, the severity of TTS depends on the duration, frequency, sound pressure, and rise time of a sound (Finneran and Schlundt 2013). If a beluga should experience TTS from noise associated with pile driving activities, a full recovery would be expected within a few days of exposure because of the temporary nature of TTS.

While the likelihood of belugas experiencing TTS is expected to be extremely low (as discussed above), of greater concern is the possibility of spatial displacement due to project activities. Noise from construction activities has been shown to cause abandonment of habitat in other marine mammals (Wartzok et al. 2003, Forney et al. 2017). The main concern in the case of this project is the potential for blocking or deterring belugas from transiting through the waters between the Port of Alaska and Point MacKenzie. Blocking passage through this constricted area is of greatest concern when belugas are traveling to and from Eagle Bay, an area that is an important foraging area for Cook Inlet belugas (Joint Base Elmendorf-Richardson 2010, Castellote et al. 2015, McGuire and Stephens 2016). Belugas may enter Knik Arm and spend days to weeks in or near Eagle Bay before heading south (past the POA) to leave Knik Arm (Ferrero et al. 2000, Hobbs et al. 2005, Castellote et al. 2016, Shelden et al. 2018).

Pile driving noise at the POA could inhibit beluga access to this important foraging area north of the Port, or from leaving Knik Arm by swimming south past the port. While Eagle Bay is an area in which belugas can spend days or even weeks lingering and foraging (Joint Base Elmendorf-Richardson 2010, Castellote et al. 2015, McGuire and Stephens 2016), it will not be ensonified – but belugas traveling from south of the Port with the intention of moving into the upper Inlet (especially Eagle Bay) may be blocked or deterred from this course by noise from pile driving. However, previous studies and monitoring projects conducted during construction activities at the POA, including pile driving and dredging (Kendall and Cornick 2015), have not shown abandonment of the area during previous periods of heightened sound-producing activities. Belugas continue to travel past the POA during yearly dredging operations (POA 2019b, USACE 2019). During previous POA pile driving activities, as discussed above, some changes in behavior have been noted, such as increased travelling behavior and swimming speed, more dispersed groups, and more sightings of lone individuals (Kendall and Cornick 2015), however belugas continued to travel past the POA to and from upper Knik Arm.

In 2016, NMFS held an expert elicitation workshop to facilitate development of a population consequences of disturbance (PCoD) model to assess the effects of disturbance on Cook Inlet belugas (Tollit et al. 2016). PCoD models have been developed to assess the non-lethal effects of disturbance on animals (Pirotta et al. 2018). These non-lethal impacts could include changes in the probability of an individual’s survival, production of offspring, or effects on the health of the individual (Tollit et al. 2016). Empirical data is rarely available to quantify the relationship between behavioral and physiological changes to fitness, and in these cases, expert elicitation has been used to provide parameters for developing a PCoD model (Tollit et al. 2016). Expert elicitation is a formal process employed when data is unavailable in which a number of experts on a particular topic are asked to predict what they think will happen in a particular situation. The experts' predictions are combined into calibrated, quantitative statements, with associated uncertainty that can be incorporated into mathematical models (Martin et al. 2012).

During the NMFS Cook Inlet beluga PCoD workshop, the experts discussed multiple mechanisms where disturbance from noise could affect belugas, but focused their expert elicitations on how noise could reduce the foraging effort of belugas, to such a level that reproductive females are certain to terminate pregnancy or abandon calves soon after birth, the number of days of disturbance in the period April-September required to reduce the energy reserves of a lactating female to a level where she is certain to abandon her calf, and the number of days of disturbance where a female fails to gain sufficient energy by the end of summer to maintain herself and her calf during the subsequent winter. A key assumption of the experts was that "a *day of disturbance* was defined as any day on which an animal loses the ability to forage for at least one tidal cycle (i.e., it forgoes 50-100% of its energy intake on that day)".

During the PCoD workshop, experts were asked several questions, Table 23 outlines these questions and summarizes their responses.

Table 23. Results from Expert Elicitation during the Cook Inlet beluga PCoD workshop (Tollit et al. 2016).

Question Posed to Experts during the PCoD Workshop	**Expert Answers**	
	Median (days)	**Inter-quartile range (days)**
Number of days of disturbance that a pregnant female beluga could tolerate in the period April, May, and June before there will be a reduction in her energy reserves when she gives birth	16	9-22
Number of days of disturbance in the period April, May, and June that would be required to reduce the energy reserves of a pregnant beluga to such a level that she is certain to terminate the pregnancy or abandon the calf soon after birth	43	27 – 53
Number of days of disturbance that a lactating female beluga could tolerate in the period April-September before her energy reserves will be insufficient to maintain her and her calf through the winter	39	33 – 58
Number of days of disturbance in the period April-September required to reduce the energy reserves of a lactating beluga to a level where she is certain to abandon her calf	69	55 – 92

While the number of days for the various scenarios/impacts to individual belugas from the PCoD workshop were less than the number of days of pile driving in both Phase 1 and Phase 2 of the proposed action, these results of the PCoD workshop may not necessarily be applicable to the proposed action. As mentioned above, the PCoD workshop assumed that any disturbance that an animal experiences (especially at the Level B threshold) on a particular day will cause the whale to lose the ability to forage for at least one tidal cycle (i.e. it forgoes 50 to 100% of its energy intake on that day). However, the POA is not an important foraging area, and belugas are also typically not lingering in the direct vicinity of the POA. There are important foraging areas both north of the POA (e.g., Eagle Bay) and south of the POA (e.g. Susitna Delta). However, as discussed previously, belugas continued to pass by the POA during previous pile driving and construction projects (ICRC 2009, Cornick 2012, USACE 2019). For these reasons, we conclude that all pile driving would not cause belugas to abandon the area and avoid traveling past the POA.

The implementation of project mitigation measures will decrease the likelihood of restricting belugas from passing by the POA, and decreasing the likelihood of exposing belugas to noise at levels that would cause disturbance and stress. These mitigation measures include not starting pile driving if belugas are observed entering, or appear likely to enter Knik Arm or leaving Knik Arm to go to other foraging areas. The north and south PSO stations will allow the POA to detect belugas that may be heading towards the POA, and ensure that pile driving does not cause them to turn away. Additionally, the intention of the mitigation measures is to ensure that the width of Knik Arm is not fully ensonified. Bubble curtains will be used on the large majority of piles, and the POA will not install the largest type of pile (144-in), which will ensonify the entire width of Knik Arm, during August, the month when belugas are most likely to be present in greatest numbers in Knik Arm. The POA will also shutdown pile driving activities if beluga whales are observed within or likely to enter the Level B harassment zone, so exposure noise exceeding the Level B thresholds are expected to be short in duration, if they occur at all. As mentioned above, the PCoD workshop assumed that any disturbance that an animal experiences (especially at the Level B threshold) on a particular day will cause it to lose the ability to forage for at least one tidal cycle, however, with the mitigation measures outlined above (and in Section 2.1.2), the intensity of disturbance is minimized, which we assume reduces the likelihood of lost foraging opportunities due to this project.

Steller Sea Lions

As discussed above, Steller sea lions are rarely observed in the action area. Noise associated with pile driving is unlikely to disturb Steller sea lions at rookeries and haulouts because the nearest haulout, rookery, or other known use site is over 200 km from the Port (see Section 4).

Steller sea lions that occur within the Level B harassment zone of pile driving activities may change their behavioral state by avoiding these sound fields or exhibit vigilance and raise their heads above water. In general, pinnipeds seem more tolerant of, or at least habituate more quickly to, potentially disturbing underwater sound than do cetaceans, and generally seem to be less responsive to exposure to industrial sound than most cetaceans, although most of these studies were conducted on ringed and bearded seals, with a few on other phocids (although see Costa et al. (2003)). Very few studies have been conducted on otariids (although see Norberg (2000) and for additional review see Appendix B and C of Southall et al. (2007)).

For Steller sea lions in particular, monitoring completed at the Kodiak Ferry Terminal and Dock Improvements Project documented 4 percent of Steller sea lions observed in the Level B exposure area (51 of 1,281) exhibited behaviors associated with disturbance, and five of these observations appeared to be reactions to passing vessels or killer whales, rather than construction activity (ABR. Inc. 2016).

Steller sea lions that occur within the Level B harassment zone are not likely to experience significant disruptions of their normal behavioral patterns because the ensonified area is temporary and pinnipeds seem rather tolerant of low frequency noise. TTS may occur if a Steller sea lion is within the Level B harassment zone. If a Steller sea lion should experience TTS from noise associated with pile driving activities, a full recovery would be expected within a few days of exposure because of the short-term nature of this condition (see *Threshold Shift* section). NMFS anticipates that few (if any) exposures would occur at received levels >160 (impulsive pipe driving) or > 122.2 dB (non-impulsive vibratory sheet pile driving) due to avoidance of high received levels, the fact that Steller sea lions are rarely in the action area, and the 100 meter shut down zone for sea lions.

Humpback Whales

As discussed above, humpback whales are rarely observed in the action area. However, if humpback whales are in the action area, their most likely response to noise disturbance would be to avoid the area (Richardson et al. 1995). Baleen whales have shown strong overt reactions to impulsive noises, at received levels between 160 and 173 dB re 1 μPa rms (Richardson et al. 1986, Ljungblad et al. 1988, McCauley et al. 2000, Miller et al. 2005, Gailey et al. 2007). TTS may occur if a humpback whale is within the Level B harassment zone, however, a full recovery would be expected within a few days of exposure because of the temporary nature of TTS. Refer to the *Threshold Shift* section for more detail on TTS.

Humpback whales are more frequently observed in lower Cook Inlet. Therefore, it is expected that few humpback whales (if any) will be exposed to pile driving noise at the POA. However, if a humpback whale is within the ensonified area, we expect that these activities will likely disturb that individual. Anticipated responses to pile driving may include avoidance of the area where the activities are occurring and change in vocal behavior. NMFS anticipates that few (if any) exposures would occur at received levels >160 (impulsive pipe driving) or > 122.2 dB (non-impulsive vibratory sheet pile driving) due to avoidance of high received levels, humpback whales being rare in the action area, and the 100 meter shut down zone for humpback whales.

6.2.2 Stressors Not Likely to Adversely Affect Listed Species[27]

6.2.2.1 Vessel Noise, Presence, and Strikes

As discussed in the *Proposed Action* section, the PCT project will use tugs and floating barges. Movement of project vessels will be localized within the vicinity of the POA. Additionally, the proposed action is not expected to increase the number of vessels that transit to and from the

[27] Stressors that may affect designated critical habitat for Cook Inlet beluga whales are discussed in Section 6.3.

POA (HDR 2020). Auditory or visual disturbance to listed species could occur during all vessel activities. A listed species could react to project activities by either investigating or being startled by vessels. Disturbance from vessels could temporarily increase stress levels or displace an animal from its habitat. Underwater noise from vessels may temporarily disturb or mask communication of marine mammals. Behavioral reactions from vessels can vary depending on the type and speed of the vessel, the spatial relationship between the animal and the vessel, the species, and the behavior of the animal prior to the disturbance from the vessel. Response also varies between individuals of the same species exposed to the same sound.

If animals are exposed to vessel noise and presence, they may exhibit deflection from the noise source, engage in low level avoidance behavior, exhibit short-term vigilance behavior, or experience and respond to short-term acoustic masking behavior, but these behaviors are not likely to result in significant disruption of normal behavioral patterns. Vessels moving at slow speeds and avoiding rapid changes in direction or engine RPM may be tolerated by some species. Other individuals may deflect around vessels and continue on their migratory path.

Beluga whales' behavioral responses to vessels include changing swimming direction, increasing swim speed, altering diving, surfacing, and breathing patterns, and changes in vocalizations (Wartzok et al. 2003). Individual animals' past experiences with vessels, age, and activity at the time that they encounter the vessel appear to be important in determining an individual's response (Wartzok et al. 2003, McQuinn et al. 2011). Older animals respond more often than younger animals, and if belugas were feeding or traveling, they responded less often than during other activities. However, when they did respond, their response was more pronounced (Fish and Vania 1971, Stewart et al. 1982, Blane and Jaakson 1994). Belugas in the Canadian High Arctic reacted to noise from icebreakers, especially higher frequency components of the icebreaker noise, up to 80 km away (Cosens and Dueck 1988, Finley et al. 1990), however, this strong response may be due in part to the whales' unfamiliarity with vessel noise in this normally quiet area.

In contrast, using acoustic recorders in Cook Inlet, Small et al. (2017) found that beluga presence in three sites (Eagle Bay, Trading Bay, and Tuxedni Bay) was not influenced by time elapsed since an anthropogenic noise was detected, suggesting that Cook Inlet belugas were not affected by the noises that were detected. However, the authors noted that these three sites were also some of the quietest sites in Cook Inlet when compared with acoustic data from other sites in Cook Inlet analyzed in other ongoing studies.

Belugas have been found to change the frequencies and source levels in response to noise in their environment (Au et al. 1985). Lesage et al. (1999) and Scheifele et al. (2005) found that noise from vessels affected beluga vocalizations in the St. Lawrence River, with changes observed in calling rates, repetition of calls, increase in call duration, and upward shift in frequency. The effects lasted longer in response to a large ferry versus smaller motorboats in the area. The St. Lawrence River population of belugas exhibit these ship noise-induced effects despite living in an area with high vessel traffic, indicating that these belugas have not become habituated to vessel noise. Changes in calling rates and duration has been reported in belugas, and other cetaceans, in response to noisy environments (Finley et al. 1990, Wright et al. 2007, Dunlop et al. 2014, Erbe et al. 2018). Additionally, repetition of calls has been reported to be an alarm response in high Arctic belugas (Sjare and Smith 1986, Finley et al. 1990).

Vessel collisions with marine mammals can lead to the death of the animal. An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or a vessel's propeller could injure or kill an animal below the water's surface. Ship strikes of smaller cetaceans such as beluga whales are much less common, possibly due to their smaller size and more agile nature. However, while likely rare, vessel strikes of belugas have been documented in the St. Lawrence River Estuary (Lair et al. 2015). In Cook Inlet, a dead beluga whale washed ashore in 2007 with "wide blunt trauma along the right side of the thorax" (NMFS 2008a), suggesting a ship strike was the cause of the injury. In October 2012, a necropsy of another Cook Inlet beluga carcass indicated the most likely cause of death was "blunt trauma such as would occur with a strike with the hull of the boat" (NMFS AKR, unpub. data). Scarring consistent with propeller injuries has also been documented among Cook Inlet belugas (McGuire et al. 2011). Ship strikes with large vessels are not likely to occur or significantly affect listed species because large ships in the action area travel at slower speeds and in a direct route. Smaller boats that travel at high speed and change direction often present a greater threat than larger, slower vessels that move in straight lines.

Similar to belugas, the agility of Steller sea lions is likely to preclude vessel strikes. Although risk of ship strike has not been identified as a significant concern for Steller sea lions (Loughlin and York 2000), the recovery plan for this species states that Steller sea lions may be more susceptible to ship strike mortality or injury in harbors or in areas where animals are concentrated (e.g., near rookeries or haulouts) (NMFS 2008b). In 2007, a Steller sea lion was found in Kachemak Bay that may have been involved in a boat collision. The Steller sea lion had two separate wounds consistent with blunt trauma (NMFS Alaska Regional Office Stranding Database accessed May 2019).

While humpback whales are among the marine mammal species most prone to ship strikes in Alaska, the majority of these strikes occur in Southeast Alaska (Neilson et al. 2012). Additionally, humpback whales are rarely observed in the action area. The POA will cease operations or reduce vessel speed to the minimum level required to maintain steerage and safe working conditions if a marine mammal approaches a vessel. This mitigation measure will help minimize the risk of collision for any humpback that may be present in the action area.

Based on the localized vessel activity in close proximity to the POA, slow vessel speeds, the implementation of mitigation measures to minimize exposure to vessel activities, and the rarity of collisions with marine mammals in Cook Inlet, NMFS concludes that the probability of a PCT project vessel striking a Cook Inlet beluga whale, Western DPS Steller sea lion, or a humpback whale is very small, and thus adverse effects to Cook Inlet beluga whales, humpback whales, or Western DPS Steller sea lions are extremely unlikely to occur.

6.2.2.2 Effects on Prey Species

Pile driving produces continuous sounds (from non-impulsive vibratory pile driving) and intermittent pulsed sounds (from impact driving). Fish react to sounds that are especially strong and/ or intermittent low-frequency sounds. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution. Hastings and Popper (2005) identified several studies that suggest fish may relocate to avoid certain areas of sound energy. Additional studies have documented effects of pile driving on fish, although several are based on studies in support of large, multiyear bridge construction projects (Scholik and Yan 2001, 2002, Popper and Hastings 2009). SPLs of sufficient strength have been known to cause injury to fish and fish mortality (Popper et al. 2014a, Popper et al. 2014b). The most likely impact to fish from pile driving activities at the project area would be temporary behavioral avoidance of the area. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution, and behavior is anticipated.

Pile driving can induce a startle response and/or an avoidance response, and can cause injury or death to fish close to the noise source (McCauley et al. 2003, Slabbekoorn et al. 2010, Casper et al. 2012, Halvorsen et al. 2012). Injury to fish depends more on the magnitude of particle motion than on sound levels as mammals perceive it (Popper and Hawkins 2019). Experimental studies indicate that pile driving associated barotrauma (i.e., damage to internal tissues) of fish occurs at sound pressure levels of 205-215 dB re: 1 μPa_{peak} (Casper et al. 2012, Halvorsen et al. 2012) . It is likely that fish will avoid sound sources within ranges that may be harmful (McCauley et al. 2003).

Sound pressure levels generated by other activities of the proposed action (vessel traffic, etc.) may cause temporary behavioral changes of prey species at close range, such as a startle or stress response. Project-related vessel sounds are not expected to cause direct injury to fish, and will behaviorally affect fish only at close range, for a short period of time.

A very small proportion of primary prey species for listed marine mammals may be temporarily disturbed due to non-acoustic sources (e.g., boat wakes, spinning propellers, in water activities), such as exhibiting a startled or flight response. These forms of disturbance would be temporary, with a geographic extent much smaller than the project action area. The risk of vessels striking prey species may exist, but vessels will be operating at speeds that will allow primary prey to avoid collisions. We expect no entanglement of prey species in project-related gear.

Based on the above information, fish may respond to noise associated with the proposed action by avoiding the immediate area. However, the expected impact of noise on marine mammal prey is very minor, and thus adverse effects to Cook Inlet beluga whales, Cook Inlet beluga whale critical habitat, Mexico DPS and Western North Pacific DPS humpback, and western DPS Steller sea lions will be immeasurably small.

6.2.2.3 Sea Floor Disturbance and Turbidity

POA is replacing an existing terminal, and permanent impacts from the presence of structures are expected to be minimal. Pile installation may temporarily increase turbidity resulting from suspended sediments. Any increases would be temporary, localized, and minimal. POA must comply with state water quality standards during these operations by limiting the extent of turbidity to the immediate project area. In general, turbidity associated with pile installation is localized to about a 25-foot (7.6 m) radius around the pile (Everitt et al. 1980), therefore, no impacts to Ship Creek or critical Cook Inlet beluga whale foraging habitats are anticipated. Because of shutdown mitigation measures, cetaceans are not expected to be close enough to the project activity areas to experience effects of turbidity, and pinnipeds could avoid localized areas of turbidity. Therefore, any detectable impact to ESA-listed species from seafloor disturbance and increased turbidity levels is unlikely to occur.

6.2.2.4 Trash and Debris

The PCT project may generate trash comprised of paper, plastic, wood, glass, and metal from construction activities. The possibility exists that trash and debris could be released into the marine environment. This type of trash and debris discharge is illegal and if it does occur, it can pose risks to marine mammals. The POA intends to comply with all applicable regulations, so the amount of project-generated trash and debris is expected to be minimal or non-existent. The expected impact of trash and debris is very minor, and thus adverse effects to ESA-listed species will be immeasurably small.

6.2.2.5 Pollutants and Contaminants

Marine mammals could be exposed to authorized discharges through project vessels. Discharges associated with some marine commercial vessels are covered under a national NPDES Vessel General Permit (VGP) for Discharges Incidental to the Normal Operation of Vessels. Commercial vessels are covered under the VGP when discharging within the territorial sea extending three nautical miles from shore. When vessels are operating and discharging in Federal waters, the discharges are regulated under MARPOL 73/78 the International Convention for the Prevention of Pollution from Ships. The EPA completes consultation on the issuance of the VGP permit with the Services and receives separate biological opinions. Previously, these opinions have concluded that EPA’s issuance of the VGP was not likely to jeopardize listed or proposed species or adversely modify designated or proposed critical habitat. Since an ESA consultation was completed for this general permit, impacts associated with marine vessel discharges have already been considered and any incidental take accounted for previously.

Accidental spills may occur from a vessel leak or onboard spill. The size of the spill influences the number of individuals that will be exposed to spilled material and the duration of that exposure. Contact through the skin, eyes, or through inhalation and ingestion could result in temporary irritation or long-term endocrine or reproductive impacts, depending on the duration of exposure. The greatest threat to cetaceans is likely from the inhalation of the volatile toxic hydrocarbon fractions of fresh oil, which can damage the respiratory system (Hansen 1985, Neff 1990), cause neurological disorders or liver damage (Geraci and St. Aubin 1990), have anaesthetic effects (Neff 1990), and cause death (Geraci and St. Aubin 1990). However, for small spills there is anticipated to be a rapid dissipation of toxic fumes into the atmosphere from rapid aging of fresh refined oil, which limits potential exposure of whales to prolonged inhalation of toxic fumes.

Although Cook Inlet beluga whales have lower contaminant loads (including PAHs) than other populations of beluga whales (Becker et al. 2000), an increase in PAHs in the Cook Inlet environment from an accidental spill could cause adverse effects. High levels of PAHs have been considered as a factor in illness and mortality among beluga whales in the Saint Lawrence Estuary (Martineau et al. 1994, Martineau et al. 2002), however, no definitive causal relationship has been demonstrated. Maternal exposure to crude oil during pregnancy may negatively impact the birth weight of young, and ingestion can decrease nutrient absorption (St. Aubin 1988). Decreased food absorption could be especially important in very young animals, those feeding seasonally, and those needing to develop large amounts of fat for survival.

Based on the localized nature of small spills, the relatively rapid weathering, and the safeguards in place to avoid and minimize oil spills, NMFS concludes that a small oil spill that results in exposure of Cook Inlet beluga whales, humpback whales, or Steller sea lions to spilled product is extremely unlikely to occur. If exposure were to occur, due to the ephemeral nature of small, refined oil spills, NMFS does not expect detectable responses from listed marine mammals.

6.3 Effects to Cook Inlet Beluga Whale Critical Habitat

Cook Inlet beluga whale critical habitat is within the action area (Figure 2 and Figure 32). As discussed in the Section 4.2.1.6 (*Cook Inlet Beluga Whale Critical Habitat*), Knik Arm is Area 1 habitat for the Cook Inlet beluga whales, which means it is the most valuable, used intensively by beluga whales from spring through fall for foraging and nursery habitat. However, the POA, the adjacent navigation channel, and the turning basin were excluded from critical habitat designation due to national security concerns (76 FR 20180, April 11, 2011). Foraging primarily occurs at river mouths (e.g., Susitna Delta, Eagle River flats), which are unlikely to be influenced by pile driving activities. The Susitna Delta is more than 20 km from the POA and Cairn Point is likely to impede any pile driving noise from propagating into northern Knik Arm.

The following describes the effects of the proposed PCT project on designated Cook Inlet beluga whale critical habitat (50 CFR § 226.220(c)). Section 4.1.1.6 describes the geographical extent and Physical and Biological Features (PBFs) of designated Cook Inlet Beluga Whale Critical Habitat. The proposed action may affect critical habitat through noise from pile driving activities, effects to prey, disturbance to the seafloor, turbidity, and possible release of pollutants. The effects of the proposed action on these PBFs are described below.

PBF1: Intertidal and subtidal waters of Cook Inlet with depths <30 feet (MLLW) and within five miles of high and medium flow anadromous fish streams.

Potential impacts to PBF1 include increased turbidity, elevation in noise levels during pile driving, and small spills. The proposed PCT at the POA is in a highly industrialized area that is not critical habitat for Cook Inlet beluga whales. The anadromous fish streams that are within 8 km (5 mi) from the action area include Sixmile Creek, Ship Creek, Chester Creek, Fish Creek, Mule Creek, Eagle River, and Goose Creek. Noise levels may increase in anadromous fish streams and potentially affect beluga whales and prey species. Impacts from noise on beluga whales and their prey species are discussed above (Section 6.2.2.2 *Effects on Prey Species*).

As discussed in Section 6.2.2.3 (*Sea Floor Disturbance and Turbidity)*, pile installation may temporarily increase turbidity resulting from suspended sediments. Any increases would be temporary, localized, and minimal. POA must comply with state water quality standards during these operations by limiting the extent of turbidity to the immediate project area. In general, turbidity associated with pile installation is localized to about a 25- foot (7.6 m) radius around the pile (Everitt et al. 1980). Therefore, it is extremely unlikely that increased turbidity from the PCT project would occur in anadromous streams.

As discussed above in the Section 6.2.2.5 (*Pollutants and Contaminants)*, small spills are expected to rapidly disperse due to tide-induced turbulence and mixing. Therefore, small spills are expected to have minimal impact to anadromous fish streams.

PBF 2: Primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole.

Potential impacts to PBF2 include increased turbidity, elevation in noise levels during pile driving, and small spills. As described in PBF1 and in Section 6.2.2.3 (*Sea Floor Disturbance and Turbidity)*, pile installation may temporarily increase turbidity resulting from suspended sediments. POA must comply with state water quality standards during these operations by limiting the extent of turbidity to the immediate project area. In general, turbidity associated with pile installation is localized to about a 25-foot (7.6 m) radius around the pile (Everitt et al. 1980). Therefore, any increases in turbidity would be temporary, localized, and have no measurable impacts to prey species.

As discussed above in Section 6.2.2.2 *(Effects on Prey Species)*, fish may respond to noise associated with the proposed action by avoiding the immediate area. However, impact of noise on beluga prey is expected to be very minor, and thus adverse effects to PBF2 will be immeasurably small. Also discussed in the *Effects on Prey Species* section, fish may be disturbed by presence of vessels, or struck, but due to the slow speed of the project vessels, and the localized presence of vessels near the POA, we expect that disturbance and vessel strike are very unlikely to occur.

In addition to noise effects on PBF2, small unauthorized spills have the potential to affect prey species including adult anadromous fishes and out-migrating smolt. Additionally, in fish and shellfish, pelagic eggs and juvenile stages inhabiting near-surface waters may experience lethal and sub-lethal effects from a large spill (Collier et al. 1996, Marty et al. 1997, Jewett et al. 2002, Jiang et al. 2017). Small spills are expected to rapidly disperse due to tide-induced turbulence and mixing. We expect no project-related measurable change in primary prey in terms of prey population levels, distribution, or availability to belugas. The probability of a spill adversely affecting prey species is very small, and thus adverse effects to PBF2 are extremely unlikely to occur.

PBF 3: Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.

Chronic exposure to small spills could affect individual whales within their lifetime through accumulation of contaminants, which can affect complex biochemical pathways that suppress immune functions and disrupt the endocrine balance of the body, causing poor growth, development, reproduction, and reduced fitness (Geraci 1990, Geraci and St. Aubin 1990).

As discussed above in Section 6.2.2.5 (*Pollutants and Contaminants)*, authorized discharges of pollutants are regulated through NPDES permits, which undergo separate ESA section 7 consultations (NMFS 2010b). As discussed in PBF 2 and in the *Pollutants and Contaminants* section, unauthorized small spills are expected to rapidly disperse due to tide-induced currents, turbulence, and mixing. We expect no project-related measurable change in primary prey in terms of prey population levels, distribution, or availability to belugas.

PBF 4: Unrestricted passage within or between the critical habitat areas.

PBF4 may be affected by noise from pile driving activities. Cook Inlet beluga whales are unlikely to be physically restricted from passing through critical habitat, however, as discussed above, noise has the potential to cause belugas to avoid the area around the POA while pile driving activities are occurring, including avoiding traveling up Knik Arm to important foraging areas. Section 6.2.1 discusses the effects of noise on belugas and the potential for noise to restrict passage between critical habitat areas. Beluga avoidance of ensonified areas has the potential to restrict their passage from one critical habitat area to another, however, Cook Inlet belugas continued to pass by the POA during previous pile driving, other construction activities, and dredging at the POA (Kendall et al. 2014, Kendall and Cornick 2015, POA 2019b, USACE 2019). Based on their reactions during prior similar activities, we expect Cook Inlet belugas will continue to pass by the POA during project activities associated with this proposed action, and moreover we expect the mitigation measures to be effective in avoiding restrictions to passage through the action area during pile driving.

PBF5: Waters with in-water noise below levels resulting in abandonment of critical habitat areas by Cook Inlet Belugas.

Pile driving will result in underwater noise in critical habitat. As discussed above, abandonment of habitat during periods of construction noise has been seen in other marine mammals (Wartzok et al. 2003, Forney et al. 2017). However, as also discussed previously, Cook Inlet beluga whales have continued to use Knik Arm through previous periods of pile driving, dredging, and other construction at the POA. Additionally, the implementation of mitigation measures will reduce the impact of in-water noise on Cook Inlet belugas in the POA area, and the likelihood of temporary abandonment of the area. Beluga whales may avoid portions of the action area during construction, but we expect they would resume using those habitat areas once the most intense noise subsides.

In summary, activities associated with the proposed PCT project are not likely to have a permanent, adverse effect on Cook Inlet beluga whale critical habitat or prey species or on the quality of acoustic habitat. Beluga whales may choose to not forage in close proximity to the PCT site during pile driving, however, the POA is not a critical foraging location for any marine mammal species.

7. CUMULATIVE EFFECTS

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area (50 CFR § 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

All of the activities described in the *Environmental Baseline* (Section 5) are expected to continue into the future. Some continuing non-Federal activities are reasonably certain to contribute to climate change within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 5).

While many of the activities (e.g., oil and gas development and coastal development) described in the *Environmental Baseline* are expected to occur into the future, most of these activities likely have a Federal nexus and will require ESA section 7 consultation. Activities without a Federal nexus that are expected to continue into the future include vessel traffic and shipping, state fisheries, pollution, and tourism, and are discussed in the following sections.

7.1 Vessel Traffic and Shipping

Vessel traffic, including shipping, is expected to continue in Cook Inlet. It is unknown whether overall vessel traffic or shipping will increase in the future, as this depends largely on economics, tourism, and other factors, but it is unlikely to decrease significantly. As a result, there will be continued risk to marine mammals of ship strikes, exposure to vessel noise and presence, and small spills.

7.2 Fisheries (State of Alaska managed)

Fishing, a major industry in Alaska, is expected to continue in Cook Inlet. As a result, there will be continued risk to marine mammals of prey competition, ship strikes, harassment, and entanglement in fishing gear. For Cook Inlet beluga whales, there is also a notable risk of continued displacement from former summer foraging habitat due to human activity associated with salmon harvest (Ovitz 2019).

NMFS assumes that ADF&G will continue to manage fish stocks and monitor and regulate fishing under their jurisdiction in Cook Inlet to maintain sustainable stocks. It remains unknown whether and to what extent marine mammal prey may be less available due to commercial, subsistence, personal use, and sport fishing, especially near the mouths of streams up which salmon and eulachon migrate to spawning areas. In addition, we do not know the full extent of the effects of fishing vessel traffic on availability of prey to belugas. The Cook Inlet Beluga Whale Recovery Team considered reduction in availability of prey due to activities such as fishing to be a moderate threat to the population.

7.3 Pollution

As the population in urban areas around Cook Inlet continues to grow, an increase in pollutants entering Cook Inlet is likely to occur. Hazardous materials are released into Cook Inlet from vessels, aircraft, and municipal runoff. Oil spills could occur from vessels traveling within the action area. In addition, oil spilled from outside the action area could migrate into the action area. There are many nonpoint sources of pollution within the action area. Pollutants can pass from streets, construction and industrial areas, and airports into Cook Inlet and beluga whale habitat. The EPA and the ADEC will continue to regulate the amount of pollutants that enter Cook Inlet from point and nonpoint sources through NPDES/APDES permits. As a result, permittees will be required to renew their permits, verify they meet permit standards, and potentially upgrade facilities. However, pollutants of emerging concern such as flame retardants and estrogen mimics are unregulated and are not monitored.

7.4 Tourism

There currently are no commercial whale-watching companies in upper Cook Inlet. The popularity of whale watching and the close proximity of beluga whales to Anchorage make it possible that such operations may exist in the future. However, it is unlikely this industry will reach the levels of intensity seen elsewhere because of upper Cook Inlet's climate and navigation hazards (e.g., shallow waters, extreme tides, high turbidity, and swift currents). We are aware, however, that some aircraft have circled around groups of Cook Inlet beluga whales, disrupting their breathing patterns and possibly their feeding activities. NMFS has undertaken outreach efforts to educate local pilots of the potential consequences of such actions, providing guidelines and encouraging pilots to "stay high and fly by."

Poorly-managed vessel-based whale watching in upper Cook Inlet could cause additional stress to the beluga whale population through increased noise and intrusion into beluga whale habitat not ordinarily accessed by boats. However, within the action area, such effects are unlikely to occur due to the low density of beluga whales and the low likelihood that vessel operators would be able to target them in a commercially viable way.

Avoidance reactions have often been observed in beluga whales when approached by watercraft, particularly small, fast-moving craft that are able to maneuver quickly and unpredictably; larger vessels that do not alter course or speed often cause little to no reaction among whales in Cook Inlet (NMFS 2008a). The small size and low profile of beluga whales, and the poor visibility within the Cook Inlet waters, may increase the temptation for whale watchers and other small watercraft operators to approach the beluga whales more closely than the 100-m minimum approach distance recommended by NMFS marine mammal viewing guidance (https://alaskafisheries.noaa.gov/pr/mm-viewing-guide).

Watercraft have been observed to harass belugas in the Twentymile River during April. It is likely that such harassment also occurs during late summer coho salmon runs in the same area. Structured observation efforts from August 10-October 9, 2018 indicate belugas presence in these waters on 12 of 22 occasions (Beluga Whale Alliance, unpublished data). NMFS is cooperating with partners to assess the degree to which such boating activities may be a cause for concern due to the associated reduced access to concentrations of prey.

8. INTEGRATION AND SYNTHESIS

The Integration and Synthesis section is the final step of NMFS's assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 6) to the environmental baseline (Section 5) and the cumulative effects (Section 7) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) result in appreciable reductions in the likelihood of both the survival or recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) result in the adverse modification or destruction of critical habitat as measured through direct or indirect alterations that appreciably diminish the value of designated critical habitat as a whole for the conservation of the species. These assessments are made in full consideration of the status of the species (Section 4).

As we discussed in the *Approach to the Assessment* section of this opinion, we begin our risk analyses by asking whether the probable physical, physiological, behavioral, or social responses of endangered or threatened species are likely to reduce the fitness of endangered or threatened individuals or the growth, annual survival or reproductive success, or lifetime reproductive success of those individuals.

As part of our risk analyses, we identified and addressed all potential stressors; and considered all consequences of exposing listed species to all the stressors associated with the proposed action, individually and cumulatively, given that the individuals in the action area for this consultation are also exposed to other stressors in the action area and elsewhere in their geographic range.

8.1 Cetacean Risk Analysis

Based on the results of the *Exposure Analysis*, we expect Cook Inlet beluga whales and Western North Pacific DPS and Mexico DPS humpback whales may be adversely affected by exposure to pile driving noise. With the implementation of mitigation measures, exposure to vessel noise and presence, sea floor disturbance, and small oil spills may occur, but the expected effects are considered immeasurably small and/or extremely unlikely to occur, and are not expected to result in take. The probability of impacts on marine mammal prey occurring from the proposed project is very small, and thus adverse effects are extremely unlikely to occur. Finally, exposure to vessel strike and marine debris is extremely unlikely to occur.

Our consideration of probable exposures and responses of listed whales to pile driving activities associated with the proposed action is designed to help us assess whether those activities are likely to increase the extinction risks or jeopardize the continued existence of listed whales.

We expect that the implementation of mitigation measures (see Section 2 for detailed information on the mitigation measures, and a summary listed below) will further reduce the impacts of these sounds to listed cetaceans, and we have considered these mitigation measures as part of the proposed action in our risk analysis.

Based on the activity scenarios for Phase 1 provided by the POA and NMFS Permits Division (Table 1 and Table 2), NMFS estimated the Phase 1 Level B take of 55 Cook Inlet beluga whales and 6 humpback whales (including Western North Pacific DPS and Mexico DPS humpback whales) that might result in behavioral harassment. In addition, up to 2 humpback whales (including Western North Pacific DPS and Mexico DPS humpback whales) may be exposed to Level A take during pile driving activities in Phase 1.

Based on the activity scenarios for Phase 2 provided by the POA and NMFS Permits Division (Table 3 and Table 4), NMFS estimated the Phase 2 Level B take of 35 Cook Inlet beluga whales and 3 humpback whales (including Western North Pacific DPS and Mexico DPS humpback whales). In addition, up to 2 humpback whales (including Western North Pacific DPS and Mexico DPS humpback whales) may be exposed to Level A take during pile driving activities in Phase 2.

For Cook Inlet beluga whales, the effects of the action and resulting risks to the species are analyzed based on a maximum of 55 belugas exposed to Level B harassment in a given Phase. NMFS AKR assumes that, if an IHA renewal is granted for activities that could not be completed in Phase 1, no more than 55 belugas would be exposed to Level B harassment during Phase 2. No more than a total of 90 exposures are authorized over the course of the PCT Project.

Because it is not possible to identify a humpback whale by DPS in the field without photo-identification linking the animal to its breeding grounds, NMFS AKR uses the estimated percentage of humpback whales by DPS to determine the number of listed animals that are likely to be taken. Of the humpback whales in the action area, 10.5 percent are predicted to be from the Mexico DPS and 0.5 percent are predicted to be from the Western North Pacific DPS (Wade et al. 2016).

These estimates represent the total number of takes that could potentially occur over the two years (Phase 1 and Phase 2), but not necessarily the number of individuals taken, as a single individual may be taken multiple times over the course of the proposed action.

Exposure to vessel noise and presence, sea floor disturbance and turbidity, trash and debris, and unintentional discharge of petroleum may occur as part of the proposed action, however, with the implementation of mitigation measures, the effects are considered highly unlikely to occur or extremely small in impact, and would not rise to the level of take. Vessel strikes are considered unlikely due localized movement of vessels within the vicinity of the POA and implementation of mitigation measures. We have records of five cetaceans with vessel collisions that were reported in Cook Inlet, however, for some of the reports, the location of the strike could have occurred outside of Cook Inlet as the vessel's transit included areas outside of Cook Inlet (Section 6.2.4). Exposure to harmful marine debris is unlikely, but exposure to non-biodegradable loops (such as uncut packing straps) remain an unquantifiable threat.

Based on the localized nature of small oil spills, the relatively rapid weathering expected for <1,000 bbl of oil, the small number of refueling activities in the proposed action, and the safeguards in place to avoid and minimize oil spills, we conclude that the probability of the proposed action causing a small oil spill and exposing beluga, Mexico DPS humpback, or Western North Pacific DPS humpback whales in Cook Inlet is sufficiently small as to be considered improbable.

As mentioned in the *Environmental Baseline* section, Cook Inlet beluga whales and Western North Pacific DPS and Mexico DPS humpback whales may be impacted by a number of anthropogenic activities present in Cook Inlet. The high degree of human activity, especially within upper Cook Inlet, has produced a number of anthropogenic risk factors that marine mammals must contend with, including: coastal and marine development, oil and gas development, ship strikes, noise pollution, water pollution, prey reduction, fisheries, tourism, direct mortalities, and research, in addition to factors operating on a larger scale such as predation, disease, and climate change. The species may be affected by multiple threats at any given time, compounding the impacts of the individual threats.

As we discussed in the *Approach to the Assessment* section of this opinion, an action that is not likely to reduce the fitness of individual whales would not be likely to reduce the viability of the populations those individual whales represent (that is, we would not expect reductions in the reproduction, numbers, or distribution of such populations). For the same reasons, an action that is not likely to reduce the viability of those populations is not likely to increase the extinction probability of the species those populations comprise; in this case, the Cook Inlet beluga, and Mexico DPS or Western North Pacific DPS humpback whale. As a result, the proposed action is not likely to appreciably reduce the Cook Inlet beluga, Mexico DPS or Western North Pacific DPS humpback whales' likelihood of surviving or recovering in the wild.

8.1.1 Humpback Whales (Mexico and Western North Pacific DPSs)

The strongest evidence supporting the conclusion that the proposed action will likely have minimal impact on humpback whale populations is because upper Cook Inlet is not known to be highly utilized by humpback whales.

Mitigation measures will reduce exposure of listed whales to loud noise from the action by putting into place measures that facilitate early detection of approaching marine mammals and reduction of acoustic output if marine mammals appear likely to enter associated disturbance zones. Individual humpback whales may experience both Level A and Level B acoustic harassment, may experience masking, and may exhibit behavioral responses from project activities. Therefore, we expect these whales may experience stress responses. If whales are not displaced and remain in a stressful environment (i.e., within the behavioral harassment zone), we expect the stress response will dissipate shortly after the individual leaves the area or after the cessation of the acoustic stressor. TTS and PTS may occur if a listed species is within the Level B or Level A harassment zone, respectively; however, the severity of TTS and PTS depends on the duration, frequency, sound pressure, and rise time of a sound (Finneran and Schlundt 2013). The calculated distances to the PTS thresholds incorporate a relatively long duration, making them conservative. Although pile driving noise is likely to cause individual whales to experience changes in their behavioral states that might have adverse consequences (Frid and Dill. 2002), these responses are not likely to alter the physiology, behavioral ecology, or social dynamics of individual whales in ways or to a degree that would reduce their fitness.

Based on the best information currently available, the proposed action is not expected to appreciably reduce the likelihood of survival and recovery of Mexico DPS or Western North Pacific DPS humpback whales.

8.1.2 Cook Inlet Beluga Whales

NMFS estimated the Cook Inlet beluga population to be about 279 animals as of 2018, with a 10-year (2008-2018) declining trend of 2.3 percent per year (Shelden and Wade 2019). The revised time-series now shows a clear pattern in the trend in abundance. Following the discontinuation of the subsistence harvest, NMFS expected a 2 to 6 percent recovery annually (NMFS 2008a). The trend reported in Shelden and Wade (2019) indicates the population was initially increasing but then started declining after 2010. The summer range of belugas in Cook Inlet has contracted steadily since the late 1970s (Figure 15). Whereas Cook Inlet beluga whales formerly made more extensive summer use of the waters off of the Kenai and Kasilof Rivers, they now make little to no use of this salmon-rich habitat during summer salmon runs (Figure 18).

Coastal development and boat traffic, especially near Anchorage, has the potential to disrupt beluga whale behavior, and may alter movements among important summer habitat patches through acoustic disruption (e.g., pile driving may hinder passage to or from Knik Arm from the Susitna Delta area). Seismic exploration in upper Cook Inlet has caused both Level A and Level B takes of Cook Inlet beluga whales. Aircraft have been observed to cause behavioral changes in feeding groups of Cook Inlet beluga whales in the Susitna Delta when aircraft circled those groups. Pollution and contaminants were listed as low relative concern for impeding the recovery of Cook Inlet beluga whales (NMFS 2016b, Muto et al. 2018). Only one known beluga whale mortality associated with fisheries interaction was reported in over 10 years. There is no current subsistence harvest of Cook Inlet beluga whale (Muto et al. 2018).

Pile driving noise at the POA could restrict beluga access to important foraging areas north of the Port, or from leaving Knik Arm by swimming south past the port. During previous POA pile driving activities, some changes in behavior have been noted, such as increased travelling behavior and swimming speed, and group composition (Kendall and Cornick 2015), however belugas continued to travel past the POA into upper Knik Arm (especially to access Eagle Bay), and leave Knik Arm. Belugas have also continued to travel past the POA during yearly dredging operations (POA 2019, USACE 2019). With the proposed mitigation measures, we expect that belugas will continue to travel past the POA to and from feeding areas during the PCT project.

Anthropogenic noise in Cook Inlet remains a concern regarding the recovery of the DPS; however, little is known regarding how possible threats, alone or cumulatively, are impacting recovery of the Cook Inlet beluga whale DPS (NMFS 2016b).

The implementation of the mitigation measures will decrease the likelihood of exposing belugas to noise at received levels that could cause Level B harassment, disturbance, or stress. Additionally, the measures are intended to reduce the likelihood of restricting belugas from passing by the POA. These mitigation measures include not starting pile driving if belugas are observed passing into or out of Knik Arm, or appear likely to do so. One of the PSO stations will be near Point Woronzof with the intention that this observer station will be able to detect belugas that may be heading towards the POA and require shutdowns if belugas enter or are likely to enter the Level B harassment zone, thus ensuring that pile driving does not cause them to turn away. Similarly, the purpose of a PSO station north of the POA will be to monitor for belugas (and to order shutdowns if belugas enter or are likely to enter the Level B harassment zone) to ensure that belugas can travel south past the POA. Additionally, the intention of the mitigation measures is to ensure that the width of Knik Arm is not fully ensonified. Bubble curtains will be used on the large majority of piles, and for the largest pile (144-in), which will ensonify the width of Knik Arm, the POA will not install this type of pile during August, the month when belugas are most likely to be present in greatest numbers in Knik Arm. The POA will also shutdown pile driving activities if beluga whales are observed within or likely to enter the Level B harassment zone, therefore, exposure to Level B thresholds are expected to be short in duration.

As discussed in Section 6, fish may respond to noise associated with the proposed action by avoiding the immediate area. However, the expected impact of noise on marine mammal prey is very minor.

Based on the best information currently available, we do not expect that the proposed action will result in serious injury or mortality of any belugas, nor will it be linked to a reduction in the Cook Inlet beluga whale population. Based on this, NMFS concludes that the proposed action is not expected to appreciably reduce the likelihood of survival or recovery of Cook Inlet beluga whales.

8.1.2.1 Cook Inlet Beluga Whale Critical Habitat

Cook Inlet beluga whale critical habitat is within the action area (Figure 2 and Figure 32). Knik Arm is Area 1 habitat for the Cook Inlet beluga whales, which means it is the most valuable, used intensively by beluga whales from spring through fall for foraging and nursery habitat. However, the POA, the adjacent navigation channel, and the turning basin were excluded from critical habitat designation due to national security concerns (76 FR 20180, April 11, 2011). Foraging primarily occurs at river mouths (e.g., Susitna Delta, Eagle River flats), which are unlikely to be influenced by pile driving activities. Other anadromous fish streams that are within 8 km (5 mi) from the action area include Sixmile Creek, Ship Creek, Chester Creek, Fish Creek, Mule Creek, Eagle River, and Goose Creek. The proposed action may affect critical habitat through noise from pile driving activities, effects to prey, disturbance to the seafloor, turbidity, vessel presence, and possible release of pollutants. The effects of the proposed action on these PBFs are described below.

Pile driving will result in underwater noise in critical habitat. As discussed above, abandonment of habitat during periods of construction noise has been seen in other marine mammals (Wartzok et al. 2003, Forney et al. 2017). However, Cook Inlet beluga whales have continued to use Knik Arm through previous periods of pile driving, dredging, and other construction at the POA. Additionally, the implementation of mitigation measures will reduce the impact of in-water noise on Cook Inlet belugas in the POA area, and the likelihood of temporary abandonment of the area. Noise may increase in anadromous fish streams and effect prey species. Fish may respond to noise associated with the proposed action by avoiding the immediate area. However, impact of noise on beluga prey is expected to be very minor.

Pile installation may temporarily increase turbidity resulting from suspended sediments. Any increases would be temporary, localized, and minimal, therefore, having no measurable impacts to prey species or critical habitat. In general, turbidity associated with pile installation is localized to about a 25- foot (7.6 m) radius around the pile (Everitt et al. 1980). Therefore, it is extremely unlikely that increased turbidity from the PCT project would occur in anadromous streams.

Prey species may be disturbed by presence of vessels, or struck, but due to the slow speed of the project vessels, and the localized presence of vessels near the POA, we expect that disturbance and vessel strike are very unlikely to occur.

Small unauthorized spills have the potential to affect critical habitat and prey species including adult anadromous fishes and out-migrating smolt. However, these spills are expected to rapidly disperse due to tide-induced turbulence and mixing.We expect no project-related measurable change to critical habitat or primary prey in terms of prey population levels, distribution, or availability to belugas. The probability of a spill adversely affecting critical or prey species is extremely unlikely to occur.

Based on this, NMFS concludes that the proposed action is not expected to appreciably diminish the value of designated critical habitat as a whole for the conservation of the listed species.

8.2 Western DPS Steller Sea Lion Risk Analysis

Based on the results of the Exposure Analysis, we expect Western DPS Steller sea lions may experience Level A and B take through exposure to underwater noise from pile driving. Exposure to vessel noise and presence, seafloor disturbance and turbidity, marine debris, and small oil spills may occur, but such exposure would have a very small impact, and we conclude that these stressors will not result in take of sea lions. The probability of impacts on marine mammal prey occurring from the proposed project is very small, and thus adverse effects are extremely unlikely to occur.

Exposure to vessel strike, authorized discharge, trash and marine debris, and small spills are considered extremely unlikely to occur. One Steller sea lion was reported within the action area with two separate head wounds consistent with blunt trauma, with suspected vessel strike as the cause of the trauma (NMFS AKR Stranding Database). There are no other reported vessel collisions or propeller strikes of Steller sea lions in Cook Inlet. The increase in ship traffic due to the proposed action is unlikely to change this pattern markedly due to the slow vessel speeds for project vessels. Therefore, we consider the likelihood of additional strikes resulting from this action to be very improbable. Exposure to non-biodegradable marine debris, specifically to debris that can cause entanglement, remains an unquantifiable risk, but associated effects from this project would be minimal. Best practices regarding waste management (cutting loops prior to disposal) will further reduce the impact of debris on Steller sea lions. Any increases in turbidity or seafloor disturbance would be temporary, localized, and minimal. Based on the localized nature of small oil spills, the relatively rapid weathering expected for <1,000 bbl of oil, the small number of refueling activities in the proposed action, and the safeguards in place to avoid and minimize oil spills, we conclude that the probability of the proposed action causing a small oil spill and exposing Western DPS Steller sea lions is extremely small, and thus the effects are considered highly unlikely to occur.

Our consideration of probable exposures and responses of Western DPS Steller sea lions to noise from pile driving associated with the proposed action is designed to help us assess whether those activities are likely to increase the extinction risks or jeopardize the continued existence of Western DPS Steller sea lions. Implementation of mitigation measures for pile driving will further reduce the potential impacts to Western DPS Steller sea lions.

The primary mechanism by which the behavioral changes we have discussed affect the fitness of individual animals is through the animal’s energy budget, time budget, or both (the two are related because foraging requires time). Most adult Steller sea lions occupy rookeries during the pupping and breeding season, which extends from late May to early July (NMFS 2008b). The closest Steller sea lion rookeries or haulouts (including the nearest designated critical habitat) are over 200 km away from the action area (50 CFR §226.202(a) and Tables 1 and 2 to 50 CFR Part 226 and 50 CFR §226.202(c)(1)). High concentrations of Steller sea lions occur in and around lower Cook Inlet, however, they are rare in upper Cook Inlet. If Steller sea lions are within the action area, the individual and cumulative energy costs of the behavioral responses we have discussed are not likely to measurably reduce the energy budgets of those Steller sea lions. As a result, the Steller sea lions' probable responses (i.e., tolerance, avoidance, short-term masking, and short-term vigilance behavior) to close approaches by vessel operations and their probable exposure to noise from pile driving are not likely to reduce their current or expected future reproductive success or reduce the rates at which they grow, mature, or become reproductively active. Therefore, these exposures are not likely to reduce the abundance, reproduction rates, or survival and growth rates of the population those individuals represent.

Based on the activity scenarios for Phase 1 provided by the POA and NMFS Permits Division (Table 1 and Table 2), NMFS estimated the Phase 1 Level B take of 13 Western DPS Steller sea lions; no Level A takes are estimated for Phase 1.

Based on the activity scenarios for Phase 2 provided by the POA and NMFS Permits Division (Table 3 and Table 4), NMFS estimated the Phase 2 Level B take of 6 Western DPS Steller sea lions and 2 Level A takes.

These estimates represent the maximum number of takes that may be expected to occur over the two Phases of the proposed action, but not necessarily the number of individuals taken, as a single individual may be taken multiple times over the course of the proposed action. Mitigation measures will reduce exposure of Western DPS Steller sea lions to loud noise from the action by putting into place measures that facilitate early detection of approaching marine mammals and reduction of acoustic output if marine mammals appear likely to enter associated disturbance zones.

Noise from pile driving is likely to cause some individual Steller sea lions to experience changes in their behavioral states that might have adverse consequences (Frid and Dill. 2002). However, these responses are not likely to alter the physiology, behavioral ecology, or social dynamics of individual Steller sea lions in ways or to a degree that would reduce their fitness. While a single individual may be exposed to harassing levels of sound multiple times over the course the proposed action, the implementation of mitigation measures to reduce exposure to high levels of pile driving noise reduces the likelihood of exposure to action-related noise capable of affecting vital life functions. In most circumstances, we assume Steller sea lions will avoid ensonified areas that may cause TTS or PTS. Steller sea lions that avoid these sound fields or encounter them briefly are not likely to experience significant disruptions of their normal behavior patterns. Southall et al. (2007) reviewed literature describing responses of pinnipeds to continuous sound and reported that the limited data suggest exposures between ~90 and 140 dB re 1 μPa generally do not appear to induce strong behavioral responses in pinnipeds exposed to continuous sounds in water.

The strongest evidence supporting the conclusion that the proposed action will not impact the Western DPS Steller sea lion population is that Steller sea lions do not use upper Cook Inlet to any appreciable degree. The endangered Western DPS Steller sea lion population is increasing at ~2 percent per year (between 2000 to 2015) throughout its range (Muto et al. 2019), but continues to decline in more western portions of that range. In the region of this project, the population of non-pups is increasing at 2.68 percent per year, while the number of pups counted were increasing at 2.82 percent per year from 2000 through 2015 (Muto et al. 2019), despite the mortality or serious injury of an estimated 307 animals per year. Between 2010 and 2014, a mean annual mortality and serious injury rate of 30 animals is due to federally-regulated commercial fishing. An estimated 15 Western DPS animals/year were killed or seriously injured by state-managed fisheries when these fisheries were observed in 1990 and 1991. NMFS stranding database indicates an additional 1.6 Western DPS animals were killed or seriously injured per year in 2010 through 2014 due to interaction with commercial fishing gear from unknown fisheries and 3.0 Western DPS animals per year were killed or seriously injured due to non-fishery-related and non-subsistence-related causes during that same time period. An estimated 230 animals are harvested each year for subsistence use.

As mentioned in the *Environmental Baseline* section, Western DPS Steller sea lions may be impacted by a number of anthropogenic activities present in Cook Inlet. The high degree of human activity, especially within upper Cook Inlet, has produced a number of anthropogenic risk factors that marine mammals must contend with, including: coastal and marine development, oil and gas development, ship strikes, noise pollution, water pollution, prey reduction, fisheries, tourism, direct mortalities, and research, in addition to factors operating on a larger scale such as predation, disease, and climate change. The species may be affected by multiple threats at any given time, compounding the impacts of the individual threats.

As we discussed in the *Approach to the Assessment* section of this opinion, an action that is not likely to reduce the fitness of individual sea lions would not be likely to reduce the viability of the population those individual sea lions represent (that is, we would not expect reductions in the reproduction, numbers, or distribution of the Western DPS). For the same reasons, an action that is not likely to reduce the viability of the population is not likely to increase the extinction probability of the Western DPS Steller sea lion. As a result, the proposed action is not likely to appreciably reduce the Western DPS Steller sea lion’s likelihood of surviving or recovering in the wild.

Based on the best information currently available, the proposed action is not expected to appreciably reduce the likelihood of survival or recovery of Western DPS Steller sea lions.

9. CONCLUSION

After reviewing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is NMFS’s biological opinion that the proposed action is not likely to jeopardize the continued existence of Cook Inlet beluga whales, Western North Pacific and Mexico DPSs of humpback whales, or Western DPS Steller sea lion, or to destroy or adversely modify designated Cook Inlet beluga whale critical habitat.

10. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species unless there is a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 U.S.C. § 1532(19)). "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity (50 CFR § 402.02). Based on NMFS guidance, the term "harass" under the ESA means to: "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (Wieting 2016). The MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment] (16 U.S.C. § 1362(18)(A)(i) and (ii)). For this consultation, the Permits Division and USACE anticipate that most take will be by Level B harassment, however small numbers of Level A takes are being authorized for humpback whales and Steller sea lions.

Under the terms of Section 7(b)(4) and Section 7(o)(2) of the ESA, taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA, provided that such taking is in compliance with the terms and conditions of an Incidental Take Statement (ITS).

Section 7(b)(4)(C) of the ESA provides that if an endangered or threatened marine mammal is involved, the taking must first be authorized by Section 101(a)(5) of the MMPA. Accordingly, **the terms of this incidental take statement and the exemption from Section 9 of the ESA become effective only upon the issuance of MMPA authorization to take the marine mammals identified in this opinion**. Absent such authorization, this incidental take statement is inoperative. Take must occur in compliance with all terms, conditions, and requirements included in the MMPA authorizations and with this Opinion and the associated ITS.

The terms and conditions described below are nondiscretionary. The Permits Division and USACE have a continuing duty to regulate the activities covered by this ITS. In order to monitor the impact of incidental take, the Permits Division and USACE must monitor and report on the progress of the action and its impact on the species as specified in the ITS (50 CFR § 402.14(i)(3)). If the Permits Division and USACE (1) fails to require the permit holder to adhere to the terms and conditions of the ITS through enforceable terms that are added to the authorization, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse.

10.1 Amount or Extent of Take

Section 7 regulations require NMFS to estimate the number of individuals that may be taken by proposed actions or utilize a surrogate (e.g., other species, habitat, or ecological conditions) if we cannot assign numerical limits for animals that could be incidentally taken during the course of an action (50 CFR § 402.14(i)(1); see also 80 FR 26832; May 11, 2015).

NMFS is reasonably certain the proposed activities at the Port of Alaska in Cook Inlet are likely to result in the incidental take of ESA-listed species by Level A (humpback whales and Steller sea lions) and Level B harassment (beluga and humpback whales, and Steller sea lions) associated with noise from pile driving. As discussed in Section 6 of this opinion, the proposed action is expected to take the following number of ESA-listed individuals described in Table 24 and Table 25. For a breakdown of calculations and exposure by stressor see Section 6 and Table 22 (belugas). The method for estimating the number of individuals of each species exposed to sound levels expected to result in Level B harassment was described in Section 6.

NMFS Permits Division estimates they will authorize the following numbers of Level B take that might result in behavioral harassment in Phase 1: 55 Cook Inlet beluga whales, 6 humpback whales (including Western North Pacific DPS and Mexico DPS), and 13 Western DPS Steller sea lions. In addition, up to 2 humpback whales (including Western North Pacific DPS and Mexico DPS) may be exposed to Level A take during pile driving activities in Phase 1. Of the humpback whales, 10.5 percent are predicted to be from the Mexico DPS (resulting in 0.63 Level B and 0.21 Level A takes) and 0.5 percent are predicted from the Western North Pacific DPS (resulting in 0.03 Level B and 0.01 Level A takes) (Wade et al. 2016).

Based on the activity scenarios for Phase 2 provided by the POA and NMFS Permits Division (Table 3 and Table 4), NMFS estimated the Level B take of 35 Cook Inlet beluga whales, 6 western DPS Steller sea lions, and 3 humpback whales (Western North Pacific and Mexico DPSs). In addition, up to 2 humpback whales (including Western North Pacific DPS and Mexico DPSs) and 2 western DPS Steller sea lions may be exposed to Level A take during pile driving activities in Phase 2. Of the humpback whales, 10.5 percent are predicted to be from the Mexico DPS and 0.5 percent are predicted to be from the Western North Pacific DPS (Wade et al. 2016).

Because it is not possible to identify a humpback whale by DPS in the field without photo-identification linking the animal to its breeding grounds, NMFS AKR uses the estimated percentage of humpback whales by DPS to determine the number of listed animals that are likely to be taken. In Phase 1 we expect 2 Level A takes and 6 Level B takes of humpback whales, and in Phase 2, 2 Level A and 3 Level B takes. Apportioning those takes by DPS yields fractions of one humpback whale take for each phase of the project and each of the two ESA-listed DPSs.

Based on the above information, NMFS AKR is authorizing takes for the number of ESA-listed individuals described in Table 24 (belugas) and Table 25 (humpback whales and Steller sea lions).

For Cook Inlet beluga whales, NMFS AKR assumes that, if an IHA renewal is granted for activities that could not be completed in Phase 1, no more than 55 belugas would be exposed to Level B harassment during Phase 2. No more than a total of 90 exposures are authorized over the course of the PCT Project.

For humpback whales, given the relatively small likelihood that an individual whale affected by the project is from one of the ESA-listed DPSs, and that it is not possible to distinguish between DPSs in the field, we will consider will consider the ESA-authorized take limit to be exceeded if and when the POA exceeds its MMPA-authorized limit on Level A or Level B take of any humpback whales.

Table 24. Authorized Beluga Whale Takes by Level B Harassment (no Level A takes are authorized).

PCT construction phase	Calculated exposure	Level B Take [1]	Percent of Stock
Phase 1—2020	94	55	19.71
Phase 2—2021	60	35	12.54

[1] Proposed take is identified as 59 percent of the calculated exposures using sighting rates.

[2] For Cook Inlet beluga whales, NMFS AKR assumes that, if an IHA renewal is granted for activities that could not be completed in Phase 1, no more than 55 belugas would be exposed to Level B harassment during Phase 2. No more than a total of 90 exposures are authorized over the course of the PCT Project

Table 25. Authorized Humpback whale and Steller sea lion Takes by Level A and Level B Harassment.

Species	Phase 1 (2020)			Phase 2 (2021)		
	Level A	Level B	Percent of stock	Level A	Level B	Percent of stock
Humpback whale[a]	2	6	0.7	2	3	0.7
Steller sea lion	0	13	<0.1	2	6	<0.1

[a] Includes Hawaii, Western North Pacific and Mexico DPSs. The fractions of the listed DPSs that are expected to be exposed are in the text above.

10.2 Effect of the Take

In Section 9 of this opinion, 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 Cook Inlet beluga whale, Mexico DPS humpback whale, Western North Pacific DPS humpback whale, or Western DPS Steller sea lion or result in the destruction or adverse modification of Cook Inlet beluga whale critical habitat.

Although the biological significance of the expected behavioral responses of Cook Inlet beluga whales, Mexico DPS humpback whales, Western North Pacific DPS humpback whales, and Western DPS Steller sea lions remains unknown, this consultation has assumed that exposure to disturbances associated with the POA's pile driving and construction activities in Knik Arm, Cook Inlet might disrupt one or more behavioral patterns that are essential to an individual animal's life history. However, any behavioral responses of these whales and pinnipeds to major noise sources, and any associated disruptions, are not expected to measurably affect the reproduction, survival, or recovery of these species.

The taking of Cook Inlet beluga whales, Mexico DPS humpback whales, Western North Pacific DPS humpback whales, and Western DPS Steller sea lions will be by incidental (acoustic) harassment only.

10.3 Reasonable and Prudent Measures

Reasonable and prudent measures (RPMs) are those actions "necessary or appropriate to minimize the impacts, i.e., amount or extent, of incidental take" (50 CFR § 402.02). RPMs are nondiscretionary.

The RPMs included below, along with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. NMFS concludes that the following RPMs are necessary and appropriate to minimize or to monitor the incidental take of Cook Inlet beluga whales, Mexico DPS humpback whales, Western North Pacific DPS humpback whales, and Western DPS Steller sea lions resulting from the proposed action.

1. The NMFS Permits Division, USACE, and POA must ensure that project activities do not occur concurrent with other in-water noise-producing activities in Upper Cook Inlet or Knik Arm or, if concurrent activities will occur, must coordinate to develop mitigation measures for those concurrent activities conducted by the POA.
2. The NMFS Permits Division, USACE, and POA must monitor and report all authorized and unauthorized takes, and monitor and report the effectiveness of mitigation measures incorporated as part of the proposed authorization for the incidental taking of ESA-listed marine mammals pursuant to section 101(a)(5)(D) of the MMPA. In addition, they must submit a report to NMFS AKR that evaluates the mitigation measures and reports the results of the monitoring program.

10.4 Terms and Conditions

"Terms and conditions" implement the reasonable and prudent measures (50 CFR § 402.14). These must be carried out for the exemption in section 7(o)(2) to apply.

In order to be exempt from the prohibitions of section 9 of the ESA, the Permits Division and USACE or any applicant must comply with the following terms and conditions, which implement the RPMs described above and the mitigation measures set forth in Section 2.1.2 of this opinion. The Permits Division and USACE or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this incidental take statement (50 CFR § 402.14).

Partial compliance with these terms and conditions may result in more take than anticipated, and may invalidate this take exemption. These terms and conditions constitute no more than a minor change to the proposed action because they are consistent with the basic design of the proposed action.

To carry out RPM #1, NMFS Permits Division, USACE or POA must undertake the following:

1.1 The POA must coordinate with Port MacKenzie to ensure that pile driving is not taking place at both Ports concurrently.

1.2 The POA must coordinate with NMFS on future POA activities to develop mitigation measures as necessary for any concurrent activities.

To carry out RPM #2, NMFS Permits Division, USACE or POA must undertake the following:

2.1 The taking of any marine mammal in a manner other than that described in this biological opinion and ITS must be reported within 24 hours to NMFS AKR, Protected Resources Division at 907-586-7638.

2.2 In the event that the proposed action causes unauthorized take of a marine mammal that results in a serious injury[28] or mortality, the applicant shall immediately cease operations associated with the activity that resulted in the serious injury or mortality, and immediately report the incident to NMFS AKR, Protected Resources Division at 907-586-7638 to jon.kurland@noaa.gov, to the Marine Mammal Stranding Hotline at 877-925-7773, and to NMFS Permitting Division (Jaclyn Daly,Jaclyn.daly@noaa.gov or 301-427-8484). Curtailing of activities shall be done with consideration of human, property, and environmental safety.

The report must include the following information:

i. Time, date, and location (latitude/longitude) of the incident;

ii. details on the nature and cause of the take (e.g., vehicles, vessels, and equipment in use at the time of take);

iii. an account of all known sound sources above 120 dB that occurred in the 24 hours preceding the incident;

iv. water depth at the location of the take;

v. environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);

vi. description of marine mammal observations in the 24 hours preceding the incident;

vii. species identification or description of the animal(s) involved;

viii. the fate of the animal(s);

ix. and any photographs or video footage of the animal obtained.

Activities that may have caused the take must cease upon the occurrence of unauthorized take, and must not resume until NMFS is able to review the circumstances of the prohibited take. NMFS Permits Division must work with NMFS AKR and the applicant to determine what is necessary to minimize the likelihood of additional prohibited take and ensure ESA compliance. The applicant must not resume the suspended activity, except in protection of safety as above, until notified by NMFS via letter, email, or telephone.

[28] Serious injury means "any injury that will likely result in mortality" (50 CFR 216.3).

2.3 In the event that an oiled ESA-listed marine mammal is spotted, the permittee must report the incident within 24 hours to NMFS AKR, Protected Resources Division at 907-586-7638, to jon.kurland@noaa.gov, sadie.wright@noaa.gov, the Marine Mammal Stranding Hotline at 877-925-7773, and to NMFS Permitting Division Jaclyn Daly 301-427-8438.

2.4 In the event that an operator reaches, or appears likely to exceed, the limit on annual take authorized for any specific activity as described in this ITS, POA or its designee must contact the Assistant Regional Administrator, Protected Resources Division, NMFS, Juneau office at 907-586-7638, and/or by email to jon.kurland@noaa.gov, and NMFS Permitting Division at 301-427-8484, and email Jaclyn.daly@noaa.gov. NMFS AKR will work with NMFS Permit Division and USACE and the operator to determine what is necessary to minimize the likelihood of further take, and determine if reinitiation of consultation is warranted (50 CFR 402.16).

2.5 The POA must evaluate the effects of pile driving noise and other in-water activities on beluga passage into or out of Knik Arm, submitting their analysis in an annual report (see T&C 2.6).

2.6 POA must submit to NMFS an annual report summarizing ESA-listed marine mammal sightings and annual takes of listed marine mammals. The annual report will be submitted within 90 days of the cessation of in-water work each year. The draft annual report will be subject to review and comment by NMFS AKR. Comments and recommendations made by NMFS AKR must be addressed in the annual report prior to NMFS acceptance of the annual report. The draft report will be considered final for the activities described in this opinion if NMFS AKR has not provided comments and recommendations within 30 days of receipt of the draft report. This annual report must contain the following information:

2.6.2 A description of the implementation and qualitative assessment of the effectiveness of mitigation measures for minimizing adverse effects of the action on ESA-listed species;

2.6.3 Lessons learned and recommendations for improvement of mitigation measures and monitoring techniques; and

2.6.4 A digital file that can be queried containing all observer monitoring data and associated metadata.

11. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR § 402.02).

NMFS recommends that the POA develop outreach materials such as signage for placement at

City of Anchorage owned coastal sites, e.g., the Ship Creek Small Boat Harbor and Point Woronzof, highlighting the endangered status of Cook Inlet beluga whales.

In order to keep NMFS's Protected Resources Division informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Port of Alaska should notify NMFS of any conservation recommendations they implement in their final action.

12. REINITIATION OF CONSULTATION

As provided in 50 CFR § 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action on listed species or designated critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat not considered in this opinion, or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount of incidental take is exceeded, section 7 consultation must be reinitiated immediately (50 CFR § 402.14(i)(4)).

13. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (Data Quality Act (DQA)) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

13.1 Utility

This document records the results of an interagency consultation. The information presented in this document is useful to NMFS, the USACE, the POA, and the general public. These consultations help to fulfill multiple legal obligations of the named agencies. The information is also useful and of interest to the general public as it describes the manner in which public trust resources are being managed and conserved. The information presented in these documents and used in the underlying consultations represents the best available scientific and commercial information and has been improved through interaction with the consulting agency.

This consultation will be posted on the NMFS Alaska Region website http://alaskafisheries.noaa.gov/pr/biological-opinions/. The format and name adhere to conventional standards for style.

13.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

13.3 Objectivity

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01 et seq.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the literature cited section. The analyses in this opinion contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA implementation, and reviewed in accordance with Alaska Region ESA quality control and assurance processes.

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